GRAS Notice (GRN) No. 305
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http://www.fda.gov/Food/FoodIngredientsPackaging/GenerallyRecognizedasSafeGRAS/GRASListings/default.htm

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August 21, 2009

Laura Tarantino, Ph.D.
Office of Food Additive Safety (HFS-200)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5100 Paint Branch Parkway
College Park, MD 20740-3835

RE: Viable and heat-treated *Carnobacterium maltaromaticum* CB1 GRAS Notification

Dear Dr. Tarantino:

In accordance with proposed 21 CFR § 170.36 (a notice of a claim for exemption based on a GRAS determination) published in the Federal Register (62 FR 18937-18964), I am submitting in triplicate, as the agent of the notifier, Griffith Laboratories, 757 Pharmacy Ave., Toronto, Ontario M1L 3J8 Canada, a GRAS notification for the use of viable and heat-treated *Carnobacterium maltaromaticum* CB1 as a preservative, at a maximum inoculation concentration of viable *C. maltaromaticum* CB1 at $1x10^9$ colony forming units/day to ready-to-eat meat products, meat, poultry and fish products, frozen meals, processed fruit salads and vegetable salads, sauces, and soft cheese and cheese spread-type products. Heat-treated *C. maltaromaticum* CB1 will be used in ready-to-eat meat products, meat, poultry, fish and mixtures, fruits and vegetables, soups and stews, sauces and dressings, and cheese and cheese spread-type products. The GRAS expert panel dossier, setting forth the basis for the GRAS determination, as well as *curriculum vitae* of the members of the GRAS panel, is enclosed.

Best regards,

(b) (6)

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition

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1. GRAS Exemption Claim

A. Claim of Exemption from the Requirement for Premarket Approval Pursuant to Proposed 21 CFR 170.36(c)(1)

Viable and heat-treated *Carnobacterium maltaromaticum* CB1 has been determined to be generally recognized as safe (GRAS) and therefore, exempt from the requirement of premarket approval, under the conditions of its intended use as described below. The basis for this finding is described in the following sections.

Signed,

(b) (6)

Date 21 August 2009

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition
801 N. Orange Avenue Suite 710
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(i) Name and Address of the Notifier

Griffith Laboratories
757 Pharmacy Ave
Toronto, Ontario
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Agent of the Notifier:

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(ii) Common Name of the Notified Substance

The common name of viable and heat-treated *Carnobacterium maltaromaticum* CB1, for the purposes of this GRAS Notification has been defined as:

"bacterial culture" or "*Carnobacterium maltaromaticum*"

(iii) Conditions of Use

Viable *Carnobacterium maltaromaticum* CB1 may be used as an ingredient in the food groups shown in Table 1 as a preservative, at levels up to $1x10^9$ colony forming units (cfu) *per* gram, as a preservative to inhibit growth of *Listeria monocytogenes*.

Table 1. Food groups selected for viable *C. maltaromaticum* CB1 supplementation

Food Category	Intended use level (cfu/g)
Ready-to-eat meat products	$1x10^4 – 1x10^9$
Meat, poultry and fish products	$1x10^4 – 1x10^9$
Frozen meals	$1x10^4 – 1x10^9$
Processed fruit salads and vegetable salads	$1x10^4 – 1x10^9$
Sauces	$1x10^4 – 1x10^9$
Soft cheese and cheese spread-type products	$1x10^4 – 1x10^9$

cfu = colony forming units

Heat-treated *C. maltaromaticum* CB1 may be used as an ingredient in the food groups shown in Table 2 as a preservative to inhibit growth of *Listeria monocytogenes*, at up to 5000 ppm, with typical use at between 1000 – 5000 ppm.

Table 2. Food groups selected for heat-treated *C. maltaromaticum* CB1 supplementation

Food Category	Intended use level (ppm)
Ready-to-eat meat products	1000-5000
Meat, poultry, fish and mixtures	1000-5000
Fruits and vegetables	1000-5000
Soups and stews	1000-5000
Sauces and dressings	1000-5000
Cheese and cheese spread-type products	1000-5000

ppm = parts *per* million

(iv) Basis of GRAS Determination

Pursuant to 21 CFR § 170.3, the use of viable and heat-treated *C. maltaromaticum* CB1 as an ingredient in food categories shown in Table 1 and Table 2, respectively, which could result in a maximum 90th percentile consumption of *C. maltaromaticum* CB1 at 1.4×10^{11} cfu *per* day from either of the two sources, has been determined GRAS by scientific procedures for its intended conditions of use. Viable and heat-treated *C. maltaromaticum* would not be added to the same food product, and therefore the levels of consumption would not be additive in nature. The safety of the viable and heat-treated *C. maltaromaticum* product as a preservative is supported by isolation of the bacteria on food products already consumed by the population, prior use of the bacteria in sausage fermentation, and animal studies, as outlined in this GRAS dossier and GRN 000159.[1] This determination is based on the views of experts who are qualified by scientific training and experience to evaluate the safety of substances used as ingredients in food. Isolation of *C. maltaromaticum* CB1 from foods already in use by the US population at levels similar to the concentration added to the food groups outlined in Table 1 and Table 2, allows for a categorical exclusion from the need for an environmental assessment, as indicated by 21 CFR § 25.32(r). Therefore, to the submitter's knowledge, no extraordinary circumstances exist that require submission of an environmental assessment.

(v) Availability of Information

The data and information that serve as a basis for this GRAS determination are available for Food and Drug Administration's (FDA) review and copying at a reasonable time at the office of:

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[1] The notice, filed October 14, 2004, listed seven *Carnobacterium maltaromaticum* strains for use in ready-to-eat and fresh comminuted meat products. An amendment dated January 27, 2005, limited the use to ready-to-eat meat products to conform with USDA regulations. An amendment, dated April 8, 2005, limited the subject of the notice to *Carnobacterium maltaromaticum* strain CB1 and provided information on the identity of this strain.

Alternatively, copies of data and information can be provided to FDA upon request, by contacting Dr. Burdock.

2. Detailed Information about the Identity of the Notified Substance

A. Identity

C. maltaromaticum CB1 is naturally selected, non-genetically modified bacteria. The general descriptive characteristics of *C. maltaromaticum* CB1 are presented in Table 3.

Table 3. General description and analytical information of viable *C. maltaromaticum* CB1

Bacterial name	*Carnobacterium maltaromaticum* CB1
Growth characteristics	Gram-positive, non-motile, non-spore forming rods occurring singly or in short chains. Colonies as pinpoint, convex, white, circular and nonpigmented when grown at 25°C for 24 hours on Trypticase Soy Agar. Optimal temperature for growth is 30°C, with a range between 6 – 40°C, with an optimal pH range from 6.0 – 7.0. It is facultatively anaerobic, with folic acid, riboflavin, panthothenate and niacin required for growth. Catalase and oxidase are not produced during growth, while arginine and esculin are hydrolyzed, with variable gas production
Packaging	The standardized, viable cell blend will be packaged into plastic foil film packages, flushed with nitrogen and the package weight will be customized to the finished product application such that between 10^3 and 10^4 viable *C. maltaromaticum* cells per gram of finished product will be achieved.
Storage	Store at ambient temperature (22°C)
Labeling	"*Carnobacterium maltaromaticum*" or "bacterial culture"
Functionality in Food	Inhibition of *Listeria monocytogenes* growth

Common or Usual Name:

The common name of *C. maltaromaticum* CB1 has been defined as "bacterial culture" or "*Carnobacterium maltaromaticum*".

B. Composition

The *Carnobacterium maltaromaticum* CB1 product (viable and heat-treated) contains *C. maltaromaticum* CB1 cells, fermentation medium and maltodextrin (an excipient for freeze drying). Maltodextrin and the fermentation medium materials have been designated as approved food additives or Generally Recognized As Safe (GRAS) for use in food manufacture.

C. Method of Manufacture of *Carnobacterium maltaromaticum* CB1

Viable and heat-treated *C. maltaromaticum* CB1 is manufactured by Griffith Laboratories in accordance with current good manufacturing practice (cGMP) for foods, and in accordance with all applicable environmental regulations to result in pure culture fermentation.

Viable *C. maltaromaticum* CB1 manufacturing procedures and specifications were described in detail in GRAS GRN 000159 and will not change with the added food categories. A detailed manufacturing flowchart is provided in Figure 1.

In the generation of the heat-treated *C. maltaromaticum* process modification of this food ingredient, immediately following the fermentation and pasteurization steps, there are two interchangeable processing methods to remove water: 1. lyophilization and milling, or alternatively, 2. evaporation and spray-drying. The fermentation medium is incubated at 25°C for 12-14 hours to achieve a cell density of 1×10^{9}-10^{10} cfu/ml. Following fermentation, maltodextrin[2] is added on a specific w/v[3] basis as a manufacturing aid to assist water removal. The fermented medium is pasteurized (*i.e.*, heat-treated, although the heat treatment does not degrade all *C. maltaromaticum* cells, to yield a maximum viable cell density $\leq 1\times10^{4}$ cfu/g) and the product is either lyophilized and milled or alternatively, evaporated and spray-dried. The product concentrates are tested against product specifications, and once approved, packaged for commerce. A graphical depiction of the manufacturing process is shown in Figure 2.

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[2] Maltodextrin is a polysaccharide, produced from starch and is easily digestible. 21 CFR §184.1444 states that maltodextrin can be used in food with no limitation other than good manufacturing practice.
[3] w/v = weight *per* volume.

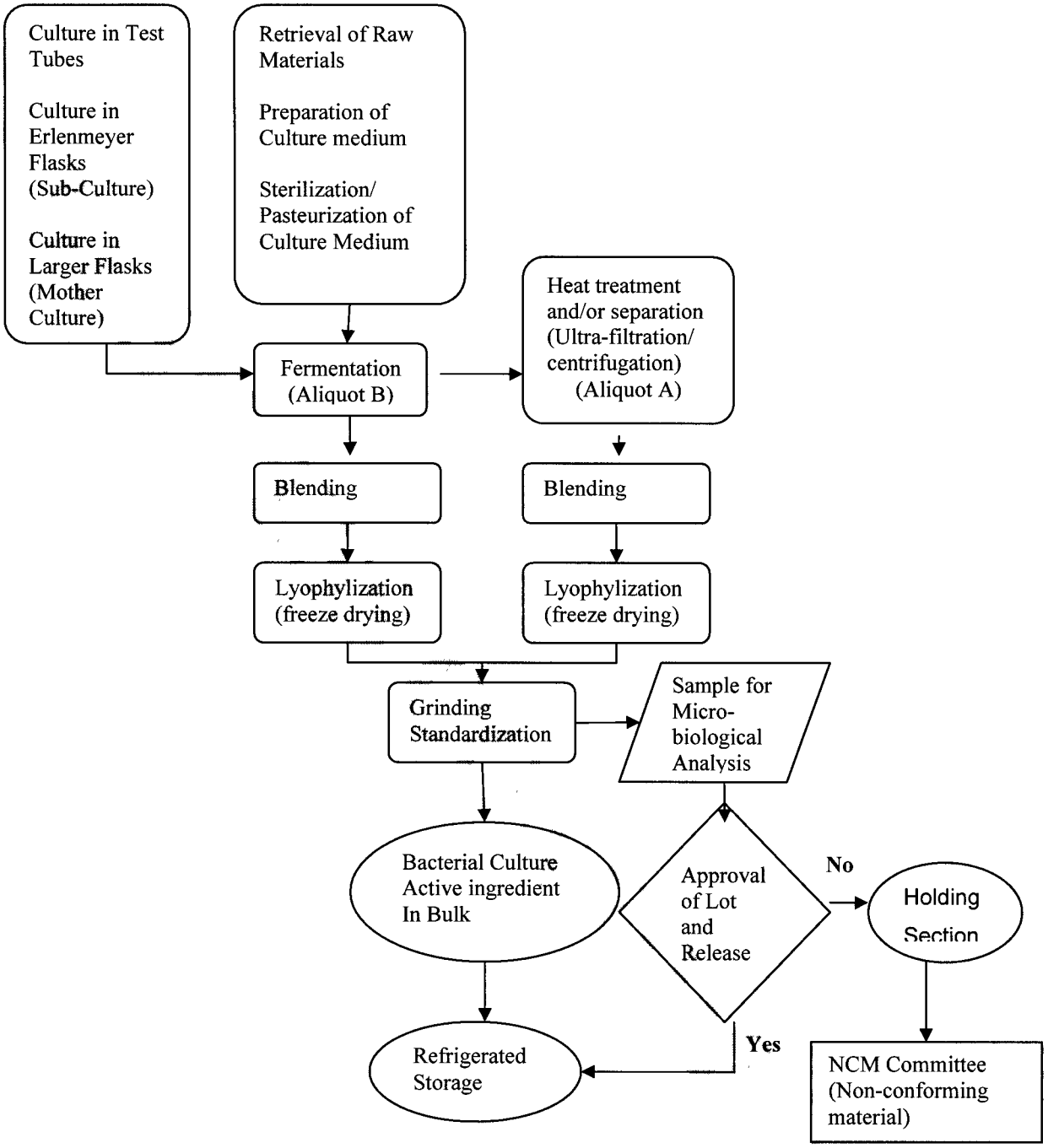

Figure 1. Schematic of the viable *C. maltaromaticum* CB1 manufacturing process

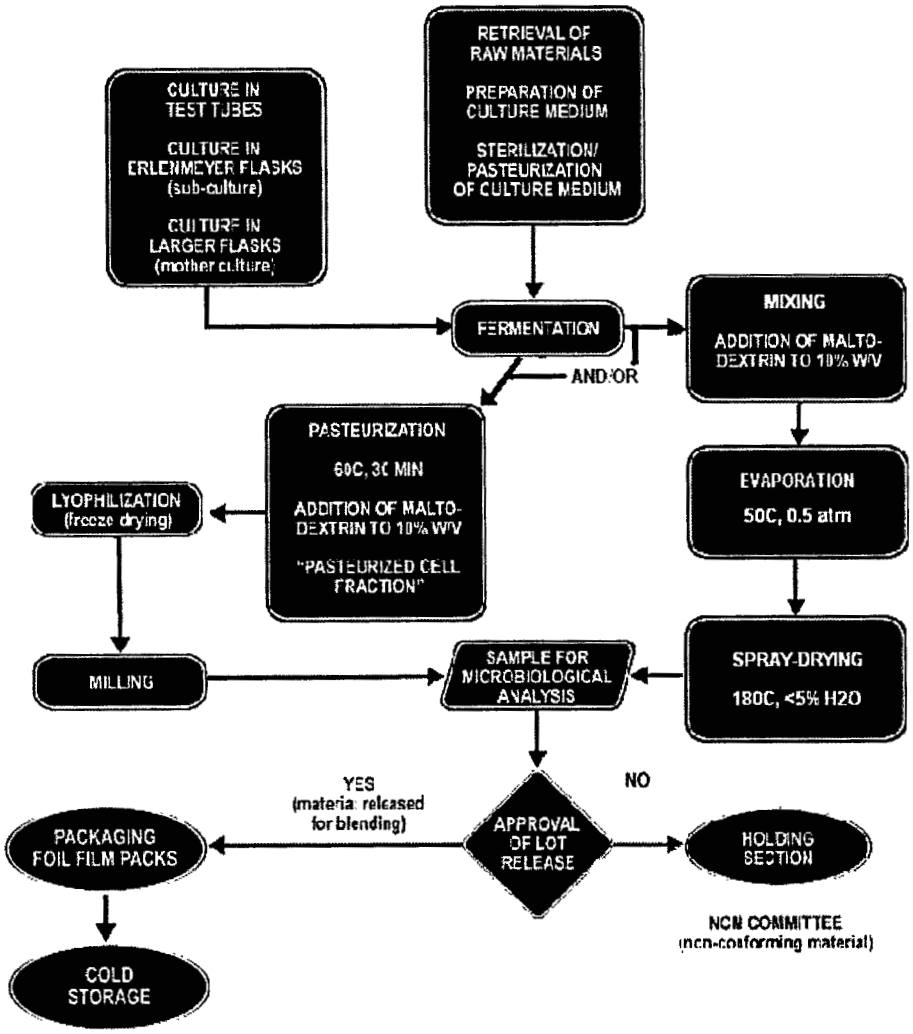

Figure 2. Process control flow chart for the production of heat-treated *C. maltaromaticum* CB1

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D. Specifications for Food Grade *Carnobacterium maltaromaticum* CB1

Viable *C. maltaromaticum* CB1 specifications were described in detail in GRAS GRN 000159 and will not change with the added food categories. Information regarding heat-treated *C. maltaromaticum* CB1 product specifications is provided in Table 4.

Table 4. Heat-treated C. *maltaromaticum* CB1 product specifications

Specification	Specification Limits	Test Method*
Physical Specifications		
Appearance	Light tan-colored free-flowing homogenous powder	Visual inspection
Residual Moisture	<5.0%	AOAC 925.45.B 44.1.03
Microbial Specifications		
Total Plate Count (CFU/g)	$<1.0\times10^4$	MFHPH-18
Yeast Molds (CFU/g)	<10/g	MFHPB-22
Coliforms (CFU/g)	<10/g	MFHPB-34
Staphylococcus aureus (CFU/g)	<10/g	MFHPH-21
Escherichia coli (CFU/g)	<10/g	MFHPB-34
Salmonella sp. (CFU/25g)	Absent in 25 g	MFHPB-20

*Test methods are available upon request; CFU = Colony Forming Unit

3. Self Limiting Levels of Use

The quantity of viable *C. maltaromaticum* CB1 is self-limiting, inhibiting its own growth to approximately 10^9 cfu/g.

4. Basis of GRAS Determination

The determination that *Carnobacterium maltaromaticum* CB1 is GRAS is on the basis of scientific procedures, as outlined in the attached **Dossier in Support of the Generally Recognized as Safe (GRAS) Status of Viable and Heat-treated *Carnobacterium maltaromaticum* CB1 as a Food Ingredient**. On the basis of the data and information described in the attached dossier and other publicly available information, there is consensus among experts qualified by scientific training and experience to evaluate the safety of substances added to food, that there is reasonable certainty that viable and heat-treated *Carnobacterium maltaromaticum* CB1 is GRAS under the intended conditions of use.

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DOSSIER IN SUPPORT OF THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF VIABLE AND HEAT-TREATED *CARNOBACTERIUM MALTAROMATICUM* CB1 AS A FOOD INGREDIENT

August 13, 2009

FINAL

Panel Members

Douglas Archer, Ph.D.

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DOSSIER IN SUPPORT OF THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF VIABLE AND HEAT-TREATED *CARNOBACTERIUM MALTAROMATICUM* CB1 AS A FOOD INGREDIENT

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DOSSIER IN SUPPORT OF THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF VIABLE AND HEAT-TREATED *CARNOBACTERIUM MALTAROMATICUM* CB1 AS A FOOD INGREDIENT

1. EXECUTIVE SUMMARY

The undersigned, an independent panel of recognized experts (hereinafter referred to as the Expert Panel)[1], qualified by their scientific training and relevant national and international experience to evaluate the safety of food ingredients, was requested by Griffith Laboratories (hereafter referred to as Griffith) to determine the Generally Recognized As Safe (GRAS) status, of *Carnobacterium maltaromaticum* CB1 based on scientific procedures. On a prior occasion[2], an independent GRAS Expert Panel critically evaluated the available information on the specific strains of *Carnobacterium maltaromaticum* CB1, CB2, CB3, LV17, UAL26, ATCC 35586 and ATCC 43225. The Expert Panel determined that according to the provision of the Federal Food Drug and Cosmetic Act (FD&C Act) and the guidance provided by 21CFR§170.30 and 21CFR§170.35, *C. maltaromaticum* is GRAS and notified to the FDA[3] for use as a preservative in ready-to-eat (RTE) and fresh comminuted[4], processed meat products at a maximum inoculation concentration of 1×10^4 colony forming units (cfu)/g.

C. maltaromaticum is to be added to foods identified herein as either a viable product or as a heat-treated product; a food consumption analysis using the pre-existing and additional food categories and use levels was conducted, indicating that the proposed use levels of viable *C. maltaromaticum* CB1 in pre-existing and additional food products resulted in an aggregate intake that does not exceed the *per capita* consumption of 1.41×10^{11} cfu/day as stated in the FDA Agency Response Letter to the previous GRAS dossier[5]. Heat-treatment and lyophilization changes to the manufacturing procedure from viable *C. maltaromaticum* CB1 to form a non-viable (*i.e.*, "heat-treated" product) also results in an aggregate intake that does not exceed the *per capita* consumption of 1.41×10^{11} cfu/day. These two uses would not be utilized in an additive fashion in a food product. Safety data provided in the previous GRAS dossier continues to support a conclusion of safety, and a critical review of the literature published since the previous *C. maltaromaticum* GRAS determination, through May 2009, did not reveal any new safety information that would negatively impact the determination of safety stated in the

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[1] Modeled after that described in Section 201(s) of the Federal Food, Drug, and Cosmetic Act, as amended. See also attachments (*curriculum vitae*) documenting the expertise of the Panel members.

[2] "Dossier in support of the Generally Recognized As Safe (GRAS) status of specific strains of *Carnobacterium maltaromaticum* as a food ingredient", finalized as a GRAS determination on September 16, 2004 and designated as GRAS (GRN 000159) on October 14, 2004 by FDA.

[3] The notice, filed October 14, 2004, listed seven *Carnobacterium maltaromaticum* strains for use in ready-to-eat and fresh comminuted meat products. An amendment dated January 27, 2005, limited the use to ready-to-eat meat products to conform with USDA regulations. An amendment, dated April 8, 2005, limited the subject of the notice to *Carnobacterium maltaromaticum* strain CB1 and provided information on the identity of this strain.

[4] Comminute = Reduce to small pieces or particles by pounding or abrading.

[5] CFSAN/Office of Food Additive Safety Agency Response Letter, GRAS Notice No. GRN 000159, dated May 27, 2005.

previous GRAS determination, or the safe use of *C. maltaromaticum* CB1 in the food categories stated herein. Griffith assures that all relevant, unpublished information in its possession related to the safety of *C. maltaromaticum* CB1 has been supplied to Burdock Group and, along with supporting documentation, has been summarized in this dossier and was made available to the Expert Panel. Following an independent, critical evaluation, the Expert Panel conferred and unanimously agreed that *C. maltaromaticum* CB1 is considered safe when consumed in the categories identified herein that does not exceed the *per capita* consumption of 1.41×10^{11} cfu/day of either viable or heat-treated *C. maltaromaticum* CB1.

2. INTRODUCTION

Carnobacterium maltaromaticum is one species of a diverse group of bacteria which are generally classified as atypical Lactic Acid Bacteria (LAB). LAB have been utilized for centuries in the food and dairy industries in the production of fermented foods (Ahn and Stiles, 1990b; Stoffels *et al.*, 1992; Buchanan and Klawitter, 1992b; Milliere and Lefebvre, 1994; Milliere *et al.*, 1994; Pilet *et al.*, 1995). Bacteriocin-producing LAB, including *C. maltaromaticum*, have been found on various food products ranging from meats and fish to fruits and vegetables (Buchanan and Klawitter, 1992b; Kelly *et al.*, 1996; Coventry *et al.*, 1997; Stiles and Holzapfel, 1997; Carr *et al.*, 2002; Di Cagno *et al.*, 2008; Singh *et al.*, 2009; Settanni and Corsetti, 2008). LAB and their metabolites, especially bacteriocins[6], are of great interest because of their bactericidal or bacteriostatic activity against organisms closely related to the producer strain, including food-borne pathogenic bacteria and spoilage bacteria (Azuma *et al.*, 2007). The production of bacteriocins is one of the methods that *C. maltaromaticum* may utilize to inhibit the growth of potentially pathogenic bacteria. Bacteriocins have been known to be isolated from beef, spoiled ham, and French mold-ripened soft cheese (Jack *et al.*, 1996; Herbin *et al.*, 1997).

LAB have a characteristic ability to produce aromatic and flavor-enhancing substances (Stiles and Holzapfel, 1997; Carr *et al.*, 2002). LAB had been characterized by their ability to produce a variety of isomers of lactic acid from the fermentation of carbohydrates. Atypical LAB (including the subject of this monograph, *C. maltaromaticum*) are distinct due to their inability to grow on acetate agar at pH 5.6, while being able to produce virtually pure L(+)-lactic acid from glucose, and for their ability to ferment both c, properties that are unusual in lactobacilli (Holzapfel and Gerber, 1983; Shaw and Harding, 1984).

Members of the atypical LAB group also include *Lactobacillus piscicola*, *Lactobacillus carnis* and *Lactobacillus divergens*, and were found to possess a number of properties that were different from normal lactobacilli. These properties included the ability to grow at pH 9.5, resistance to thallous acetate, antibiotic resistance, specific vitamin requirements and, as previously mentioned, inability to grow on acetate agar (Rogosa *et al.*, 1951; Collins *et al.*, 1987; Stiles and Holzapfel, 1997). In addition, *L. piscicola*, *L. carnis* and *L. divergens* do not synthesize *cis*-vaccenic acid in their cell membranes as do other *Lactobacillus* species. Instead, this group synthesizes the major C18:1 isomer as oleic acid ($\Delta_{9,10}$), indicative of a different

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[6] Bacteriocins = Ribosomally synthesized, low molecular weight, proteinaceous materials that are able to inhibit the growth or kill closely related bacteria.

unsaturated fatty acid synthase pathway. Further investigation using gene mapping, physical characteristics, biochemical and chemical data, revealed that members of this group were all the same species; *L. piscicola*. *L. carnis* and *L. divergens* were then re-classified by Collins *et al.* (1987) into a new genus, *Carnobacterium* (L. gen. N. *carnis*, of flesh; Cr. Dim. N. *bakterion*, a small rod; M.L. neut. N. *Carnobacterium*, flesh rodlet). This was further substantiated when a 16S rRNA sequence analysis demonstrated that the *Carnobacterium* genus forms a distinct phylogenetic clade[7] within the lactic acid bacteria and included *C. funditum*, *C. alterfunditum*, *C. gallinarum* and *C. mobile*. *Lactobacillus maltaromaticus* was further defined as an objective synonym of *C. piscicola* (Miller *et al.*, 1974; Collins *et al.*, 1991; Lai and Manchester, 2000; Lai *et al.*, 2004).

More recently, phenotypic and genetic characterization of *L. maltaromaticus* strains DSM 20342T, DMS 20344 and JCM1154, determined that these strains also belonged in the genus *Carnobacterium*. Further comparison with *C. piscicola* resulted in the decision that these two species should be considered synonymous. As a result, *C. piscicola* was reclassified as *C. maltaromaticum* com. nov. (Collins *et al.*, 1987; Mora *et al.*, 2003). Because the common name of *C. maltaromaticum* was used in the previous GRAS determination (APPENDIX 4), this name will also be used for this GRAS determination.

Studies conducted in the past decade have shown that humans have been exposed to *C. maltaromaticum* and other food-borne bacteria that produce bacteriocins (Coventry *et al.*, 1997; Amezquita and Brashears, 2002). LAB in general have been used for centuries in the fermentation and preservation of food products (*e.g.* yogurts, sausages, vegetables, breads, wine, cheeses and milk) (Ahn and Stiles, 1990a; Stoffels *et al.*, 1992; Buchanan and Klawitter, 1992b; Milliere and Lefebvre, 1994; Milliere *et al.*, 1994; Pilet *et al.*, 1995). In addition, *C. maltaromaticum* has been used as part of a starter bacterial culture in sausage fermentation in France[8]. *Carnobacterium* spp. are a common part of the microflora found on vacuum-packaged meat, poultry, fish and cheese products and, in some cases, they can represent a predominant constituent population[9] on products such as smoked fish, chicken, beef, and cheese, without being considered spoilage organisms (Ahn and Stiles, 1990a; Lewus *et al.*, 1991; Stoffels *et al.*, 1992; Buchanan and Klawitter, 1992a; Pilet *et al.*, 1995).

C. maltaromaticum CB1 was previously determined GRAS and was notified to FDA as GRN 000159. [10] The previous GRAS determination found that *C. maltaromaticum* CB1 was GRAS for use as a preservative in ready-to-eat (RTE) meat products at a maximum inoculation concentration of 1×10^4 colony forming units (cfu)/g. This GRAS determination assesses the addition of viable *C. maltaromaticum* to several additional food categories, including meat, poultry and fish products, frozen meals, processed fruit salads and vegetable salads, sauces, and

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[7] Clade = A group of biological taxa or species that share features inherited from a common ancestor.
[8] Unpublished information provided in the previous GRAS dossier submitted as GRN 000159.
[9] Reports indicate levels of 1×10^8 cfu/g or higher (Donald and Gibson, 1992; Huss *et al.*, 1995; Paludan-Muller *et al.*, 1998).
[10] The notice, dated October 8, 2004, listed seven *Carnobacterium maltaromaticum* strains for use in ready-to-eat and fresh comminuted meat products. An amendment dated January 27, 2005, limited the use to ready-to-eat meat products to conform with USDA regulations. An amendment, dated April 8, 2005, limited the subject of the notice to *Carnobacterium maltaromaticum* strain CB1 and provided information on the identity of this strain.

soft cheese and cheese spread-type products. In addition, an assessment of the safety-in-use of heat-treated *C. maltaromaticum* in ready-to-eat meat products, meat, poultry, fish and mixtures, fruits and vegetables, soups and stews, sauces and dressings, and cheese and cheese spread-type products was conducted.

2.1. Description

C. maltaromaticum CB1 historically belongs to a group of lactic acid bacteria (LAB) that metabolize glucose heterofermentatively to produce equimolar amounts of lactic acid, carbon dioxide, ethanol and acetic acid from sugars, and was previously included in the genus *Lactobacillus* (APPENDIX 4).

2.2. History of use

Carnobacterium species have been isolated from vacuum-packaged meat, fish and French soft cheeses, as summarized in GRN 000159, used as part of a starter bacterial culture in sausage fermentation in France (Shaw and Harding, 1984; Schillinger *et al.*, 1993; Milliere *et al.*, 1994; Nissen *et al.*, 1994; Pilet *et al.*, 1995).[8] *C. maltaromaticum* CB1 was determined as GRAS in 2004 as a food ingredient for use as a preservative in ready-to-eat (RTE), processed meat products at a maximum inoculation concentration of $1x10^4$ colony forming units (CFU)/g (APPENDIX 4).

2.3. Current uses

C. maltaromaticum CB1 is used as a preservative in ready-to-eat (RTE), processed meat products at a maximum inoculation concentration of $1x10^4$ colony forming units (CFU)/g (APPENDIX 4).

2.4. Regulatory status

Specific strains of *C. maltaromaticum* were determined GRAS for use in RTE meat products by an Expert Panel in 2004. The GRAS was submitted as a GRAS Notification (GRN 000159) to the FDA in 2004.[3] FDA reviewed the GRAS determination and stated that the agency "has no questions at this time regarding Griffith's conclusion that *C. maltaromaticum strain* CB1 is GRAS as an inhibitor of *L. monocytogenes* in RTE meat products under conditions set by USDA/FSIS."

2.5. Proposed use or uses

C. maltaromaticum CB1 lyophilized powder or heat-treated product is to be used as a preservative.

3. DESCRIPTION, SPECIFICATIONS AND MANUFACTURING PROCESS

8. Description and Specifications

C. maltaromaticum historically belongs to a group of lactic acid bacteria (LAB) that metabolize glucose heterofermentatively to produce equimolar amounts of lactic acid, carbon dioxide, ethanol and acetic acid from sugars, and was previously included in the genus

Lactobacillus (APPENDIX 4). *C. maltaromaticum* CB1 is a gram-positive, non-motile, non-sporeforming rod-shaped facultatively anaerobic bacterium that occurs singly and in short chains. The colonies are pinpoint, convex, white, circular and nonpigmented when grown at 25°C for 24 hous on TSA (APPENDIX 4). Carnobacteria have been isolated from refrigerated, vacuum-packaged fish and unprocessed beef and lamb, and French soft cheese, as previously described in GRN 000159 (APPENDIX 4). Alkaline pH (up to pH 9.5) promotes the growth of Carnobacterium colonies, while inhibiting other Lactobacillus species. Differentiation of *C. maltaromaticum* from other bacteria may be accomplished by modification of growth substrates (APPENDIX 4). *C. maltaromaticum* forms an umbolate or *beta*-type colony when inosine is substituted for sucrose in Cresol Red Thallous Acetate Sucrose agar. *C. maltaromaticum* strain CB1 specified in this GRAS document has been tested for resistance to 27 antibiotics, and was sensitive to amoxicillin + clavulanic acid, imipenem, tetracycline and tobromycin, with intermediate sensitivity to chloramphenicol, ciprofloxacin, erythromycin, gentamicin, netilmicin, and rifampin. The antibiotic resistance profile for *C. maltaromaticum* CB1 correlates well with the antibiotic resistance profiles of *Lactobacillus* species already being added to food or found in food naturally, which indicates that the addition of this strain of *C. maltaromaticum* to foods would not add any new or significant antibiotic resistance determinants that are not normally found in commensals or probiotic lactobacilli (APPENDIX 4). Specifications for *C. maltaromaticum* CB1 are provided in Table 1.

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Table 1. Specifications of *Carnobacterium maltaromaticum* lyophilized bacterial powder stated in the previous GRAS determination (GRN 000159)[2] and maintained in this GRAS determination.

Active Ingredients	*Carnobacterium maltaromaticum*	
Excipients	Maltodextrin	
Shelf Life	> one year	
Storage Conditions	Room Temperature (22°C)	
Physical Aspects	**Specifications**	**Method**
Appearance	Pass	Visual inspection APT plate and comparison to standard plate photograph and description
Concentration	Between $3.2x10^6$/g and $3.2x10^7$ viable cells/g	A.P.H.A./USP
Residual moisture	<5%	O'Haus
Microbiological Specifications		
Lactic Acid Bacteria	Between $3.2x10^6$/g and $3.2x10^7$ cfu/g or between $1.3x10^9$ and $1.4x10^{10}$ cfu/package	A.P.H.A./USP
Non Lactic acid bacteria	<100/g	A.P.H.A./USP
Yeasts	<100/g	A.P.H.A./USP
Molds	<100/g	A.P.H.A./USP
Anaerobic Spore Forming Bacteria	<10/g	A.P.H.A./USP
Clostridium botulinum	Absent *per* 50 g	A.P.H.A./USP
Total coli forms	<10/g	A.P.H.A./USP
Staphylococcus aureus	<100/g	A.P.H.A./USP
E. coli	Absent *per* 25 g	A.P.H.A./USP
Salmonella spp.	Absent *per* g	A.P.H.A./USP

A.P.H.A. = American Public Health Association; USP = United States Pharmacopoeia

3.2. Manufacturing Process

Viable and heat-treated *C. maltaromaticum* CB1 is manufactured by Griffith Laboratories in accordance with current good manufacturing practice (cGMP) for foods, and in accordance with all applicable environmental regulations to result in pure culture fermentation. These materials have been designated as approved food additives or Generally Recognized As Safe (GRAS) for use in food manufacture.

3.2.1. Manufacturing process for viable *C. maltaromaticum*

Viable *C. maltaromaticum* manufacturing procedures and specifications were described in detail in GRAS GRN 000159 (APPENDIX 4) and will not change with the added food categories. A detailed manufacturing flowchart is provided in Figure 1.

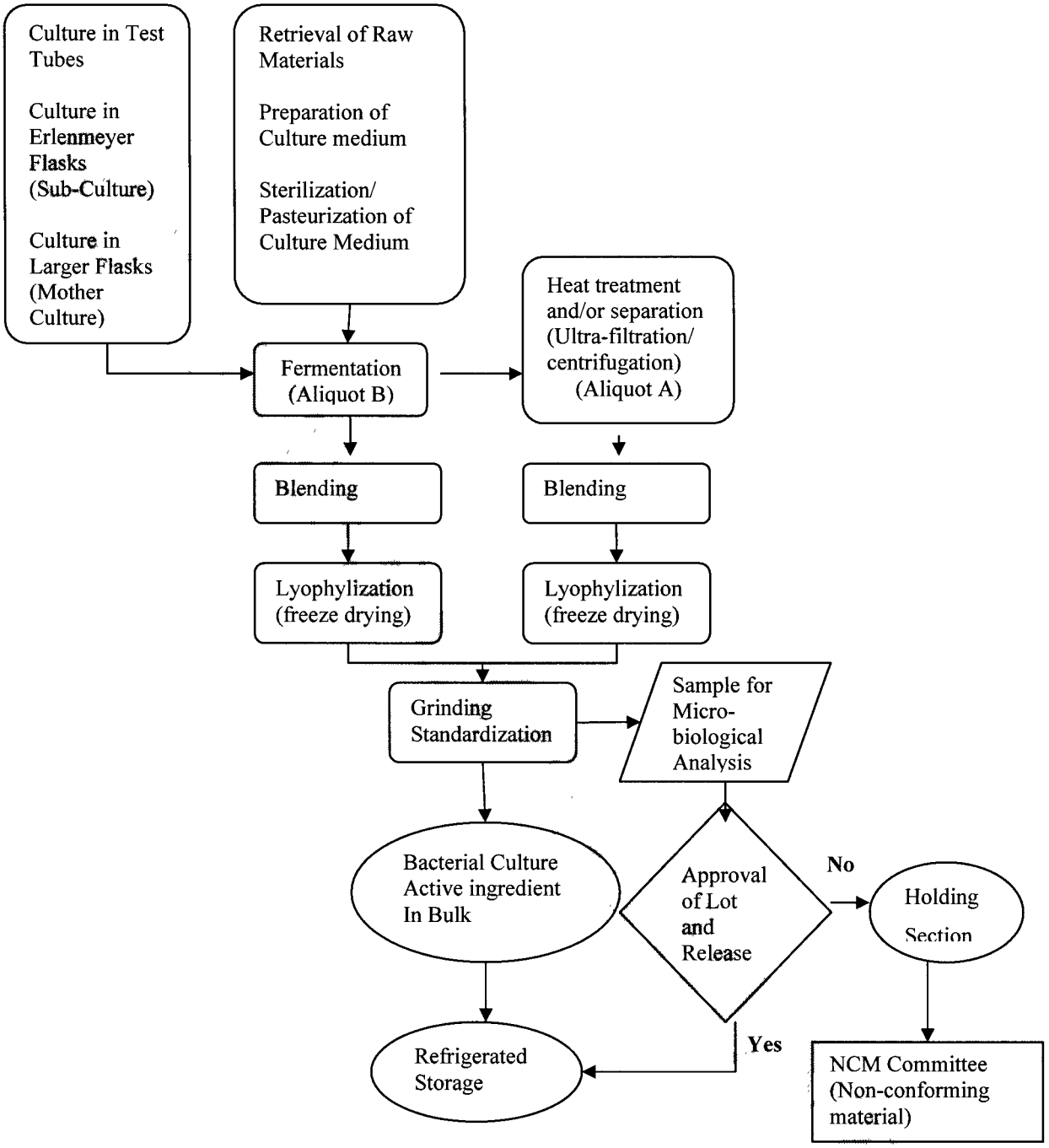

Figure 1. Manufacturing process for *C. maltaromaticum* stated in GRAS determination

3.2.2. Manufacturing process for heat-treated *C. maltaromaticum* CB1

In the generation of the heat-treated *C. maltaromaticum* process modification of this food ingredient, immediately following the fermentation and pasteurization steps, there are two

interchangeable processing methods to remove water: 1. lyophilization and milling, or alternatively, 2. evaporation and spray-drying. The fermentation medium, which contains a carbon and energy source (primarily dextrose[11]), nitrogen sources (food grade yeast nitrogen base and hydrolyzed vegetable protein), and disodium hydrogen phosphate (Na_2HPO_4; to stabilize the pH during the fermentation process), is incubated at 25°C for 12-14 hours to achieve a cell density of 1×10^9-10^{10} cfu/ml. Following fermentation, maltodextrin[12], a starch-derived carbohydrate, is added on a specific w/v[13] basis as a manufacturing aid to assist water removal through either the lyophilization method or the evaporation and spray-drying method, to provide a final concentration of 72-76% maltodextrin in the final products. The fermented medium is pasteurized (*i.e.*, heat-treated, although the heat treatment does not degrade all *C. maltaromaticum* cells, to yield a maximum viable cell density $\leq 1\times10^4$ cfu/g) and the product is either lyophilized and milled or alternatively, evaporated and spray-dried. The product concentrates are tested against product specifications, and once approved, packaged for commerce (Griffith Laboratories, 2008a). A graphical depiction of the manufacturing process is shown in Figure 2. Information regarding heat-treated *C. maltaromaticum* product specifications is provided in Table 2.

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[11] Dextrose is a crystalline glucose produced from starch. 21 CFR §184.1857 states that dextrose be used in food with no limitation other than good manufacturing practice.

[12] Maltodextrin is a polysaccharide, produced from starch and is easily digestible. 21 CFR §184.1444 states that maltodextrin can be used in food with no limitation other than good manufacturing practice.

[13] w/v = weight *per* volume.

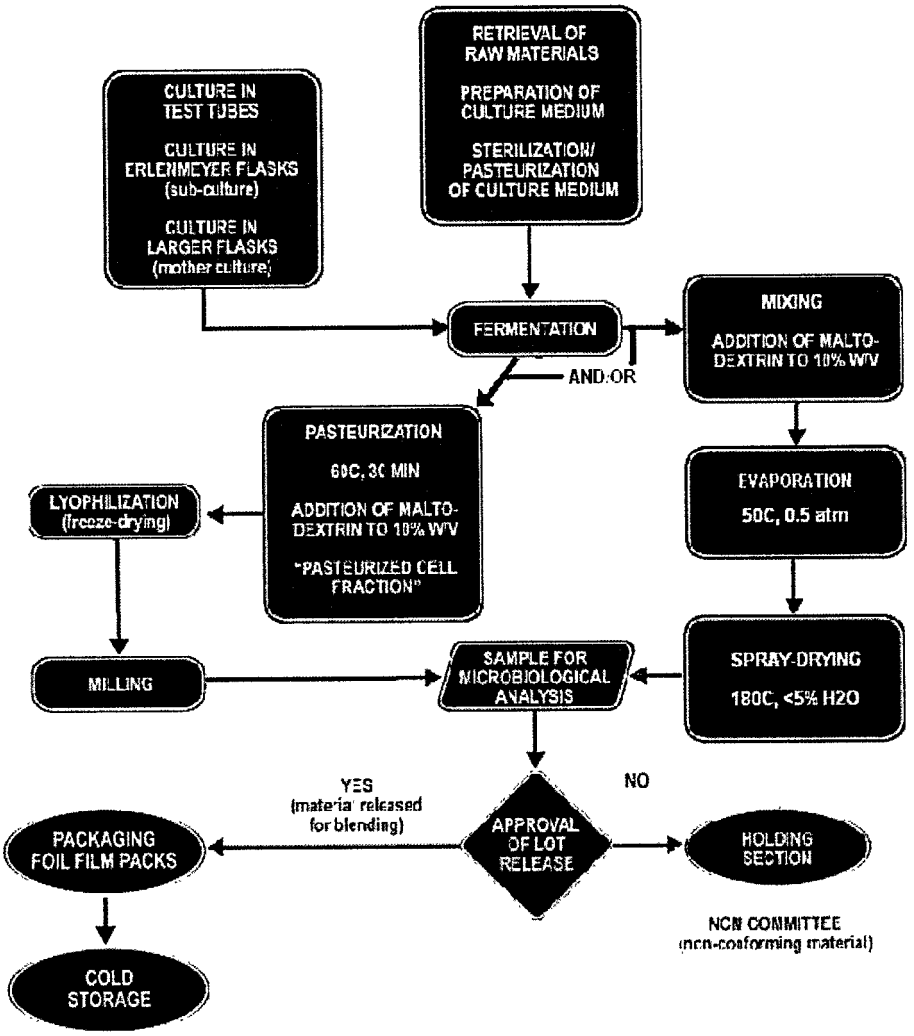

Figure 2. Process control flow chart for the production of heat-treated *C. maltaromaticum* (Griffith Laboratories, 2008b)

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Table 2. Heat-treated C. *maltaromaticum* CB1 product specifications (Griffith Laboratories, 2008c)

Specification	Specification Limits	Test Method*
Physical Specifications		
Appearance	Light tan-colored free-flowing homogenous powder	Visual inspection
Residual Moisture	<5.0%	AOAC 925.45.B 44.1.03
Microbial Specifications		
Total Plate Count (CFU/g)	$<1.0\times10^4$	MFHPH-18
Yeast Molds (CFU/g)	<10/g	MFHPB-22
Coliforms (CFU/g)	<10/g	MFHPB-34
Staphylococcus aureus (CFU/g)	<10/g	MFHPH-21
Escherichia coli (CFU/g)	<10/g	MFHPB-34
Salmonella sp. (CFU/25g)	Absent in 25 g	MFHPB-20

*Test methods are available upon request; AU = Activity Unit; CFU = Colony Forming Unit

In summary, a dry-formulated pasteurized bacterial culture of *C. maltaromaticum* is prepared by lyophilizing or spray-drying a fermented, pasteurized culture of the bacteria in the presence of maltodextrin (a manufacturing aid), to increase the solids content as required for successful lyophilization or evaporation and spray-drying.

3.3. Stability

The final dried, blended viable product is packaged into foil film packages using a nitrogen flush or vacuum packager. Package weight is customized to finished product final application use and stored under cool, dry conditions prior to distribution. Product shelf life of the original (*i.e.*, viable) *C. maltaromaticum* CB1 product has been determined to be twelve months under ambient storage conditions (22°C) in original sealed packaging, as determined by bacteriocin activity that did not decrease below 2,500 activity units (AU) *per* gram.

Based on the minimum product specifications, the predicted shelf-life of the heat-treated *C. maltaromaticum* CB1 product at 22°C was measured to be 153 weeks (approximately 2.9 years). Additionally, an accelerated shelf-life study was conducted and found that at 22°C, the predicted shelf-life of the heat-treated *C. maltaromaticum* product to be 323 weeks (approximately six years). These data fully support the claimed product shelf-life of at least one year when stored at 22°C (Griffith Laboratories, 2008a).

4. ESTIMATED DAILY INTAKE

In order to determine whether the incorporation of heat-treated or viable *C. maltaromaticum* CB1 into the pre-existing and new food categories would exceed the consumption estimates stated in the previous GRAS determination (APPENDIX 4), a revised

consumption analysis[14] was conducted for this GRAS determination. Foods included in the consumption analysis were chosen by Griffith Laboratories based on a list of foods generated by searching the NHANES database using descriptor words. Only those foods which represented a target food were selected for inclusion into the analysis. The consumption calculations in this GRAS determination include use of viable or heat-treated *C. maltaromaticum* CB1 product to be applied to food categories stated the previous GRAS dossier[15], in addition to the new food categories in this GRAS determination. Foods stated in the previous GRAS dossier are shown in Table 3. This GRAS will include the additional general food categories stated in Table 4 as well as a heat-treated *C. maltaromaticum* CB1 version of this ingredient (Table 5 and Table 6). Specific food categories and *C. maltaromaticum* CB1 use levels for both viable and heat-treated bacteria can be found in APPENDIX 1 and APPENDIX 2, respectively. The amount of *C. maltaromaticum* CB1 expected to be on the product at the time of consumption was then multiplied by the amount of each food consumed *per* day, averaged for the population of eaters, then extrapolated out the US population.

The food categories stated in this GRAS determination include foods for which standards of identity exist, as outlined in US regulations.[16] An ingredient that is lawfully added to food products may be used in a standardized food only if it is permitted by the applicable standard of identity. When a *C. maltaromaticum* preparation would be applied to meat and poultry products and other foods whose standards of identity do not permit the addition of antimicrobial agents, the products would need to be descriptively named, such as "pork chop with an antimicrobial solution to reduce microorganisms" and again, the *C. maltaromaticum* preparation would need to be provided in the ingredient statement on the product labeling.

4.1. Consumption of viable *C. maltaromaticum* CB1

The GRAS determination for *C. maltaromaticum* (GRN 000159) specified an inoculation range of 1×10^3 to 1×10^4 colony forming units (cfu)/g of product to be applied to the surface to inhibit the growth of *L. monocytogenes*. Calculations of the estimated daily intake (EDI) for the GRAS dossier completed in 2004 and was further discussed in the GRAS Notification response letter by FDA,[17] incorporated the fact that *C. maltaromaticum* CB1 is a dynamic ingredient, usually multiplying during the storage period, which results in a saturated maximum growth concentration that plateaus at 1×10^8 to 1×10^9 cfu/g. This results in an added consumption to the diet of approximately 4.3×10^9 cfu/day and a *per capita* consumption of 1.41×10^{11} cfu/day based on the consumption of meat.[18]

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[14] The revised consumption analysis was conducted using INHANES (2003-2004) survey data, and the mean and 90th percentile consumption values are based on the weight of the respondents that participated in the survey.

[15] Previous GRAS dossier included ready-to-eat (RTE) meat products and fresh comminuted, processed meat products; however, the original GRAS dossier was amended for use only in RTE products.

[16] Title 21 of the US Code of Federal Regulations (CFR), section 130, 2008. Food standards

[17] FDA Agency response letter: GRAS notice No. GRN 000159, dated May 27, 2005.

[18] *Per captia* consumption of meat was calculated to be 141 g/d, multiplied by $1x10^9$ cfu/g yields $1.41x10^{11}$ cfu/day.

A consumption analysis was conducted, which incorporated the foods stated in the previous GRAS determination (Table 3), plus the additional foods stated in Table 4, for which standards of identity do not preclude its use.[19]

Table 3. Previous GRAS (GRN 000159) general food categories for use of viable *C. maltaromaticum* CB1[19]

Ready-to-eat meat products	Fresh comminuted, processed meat products

Table 4. General food categories for use with viable *C. maltaromaticum* CB1 under this GRAS Determination

Soft cheese and cheese spread-type products	Processed fruit salads and vegetable salads
Meat, Poultry, Fish products	Sauces
Frozen meals	

The use of viable *C. maltaromaticum* CB1 in the foods stated in Table 3 and Table 4 resulted in a mean and 90th percentile daily intake of 3.4×10^{10} cfu/day (5.4×10^{8} cfu/kg/day) and 1.1×10^{11} cfu/day (1.7×10^{9} cfu/kg/day), respectively. These numbers incorporate the growth characteristic of this bacterium on certain food products and the absence of growth on other food products, and that for certain food products *C. maltaromaticum* will be degraded during the cooking process. This results in an aggregate intake that does not exceed the original *per capita* consumption estimate for *C. maltaromaticum* of 1.41×10^{11} cfu/day.

4.2. Consumption of heat-treated *C. maltaromaticum* CB1

During the manufacturing process of heat-treated *C. maltaromaticum* CB1, raw materials, such as maltodextrin and dextrose, are added to the production fermentation. These excipients are GRAS or approved food additives for this use and account for much of the bulk weight of the product when applied to foods. Heat-treated *C. maltaromaticum* CB1 does not exhibit significant bacterial growth, due to the small number of proliferating cells. The product specifications state that the heat-treated *C. maltaromaticum* CB1 contains $<1\times10^{4}$ cfu/g. This allows for a more specific amount of product to be applied and therefore the calculation of a more conservative estimated intake is possible. Griffith Labs intends to use heat-treated *C. maltaromaticum* CB1 independently of the viable *C. maltaromaticum* CB1 product to the general food products stated in Table 5 and Table 6, for which standards of identity do not preclude its use.

Table 5. GRAS dossier (GRN 000159) general food categories for use of viable *C. maltaromaticum* CB1[19]

Ready-to-eat meat products	Fresh comminuted, processed meat products

[19] The GRAS notice (GRN No. 000159) stated the use of *C. maltaromaticum* for use in ready-to-eat and fresh comminuted meat products. An amendment dated January 27, 2005, limited the use to ready-to-eat meat products to conform with USDA regulations.

Table 6. General food categories for use with heat-treated *C. maltaromaticum* CB1

Cheese and cheese-type products	Fruits and vegetables
Meat, Poultry, Fish, and Mixtures	Sauces and dressings
Soups and stews	

The product specification information supplied in the previous GRAS dossier (APPENDIX 4) (Table 1) stated a concentration of *C. maltaromaticum* CB1 at a maximum of 3.2×10^7 cfu/g of ingredient[20] which, when added at the specified concentration of 0.1-0.5 g ingredient *per* 100 g food, results in the application of 1.6×10^5 cfu/g food. This amount of *C. maltaromaticum* is below the previously determined maximum growth endpoint on a given food of *C. maltaromaticum* CB1 on foods, as stated in the previous GRAS at 5×10^7 cfu/g food. An overall eaters only consumption for the mean and 90th percentile of the heat-treated *C. maltaromaticum* CB1 product added to the foods in APPENDIX 2 was determined to be 1.4 g/day (22.6 mg/kg/day) and 3.0 g/day (47.2 mg/kg/day), respectively, with the bulk of the weight being attributed to the addition of maltodextrin[21]. The calculated amount of heat-treated *C. maltaromaticum* CB1 product applied *per* gram of food is 0.3125 mg. Multiplication of the maximum concentration of added bacterial powder (3.2×10^7 cfu/g of ingredient) times the maximum consumption level of 3.0 g/day equals 9.6×10^7 cfu/day. The consumption estimates calculate a maximum of 9.6×10^7 cfu/day consumed across all food categories to which the heat-treated *C. maltaromaticum* CB1 will be added, and a maximum consumption of 3 grams of bacterial powder *per* day. Therefore the product, when applied at a concentration range of 0.1-0.5% w/v or 1-5 mg/g food product, results in the maximum consumption estimate of 9.6×10^7 cfu/day, does not exceed the consumption estimate of 1.41×10^{11} cfu/day as stated in the GRAS dossier FDA notification letter.

5. SAFETY EVALUATION

The body of scientific literature describing the use and safety of *C. maltaromaticum* CB1 indicates an overall low degree of toxicity. GRN 000159 (APPENDIX 4) summarized research conducted on biogenic amine (*e.g.*, histamine and tyramine) formation by *Carnobacterium* species, noting that *Carnobacterium* species growing on vacuum-packed, cold-smoked salmon did not increase tyramine concentrations above those noted in commercial vacuum-packed, cold-smoked salmon or some French cheeses (APPENDIX 4).

One of the methods used by *C. maltaromaticum*, and LAB in general, to inhibit potentially pathogenic bacteria may be through the production of bacteriocins. These bacteriocins are able to kill closely related gram-positive bacteria, and a few have a broader spectrum that targets food-borne pathogens (Klaenhammer, 1993). More specifically, a bacteriocin from *C. maltaromaticum* was found to inhibit the growth of *Listeria monocytogenes*

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[20] As stated in GRN 000159 specifications for viable *C. maltaromaticum* product.
[21] Heat-treated *C. maltaromaticum* ingredient contains 72-76% maltodextrin.

(Schobitz *et al.*, 1999). A literature search was conducted for relevant scientific publications related to the safety of *Carnobacterium maltaromaticum* CB1 which have appeared since the previous GRAS determination in 2004 (APPENDIX 4), but no additional information was found.

Bacteriocins have been isolated from beef, ham, and from French mold-ripened soft cheese (Jack *et al.*, 1996; Herbin *et al.*, 1997). Since the bacteriocins produced by LAB have been isolated from foods such as meat and dairy products, both *C. maltaromaticum* and its bacteriocins have been consumed for centuries (Shaw and Harding, 1984; Schillinger *et al.*, 1993; Milliere *et al.*, 1994; Nissen *et al.*, 1994; Pilet *et al.*, 1995). *C. maltaromaticum*-generated bacteriocins have been shown to be susceptible to proteolytic enzymes as well as simulated gastric fluid (SGF)[22], indicating (1) ingestion of bacteriocins would not have a deleterious effect on the beneficial gut microorganisms (Schillinger *et al.*, 1993) and (2) a low potential for the production of allergenicity or toxicity (Griffith Laboratories, 2003). In addition, the search of the scientific literature did not uncover any reports of *C. maltaromaticum* having been reported to be toxigenic or pathogenic, although *C. maltaromaticum* has been cited as an opportunistic pathogen *via* open wound infection (Chmelar *et al.*, 2002).

Fermented foods occasionally contain increased levels of biogenic amines (organic bases usually produced by amino acid decarboxylation). Tyramine is an organic acid that is vasoactive in nature, with the potential (at high levels) to cause peripheral vasoconstriction, increased cardiac output and respiration, elevated blood glucose and norepinephrine release (McCabe-Sellers *et al.*, 2006). The intestinal tract typically degrades tyramine through monoamine oxidase enzymes, although certain monoamine oxidase inhibitor drugs may inhibit tyramine degradation, as was discussed in the previous GRAS dossier.[2] Therefore, various food items were incubated with viable *C. maltaromaticum* and analyzed for tyramine formation (Griffith Laboratories, 2009). The data were compared to tyramine values reported by McCabe-Sellers *et al.* (McCabe-Sellers *et al.*, 2006) and the Vanderbilt University (Table 7).[23] These results indicate that the addition of *C. maltaromaticum* to various meats and cheese does not increase tyramine concentrations to levels significantly greater than tyramine levels in other commonly consumed foods already on the market.

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[22] SGF was produced in accordance with USP (2000) methods.

Table 7. Tyramine levels reported in foods incubated with *C. maltaromaticum* CB1 compared to other reported tyramine values in foods

Food Item	#Reference Amount (g or ml)	Tyramine content (µg/g)	Tyramine *per* reference amount (mg/serving)
Griffith Laboratories (2009)*			
Sliced turkey with *C.*	55	133	7.3
Sliced ham with *C. maltaromaticum*	55	74	4.1
Sliced roast beef with *C.*	55	78	4.3
Control sliced roast beef	55	82	4.5
Cheese with *C. maltaromaticum***	30	11.4	0.3
Control cheese	30	2.2	0.01
Handbook of Food-Drug interactions (McCabe *et al.*, 2003)			
Holland cheese	30	138	4.1
Blue Danish cheese	30	369.5	11.1
English stilton	30	1156.9	34.7
Ground beef, chuck	100	40	4
Mortadella	30	184	5.5
Salami	30	188	5.6
Chorizo	60	324.6	19.5
Herring	100	300	30
Mackerel	100	100	10
Tuna	100	500	50
Vanderbilt university[23]			
Cheddar cheese	30	1400	43
Stilton	30	2000	61
Tap beer	355	110	38
Dry sausage	55	780	43
Pickled herring (in brine)	55	1560	86

#Reference amount is a typical serving size; *Unless otherwise noted, the products were evaluated at the end of shelf life; **Cottage-type cheese was incubated with *C. maltaromaticum* for 14 days. Tyramine was not detected when evaluated at the 7-day incubation period.

[23] Meal ideas and menus: Avoiding high-tyramine foods made easy. http://www.mc.vanderbilt.edu/neurology/Tyramine%20Menu%20Book%2006227101.pdf; site visited April 27, 2009

No new studies on the safety of *C. maltaromaticum* have been published since the previous GRAS determination (APPENDIX 4). However, studies reporting growth characteristics of *C. maltaromaticum* or the ability of *C. maltaromaticum* or its bacteriocins to inhibit *Listeria monocytogenes* have been published and will be briefly discussed below.

5.1. Growth characteristics of *Carnobacterium* on cold-smoked salmon

This study aimed to evaluate the effect of three biopreservative *Carnobacterium* strains (*C. divergens* V41, *C. maltaromaticum*[24] V1 and SF668) showing high inhibition potential of *Listeria monocytogenes* on microbiological, chemical and sensory quality of cold-smoked salmon (CSS) (Brillet *et al.*, 2005). The spoiling potential of the three strains of LAB[25] were tested in sterile CSS blocks. Sensory evaluation (characteristics including odor, flavor, texture and color) and analysis of physico-chemical indices (pH, total volatile basic nitrogen (TVBN) and biogenic amines) after inoculation (2% v/w)[26] and storage under vacuum for nine days at 4°C followed by 19 days at 8°C were evaluated. The initial level of *Carnobacterium* spp. was 1×10^5 cfu/g in inoculated CSS blocks. A control CSS block was inoculated with 2% sterile saline. Results showed that *C. divergens* V41 grew slightly faster then the other strains. None of the carnobacteria showed any adverse effect on quality of the product (*i.e.* no off-odor detection, no TVBN production, no acidification and no biogenic amine except a small production of odor and tyramine by *C. divergens* V41).

In a second experiment, *C. divergens* V41 was sprayed (1% v/w) on each side of sliced commercial freshly-processed CSS blocks provided by five different Norwegian salmon sources (Brillet *et al.*, 2005). These slices were then packaged in the same condition as would be found in supermarkets and stored using the same conditions as stated above. Inoculation for this experiment was $1\times10^{4\text{-}5}$ cfu/g. The effect of inoculation on the sensory characteristics, physico-chemical parameters and natural microflora was evaluated during four weeks of storage at refrigerator temperatures. In this experiment, investigating the use of *C. divergens* V41 in commercial CSS slices, it was found that when the natural microflora was initially weak (two batches, <20 cfu/g), *C. divergens* V41 reached $10^{7\text{-}8}$ cfu/g with a slight inhibition of endogenous Enterobacteriaceae, lactobacilli and yeasts. The presence of *C. divergens* V41 was detected *via* a slight off-odor and flavor but not considered spoiled. In contrast, when the initial microflora was initially high (two batches, $>10^{4\text{-}5}$cfu/g), no effect on the micoflora, TVBN and biogenic amine production was observed. Further, the sensory characteristics were not considered to be effected.

In conclusion, Brillet *et al.* (2005) found that the carnobacteria tested did not show any adverse effect on the quality of the CSS product. Furthermore, while the growth of the *Carnobacterium* strains differed, the study concluded that biopreservation of CSS using LAB was a promising way to inhibit the growth of pathogenic bacteria, such as *L. monocytogenes,* with little effect on the product quality.

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[24] The authors cited the bacteria using previous nomenclature as *Carnobacterium piscicola* V1.
[25] LAB was isolated from multiple sources. *C. divergens* was isolated from salmon intestine, *C. maltaromaticum* V1 was isolated from trout intestine, and *C. maltaromaticum* SF668 was isolated from commercial Norwegian CSS.
[26] v/w = volume *per* unit weight.

Joffraud *et al.* (2006) investigated the spoilage potential of bacteria isolated from CSS *via* off odor production from the interaction of bacterial species using sensory analysis at the end of a storage period. In order to investigate the potential effect of combined bacteria on spoilage, sterile CSS blocks were inoculated (1×10^3-1×10^5 cfu/g) as pure cultures as well as mixed paired-cultures. The two main LAB found on commercial CSS, *L. sakei* and *C. maltaromaticum,*[27] were mixed together and applied to CSS. In addition, each one of them was paired with *B. thermosphacta*, *S. liquefaciens*-like bacteria and *Vibrio* sp., respectively. A control sample contained sterile water in replacement of the inoculum. CSS blocks were inoculated with specific stand-alone bacteria or a pair of bacteria. Treated CSS blocks were then vacuum-packaged and stored for 5-6 weeks at 8°C to mimic abuse temperatures. The results of the experiment show that indeed, all bacteria grew to their maximum growth potential of 1×10^7-1×10^9 cfu/g within 1-2 weeks of storage with *L. sakei* and *Vibrio* sp. growing fastest. *Vibrio* sp. and *C. maltaromaticum* were considered least spoiled, whereas *L. sakei* and *S. liquifaciens*-like bacteria were considered most spoiled and rejected by the sensory panel. When combined, *L. sakei* was able to inhibit the growth of the co-cultured strain of bacteria by 1×10^3 cfu/g. *C. maltaromaticum* growth was either unaffected or weakly inhibited (1×10^1 cfu/g) in the co-cultured environment.

Results from these three experiments show evidence of interactions between inoculation strains in terms of growth patterns and sensory analysis. However, based on the results of their experiments, the authors state that spoilage of CSS is difficult to detect but knowledge of these interactions is essential for the development of preservation techniques and predictive microbiology of foods in which a mixed flora develops during storage contributing to spoilage.

5.2. Spoilage potential and metabolic activity of *Carnobacterium* species in MAP shrimp

A study conducted by Laursen *et al.* (2006) set out to evaluate the metabolic activity and spoilage potential of *Carnobacterium* spp., using shrimp meat. Modified atmosphere packaged (MAP) shrimp have been previously shown to spoil due to activity of certain strains of *C. maltaromaticum* and *Brochothrix thermosphacta* (Mejlholm *et al.*, 2005). Spoilage and metabolic activity of *C. maltaromaticum* (cluster H and cluster L)[28,29], *C. divergens, and C. mobile* were studied alone and in co-culture with *B. thermosphacta* in shrimp meat. An additional evaluation was conducted on a specific cluster of *C. maltaromaticum* (cluster L) to study its inhibitory potential on the growth of *B. thermosphacta* and *L. monocytogenes*. Activity of the carnobacteria was evaluated using sensory, microbiological and analytical methods including GC-MS and HPLC analyses (Laursen *et al.*, 2006).

Briefly, shrimp were inoculated with 1% (v/w) of solutions containing mixtures of (1) isolates from different *Carnobacterium* species, (2) *B. thermosphacta* isolates, or (3) mixtures of *Carnobacterium* isolates in co-cultures with a mixture of isolates of *B. thermosphacta*. All solutions contained an initial concentration of 1×10^5 cfu/g. The control shrimp were inoculated

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[27] The authors cited the bacteria using previous nomenclature as *Carnobacterium piscicola.*

[28] A phylogenetically related group of strains, Cluster H consisted of isolates F29-1, FM-C4, N1, ML1-95, OB6-1b and R1.7. (Laursen *et al.*, 2005)

[29] A phylogenetically related group of strains, Cluster L consisted of isolates F46-1 and ML1-97 (Laursen *et al.*, 2005).

with 1% v/w[30] of a 1.6% v/w NaCl solution without bacteria. Inoculated shrimp were packed in a MAP and then stored at 5°C. Shrimp from each sub-batch were characterized by sensory evaluation, by microbiological and chemical methods, and by analysis of volatile compounds immediately after packaging and again after ten days of storage.

Shrimp inoculated with different mixtures of *Carnobacterium* isolates showed bacterial growth to 1×10^8 cfu/g during storage at 5°C. After ten days, growth and metabolism of *C. maltaromaticum* cluster H and *C. divergens* isolates resulted in development of off-flavors and the sensory rejection of 43% of the samples. Shrimp inoculated with *C. maltaromaticum* cluster *L.* or *C. mobile* isolates developed only a mild off-odor and differed very little from the control shrimp. After inoculation, both *B. thermosphacta* and *Carnobacterium* species grew to 1×10^8 cfu/g after ten days at 5°C. Inoculated sub-batches of shrimp all developed off-flavors of strong intensity. *C. mobile*, however, had little effect on off-flavors and metabolites produced by *B. thermosphacta* in shrimp. Gas chromatograph results of metabolites produced from *B. thermosphacta* confirmed the presence of odor active compounds. Co-cultures of *B. thermosphacta* and *C. divergens* or *C. maltaromaticum* cluster H formed less odor-active compounds than *B. thermosphacta* alone.

The authors stated that *C. maltaromaticum* cluster L has limited spoilage activity compared to other studied isolates of *C. maltaromaticum* and *C. divergens.* They also state that when used as a protective culture in high concentration in cooked and peeled MAP shrimp, *C. maltaromaticum* cluster L, "unfortunately", was (1) unable to prevent growth of *L. monocytogenes*, (2) unable to markedly reduce growth of *B. thermosphacta*, and (3) unable to clearly delay sensory spoilage of the product. Despite this lack of effect in MAP shrimp, the authors suggest further investigation of applying *Carnobacterium* in other products to further evaluate their potential and limitations as a biocontrol protective culture.

Carnobacterium spp. does not disguise spoilage in food, but can help to prevent it; however, spoilage activity shows intraspecies as well as interspecies variation (Leisner *et al.*, 2007). These authors confirm the protective effect of isolated strains from *C. maltaromaticum*; however, use of the strains investigated in this study in modified atmosphere packaged shrimp may be limited due to sensory spoilage concerns.

5.3. Inhibition of *L. monocytogenes* using freeze-dried bacteriocin powder in food

Azuma *et al.* (2007) tested the effectiveness of freeze-dried, bacteriocin-producing *C. maltaromaticum* CS526[31] and evaluated it for its inhibitory potential against *L. monocytogenes* growth in a food model. To accomplish this, a 10% solution of milk whey powder was fermented with either the bacteriocinogenic *C. maltaromaticum* CS526 Bac^+ fermentate (Bac^+-F) or its nonbacteriocinogenic mutant strain CS526 Bac^- fermentate (Bac^--F) to give a final inoculum level of 1×10^7 cfu/ml, at 30°C for twelve hours and lyophilized with a freeze dryer. A three-strain mixture of *L. monocytogenes* was used in this study to inoculate ground meat (50:50 beef and pork ratio) at a final inoculum level of 1×10^5 cfu/g. The ground meat was heated on a hot

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[30] Volume *per* weight.

[31] The authors cited the bacteria using previous nomenclature as *Carnobacterium piscicola* CS526.

plate for eight minutes at 140°C and then the Bac^+-F powder was added to give a final concentration of 1%, 5% or 10% w/w[32]. Control experiments were carried out using Bac^--F powder or non-fermented whey powder to replace the Bac^+-F powder. Freshly mixed *L. monocytogenes* solution (0.8 ml) was added to 80g of pre-roasted meat containing the powders to give the final *L. monocytogenes* inoculum level of 1×10^5 cfu/g. The inoculated food samples were incubated at 4°C and 12°C for 25 days and five days, respectively, after which they were enumerated for CFU/ml and analyzed for bacteriocin activity.

In ground meat containing Bac^--F, *L. monocytogenes* populations increased from 1×10^5 to 1×10^7-10^{10} cfu/g at each concentration and throughout the storage period. A concentration-dependent inhibitory effect against *L. monocytogenes* was observed in ground meat containing Bac^+-F. *L. monocytogenes* in ground meat treated with 10% and 5% Bac^+-F rapidly decreased from 1×10^5 cfu/g to less than the detection limit (3.0×10^3 cfu/g) within five days at 4°C. However, at 5% of Bac^+-F, growth was observed after 15 days. At 12°C, *L. monocytogenes* in ground meat containing 10% Bac^+-F rapidly declined to below the detection limit within one day, and the bacteriostatic effect was observed for up to four days. Ground meat with 5% Bac^+-F showed *L. monocytogenes* populations decreasing from initial inoculation levels to 1×10^4 cfu/g within one day, but then increased throughout the storage period.

These data confirm that the freeze-dried *C. maltaromaticum* CS526 powder can be an effective tool to help control *L. monocytogenes* growth and extend the shelf-life of food.

5.4. Inhibition of *L. monocytogenes* in a processed meat using the biopreservative *C. maltaromaticum* CB1 with sodium lactate (SL) and sodium diacetate (SDA)

An unpublished study conducted by Griffith Laboratories used various concentrations of the biopreservative *C. maltaromaticum* CB1 added to meat batter prior to cooking in order to determine the efficacy of the biopreservative and its inhibitory effect against the growth of a cocktail of *L. monocytogenes* during extended storage at 4°C (Carlson *et al.*, 2007). Sodium lactate (SL) and sodium diacetate (SDA) were added to a wiener meat batter at a concentration of 3.3% SL and 0.1% SDA. The biopreservative was added at a range of doses from 0.01-5%. Three batches of wieners were prepared on three separate manufacturing dates. The end product was refrigerated, sliced and inoculated with a cocktail of four strains of *L. monocytogenes* prior to being stored at 4°C for up to 70 days. A standard bacterial plating technique was used to analyze samples at pre-selected times.

The results of this study showed that without the SL/SDA, the biopreservative, or the combination of both, *Listeria* spp. increased to a maximum population of 5×10^8 cfu/g within 35 days. In contrast, wieners treated with the SL/SDA, or the biopreservative showed a slower growth line compared to control and reached 1×10^8 cfu/g within 70 days of storage. In the treatment group which received SL/SDA as well as the biopreservative (minimum 0.5%), an initial decrease below the inoculum level was observed and *L. monocytogenes* counts were maintained below the inoculum level throughout the 10-week storage period. The authors concluded that a combination of SL/SDA and biopreservative allowed for control of *L.*

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[32] Weight/weight.

monocytogenes in ready-to-eat meats, giving meat processors an alternative for decreasing *L. monocytogenes* in meats (Carlson *et al.*, 2007).[33]

5.5. Potential for pathogenicity of *C. maltaromaticum*

A recent study conducted by Jensen *et al.* (2007) examined the sensitivity of strains of *Drosophilia melanogaster* to various human pathogenic and nonpathogenic gram-positive bacteria (Table 8) using a thorax injection technique. The authors examined whether infection with these bacteria resulted in mortalities similar to those observed for infection with *L. monocytogenes* or *Staphylococcus aureus*. The negative control was *D. melanogaster* Oregon R strain infected, *via* injection into the thorax, with *Escherichia coli*.

Table 8. Bacterial strains and source studied with *D. melanogaster* host (Jensen *et al.*, 2007)

Bacterial species, strain (and type)	Source
Bacillus subtilis K1-E2	Laboratory collection
C. maltaromaticum	Food isolate (pork meat)
C. maltaromaticum Cm 1-2	Environment (*Sphagnum* pond)
Escherichia coli OP50[a]	Nonpathogenic lab strain
Lactobacillus plantarum ATCC 14917	Food isolate (Sauerkraut)
Listeria monocytogenes EGD (serotype 1/2[a])	Laboratory collection
Listeria innocua Div-A8	Food isolate (mackerel)
Pediococcus acidilactici LMG 17692	Food isolate (chili)
Staphylococcus aureus NCTC 8325-4 (t211)	Human clinical isolate
S. aureus K3-B2 (t524)	Food isolate (cheese)
S. aureus J15033 (t230)	Human clinical isolate

[a] Used as a control.

It was found that after injection with various species of gram-positive bacteria, *L. monocytogenes* and *S. aureus* killed the host rapidly compared with the negative control. Infection with *L. innocua, B. subtilis* or *C. maltaromaticum* also resulted in a high fly mortality, whereas *L. plantarum* and *P. acidilactici* resulted in a slightly increased mortality. Strains of *D. melanogaster*, which were selected for heat, cold and desiccation resistance, respectively, and were subjected to infection by *L. monocytogenes, S. aureus,* and *E. coli* showed mortality rates comparable with that of the Oregon R control strain. The authors concluded that the *D. melanogaster* model was inadequate for differentiating between virulent and nonvirulent gram-

[33] A copy of the poster prepared by the authors is included in APPENDIX 3.

positive bacteria in humans, as nonpathogenic bacteria caused partial or high mortality in this study.

5.6. Effect of lactic acid and lactic acid bacteria on growth of spoilage microorganisms in vacuum-packed cold-smoked salmon

The study conducted by Vescovo *et al.* (2006) investigated the inhibition of *Listeria innocua* growth by lactic acid cultures in contaminated vacuum-packed cold-smoked salmon (CSS). Vacuum-packaged CSS was used as a commonly consumed model for bacterial growth and spoilage. The authors evaluated the antagonistic activity of selected LAB strains, singly and in association, towards *L. innocua* growth on CSS. The 100 g fillets were purchased at local retailers two days after processing and were said to have a shelf-life of four weeks. Ten-gram samples of salmon were subjected to the following treatments: CSS (control samples), CSS inoculated with *L. innocua* (concentration range from $1\times10^{4\text{-}5}$ cfu/g of product), CSS inoculated with both *L. innocua* as in the test sample, as well as LAB cultures singly or in association as follows: *C. maltaromaticum* Sal_3[34] (1×10^6 cfu/g), *Lactobacillus casei* T_3 (1×10^6 cfu/g), *L. casei* T_3 (1×10^8 cfu/g), *Lactobacillus plantarum* Pe_2 (1×10^6 cfu/g), *L. casei* T_3 associated with *C. maltaromaticum* Sal_3 (each 1×10^6 cfu/g) and *L. casei* T_3 associated with *L. plantarum* Pe_2 (each 1×10^6 cfu/g). Salmon pieces were sprayed with bacterial suspensions (50µl) of *L. innocua* and allowed to absorb for two hours in a sterile environment. After absorption, samples were vacuum-packed in nylon/polyethylene films and stored at 4°C for 30 days.

All of the strains were able to colonize the CSS substrate, singly or in co-culture, except for *L. casei* T_3 (1×10^8 cfu/g). The strains of bacteria expressed different levels of antagonistic effect against the *L. innocua* VR13560 strain. *C. maltaromaticum* Sal_3 and *L. plantarum* Pe_2 strains, inoculated singly at 1×10^6 cfu/g, reduced *L. innocua* counts to 5×10^2 and 6×10^2 cfu/g, respectively. *L. casei* T_3 was bacteriostatic when inoculated at 1×10^6 cfu/g, but bactericidal at 1×10^8 log cfu/g, reducing *L. innocua* to 1.9×10^3 cfu/g in comparison with the test at the end of storage. The mixture of *L. casei* T_3-*L. plantarum* Pe_2 was the most effective among the treatments at 1×10^6 log cfu/g inoculum by reducing the *L. innocua* counts to 1.5×10^3 cfu/g compared with the test control. The treatment of *L. casei* T_3-*C. maltaromaticum* Sal_3 mixture was less effective than *C. maltaromaticum* Sal_3 alone.

In summary, the growth of *L. innocua* VR13560, inoculated in CSS, can be controlled or reduced by the addition of antimicrobial-producing lactic cultures such as *C. maltaromaticum*; addition of *C. maltaromaticum* to CSS did not have any effect on the quality of the end-products. The authors concluded that the use of *C. maltaromaticum* as a biopreservative is a useful tool to limit spoilage-microorganism growth and increase safety of these meat products.

5.7. Identification of bacteriocin-producing lactic acid bacteria isolated from vegetables

Ready-to-eat vegetable salads may contain heavy microbial loads which contribute to spoilage of the salads and can lead to foodborne illness. A study by Uhlman *et al.* (1992)

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[34] The authors cited the bacteria using previous nomenclature as *Carnobacterium piscicola* Sal_3.

screened 123 strains of LAB isolated from vegetable sources for antimicrobial activity against *L. innocua*, *B. cereus* and *S. aureus*.

Two strains[35], one isolated from a commercial salad mix consisting of endives, lettuce and radishes and the other isolated from fermented carrots, were found to have antimicrobial activity against *L. innocua*, *B. cereus* and *S. aureus*. In addition, the two strains were found to have inhibitory activity against a broad range of bacteria including enterococci, lactobacilli, leuconostocs, pediococci, and carnobacteria. These findings show the presence of bacteriocin-producing LAB like *C. maltaromaticum* on vegetables which can help to provide safeguarding and quality assurance to a range of traditional and novel food products.

6. EVALUATION

Carnobacterium maltaromaticum CB1 is an atypical lactic acid bacterium that metabolizes glucose heterofermentatively and is facultatively anaerobic. It is a gram-positive, non-motile, non-sporeforming rod-shaped bacterium that occurs singly and in short chains. The colonies are pinpoint, convex, white, circular and nonpigmented when grown at 25°C for 24 hours on TSA.

The safety data on *C. maltaromaticum* published and stated in the previous GRAS determination for the CB1 strain suggest an overall low degree of toxicity. No additional safety information on the consumption of *C. maltaromaticum* has been published since the previous GRAS determination that was notified to FDA under GRN 000159. Bacteriocin-producing LAB, including *C. maltaromaticum*, are used in the fermentation and preservation of food products, including yogurts, sausages, breads, wine, cheeses and milk. Agricultural practices currently produce and store these food products that contain LAB at bacteria at levels exceeding 1×10^7 cfu/g. *Carnobacterium* spp. are common components of the microflora on vacuum-packaged meat, poultry, fish and cheese products and, in some cases, they can represent a predominant constituent population, reaching levels of 1×10^8 cfu/g or higher without being considered spoilage organisms. Consumption of *C. maltaromaticum* from these sources was estimated to be as high as 1.4×10^{11} cfu/day. This level was not considered to pose a safety issue. Griffith Laboratories has proposed to utilize viable *C. maltaromaticum* CB1 in RTE meat products stated in the previous GRAS determination, as well as in additional meat, poultry and fish products, soups, frozen dinners, raw and processed fruits and vegetables, salads, dressings and sauces, for which standards of identity do not preclude its use. In addition, a variation in the processing method includes pasteurization of the *C. maltaromaticum* CB1 product and subsequent dilution with maltodextrin to form a heat-treated *C. maltaromaticum* CB1 product. The viable *C. maltaromaticum* product and the heat-treated *C. maltaromaticum* product will not be utilized in the same food product.

The viable *C. maltaromaticum* CB1 product has previously been found to be GRAS by an Expert Panel when added to ready-to-eat products at an inoculation range between 1×10^3 to

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[35] The authors identified strains D53 and 23 from *Lactococcus lactis* by DNA-DNA hybridizations which were isolated from a ready-to eat salad and fermented carrots, respectively.

1×10^4 cfu/g of product, resulting in the added consumption of bacteria from these food categories to be approximately 4.3×10^9 cfu/day. With the addition of the new food categories as stated in APPENDIX 1, the daily consumption at the 90th percentile of viable *C. maltaromaticum* CB1 is 1.1 x 10^{11} cfu/day (1.7×10^9 cfu/kg/day).

Additionally, it is proposed that heat-treated *C. maltaromaticum* CB1 will be incorporated into various food categories which include meat products such as beef, pork, lamb, poultry and fish as well as cheeses, certain raw fruits and vegetables and low-acid dressings (APPENDIX 2), at 0.5% weight *per* volume solution for the purpose of enhancing food preservation and decreasing bacterial growth. The 90th percentile consumption estimate of heat-treated *C. maltaromaticum* CB1 among all stated food categories would be 3.0 g/day, or 9.6 x 10^7 cfu/day of heat-treated *C. maltaromaticum* CB1.

Based on a critical review of the consumption data including new food groups, consumption of the number of cfu/day from heat-treated *C. maltaromaticum* CB1 does not exceed the consumption estimate of 1.4×10^{11} cfu/day stated in the previous GRAS determination and subsequent FDA notification letter for viable *C. maltaromaticum* CB1. Further, safety data provided in the previous GRAS dossier continues to support a conclusion of safety. Also, *C. maltaromaticum* CB1 was found not to increase levels of tyramine in meat or cheese above levels commonly consumed in foods, and a critical review of the literature published since the previous GRAS determination did not reveal any new safety data that would negatively impact the original GRAS decision of safe use for *C. maltaromaticum* CB1.

Product shelf life of the original (*i.e.*, viable) *C. maltaromaticum* CB1 product has been determined to be twelve months under ambient storage conditions (22°C) in original sealed packaging, and data on the heat-treated *C. maltaromaticum* CB1 product indicate a shelf-life of at least one year when stored at 22°C.

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7. CERTIFICATION

The undersigned authors of this document—a dossier in support of GRAS status determination for use of viable and heat-treated *Carnobacterium maltaromaticum* CB1—hereby certify that, to the best of their knowledge and belief, this document is a complete and balanced representation of all available information, favorable as well as unfavorable, known by the authors to be relevant to evaluation of the substance described herein.

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8. CONCLUSION

After critically evaluating the information available, the Expert Panel has determined by scientific procedures that, based on common knowledge throughout the scientific community about the safety of substances directly or indirectly added to food, there is reasonable certainty that viable and heat-treated *Carnobacterium maltaromaticum* CB1, produced in accordance with current Good Manufacturing Practice (cGMP), is safe under the intended conditions of use, and is therefore Generally Recognized As Safe (GRAS). This GRAS determination evaluated the use of viable and heat-treated *C. maltaromaticum* CB1 when utilized separately in several food categories. *C. maltaromaticum* CB1 use levels are considered safe at a maximum consumption estimate of 1.4×10^{11} cfu/day, which encompasses all new food categories as found in APPENDIX 1. In addition, total daily consumption of heat-treated *C. maltaromaticum* product (containing approximately 75% maltodextrin), when added to the food categories specified in APPENDIX 2 was determined to be 3.0 g/day at the 90th percentile, which would result in the consumption of a maximum of 9.6×10^{7} cfu/day heat-treated *C. maltaromaticum* CB1. In particular, the Expert Panel has evaluated the proposed use of viable and heat-treated *C. maltaromaticum* CB1 at specified levels in the food products stated herein and has determined that such use of *Carnobacterium maltaromaticum* CB1 is Generally Recognized As Safe (GRAS).

9. SIGNATURES

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11. APPENDIX 1

Table A. Foods selected for the consumption analysis of viable *C. maltaromaticum**

Food Product	cfu/g
CHEESE, BLUE OR ROQUEFORT (semi-soft)	10000
CHEESE, CAMEMBERT	1000000000
CHEESE, BRIE	1000000000
CHEESE, FETA (INCLUDE GOAT CHEESE)	10000
CHEESE, GOAT	10000
CHEESE, MOZZARELLA, NFS (INCLUDE PIZZA CHEESE)	10000
CHEESE, MOZZARELLA, WHOLE MILK	10000
CHEESE, MOZZARELLA, PART SKIM (INCL "LOWFAT")	10000
CHEESE, MOZZARELLA, LOW SODIUM	10000
CHEESE, MOZZARELLA, NONFAT OR FAT FREE	10000
CHEESE, PORT DU SALUT	10000
QUESO ASADERO (INCL OAXACAN-STYLE STRING CHEESE)	10000
QUESO FRESCO (HISPANIC-STYLE FARMER CHEESE)	1000000000
CHEESE, COTTAGE, NFS	10000
CHEESE, COTTAGE, CREAMED	10000
COTTAGE CHEESE, FARMER'S	10000
CHEESE, RICOTTA	10000
CHEESE, COTTAGE, W/ FRUIT	10000
CHEESE, COTTAGE, W/ VEGETABLES	10000
CHEESE, COTTAGE, DRY CURD	10000
CHEESE, COTTAGE, SALTED, DRY CURD	10000
P.R. WHITE CHEESE (QUESO DEL PAIS, BLANCO)	1000000000
CHEESE, COTTAGE, LOWFAT	10000
CHEESE, COTTAGE, LOWFAT, W/ FRUIT	10000
CHEESE, COTTAGE, LOWFAT, W/ VEGETABLES	10000
CHEESE, COTTAGE, LOWFAT, LOW SODIUM	10000
CHEESE, COTTAGE, LOWFAT, LACTOSE REDUCED	10000
CHEESE, CREAM	10000
CHEESE, CREAM, LIGHT/LITE (FORMERLY CALLED CR CHEESE LOWFAT)	10000
CHEESE SPREAD, NFS	10000
CHEESE SPREAD, AMERICAN OR CHEDDAR CHEESE BASE	10000
CHEESE SPREAD, SWISS CHEESE BASE	10000
CHEESE SPREAD, CREAM CHEESE OR NEUFCHATEL BASE	10000
CHEESE SPREAD, PRESSURIZED CAN	10000
COTTAGE CHEESE, W/ GELATIN DESSERT	10000
COTTAGE CHEESE, W/ GELATIN DESSERT & FRUIT	10000
COTTAGE CHEESE W/ GELATIN DESSERT & VEGETABLES	10000
CHEESE W/ NUTS (INCL CHEESE BALL)	10000
DIP, CREAM CHEESE BASE	10000
SHRIMP DIP, CREAM CHEESE BASE (INCL CLAM DIP)	10000
DIP, CHEESE W/ CHILI PEPPER (CHILI CON QUESO)	10000
DIP, CHEESE BASE OTHER THAN CREAM CHEESE	10000
CHEESE SPREAD SANDWICH	10000

Food Product	cfu/g
MEAT, NFS	10000
BEEF, NS AS TO CUT, COOKED, NS AS TO FAT	10000
BEEF, NS AS TO CUT, COOKED, LEAN & FAT	10000
BEEF, NS AS TO CUT, COOKED, LEAN ONLY	10000
STEAK, NS AS TO TYPE OF MEAT, COOKED, NS AS TO FAT	10000
STEAK, NS AS TO TYPE OF MEAT, COOKED, LEAN & FAT	10000
STEAK, NS AS TO TYPE OF MEAT, COOKED, LEAN ONLY	10000
BEEF, PICKLED	10000
BEEF, NS AS TO CUT, FRIED, NS AS TO FAT EATEN	10000
BEEF STEAK, NS AS TO COOKING METHOD, NS AS TO FAT	10000
BEEF STEAK, NS AS TO COOKING METHOD, LEAN & FAT	10000
BEEF STEAK, NS AS TO COOKING METHOD, LEAN ONLY	10000
BEEF STEAK, BROILED OR BAKED, NS AS TO FAT	10000
BEEF STEAK, BROILED OR BAKED, LEAN & FAT	10000
BEEF STEAK, BROILED OR BAKED, LEAN ONLY	10000
BEEF STEAK, FRIED, NS AS TO FAT	10000
BEEF STEAK, FRIED, LEAN & FAT	10000
BEEF STEAK, FRIED, LEAN ONLY	10000
BEEF STEAK,BREADED/FLOURED,BAKED/FRIED,NS AS TO FAT	10000
BEEF STEAK, BREADED/FLOURED,BAKED/FRIED, LEAN & FAT	10000
BEEF STEAK, BREADED/FLOURED, BAKED/FRIED, LEAN ONLY	10000
BEEF STEAK, BATTERED, FRIED, NS AS TO FAT	10000
BEEF STEAK, BATTERED, FRIED, LEAN & FAT	10000
BEEF STEAK, BATTERED, FRIED, LEAN ONLY	10000
BEEF STEAK, BRAISED, NS AS TO FAT	10000
BEEF STEAK, BRAISED, LEAN & FAT	10000
BEEF STEAK, BRAISED, LEAN ONLY	10000
BEEF, OXTAILS, COOKED	10000
BEEF, NECK BONES, COOKED	10000
BEEF, SHORTRIBS, COOKED, NS AS TO FAT	10000
BEEF, SHORTRIBS, COOKED, LEAN & FAT	10000
BEEF, SHORTRIBS, COOKED, LEAN ONLY	10000
BEEF, SHORTRIBS, BBQ, W/ SAUCE, NS AS TO FAT	10000
BEEF, SHORTRIBS, BBQ, W/ SAUCE, LEAN & FAT	10000
BEEF, SHORTRIBS, BBQ, W/ SAUCE, LEAN ONLY	10000
BEEF, LOW HEAD, COOKED	10000
BEEF, ROAST, ROASTED, NS AS TO FAT	10000
BEEF, ROAST, ROASTED, LEAN & FAT	10000
BEEF, ROAST, ROASTED, LEAN ONLY	10000
BEEF, POT ROAST, BRAISED OR BOILED, NS AS TO FAT	10000
BEEF, POT ROAST, BRAISED OR BOILED, LEAN & FAT	10000
BEEF, POT ROAST, BRAISED OR BOILED, LEAN ONLY	10000
BEEF, STEW MEAT, COOKED, NS AS TO FAT	10000
BEEF, STEW MEAT, COOKED, LEAN & FAT	10000
BEEF, STEW MEAT, COOKED, LEAN ONLY	10000
CORNED BEEF, COOKED, NS AS TO FAT	10000
CORNED BEEF, COOKED, LEAN & FAT	10000

Food Product	cfu/g
CORNED BEEF, COOKED, LEAN ONLY	10000
CORNED BEEF, CANNED, READY TO EAT	10000
BEEF BRISKET, COOKED, NS AS TO FAT	10000
BEEF BRISKET, COOKED, LEAN & FAT	10000
BEEF BRISKET, COOKED, LEAN ONLY	10000
BEEF, SANDWICH STEAK (FLAKED,FORMED, THINLY SLICED)	10000
GROUND BEEF, RAW	1000000000
GROUND BEEF OR PATTY	10000
GROUND BEEF,MEATBALLS, MEAT ONLY, NS AS TO REG/LEAN	10000
GROUND BEEF OR PATTY, BREADED, COOKED	10000
GROUND BEEF, REGULAR, COOKED	10000
GROUND BEEF, LEAN, COOKED	10000
GROUND BEEF, EXTRA LEAN, COOKED	10000
GROUND BEEF W/ TEXTURED VEGETABLE PROTEIN, COOKED	10000
BEEF, BACON, COOKED	10000
BEEF, BACON, COOKED, LEAN ONLY	10000
BEEF BACON, FORMED, LEAN MEAT ADDED (INCL SIZZLEAN)	10000
BEEF, PASTRAMI (BEEF, SMOKED, SPICED)	1000000000
PORK, NS AS TO CUT, COOKED, NS AS TO FAT EATEN	10000
PORK, NS AS TO CUT, COOKED, LEAN & FAT EATEN	10000
PORK, NS AS TO CUT, COOKED, LEAN ONLY EATEN	10000
PORK, NS AS TO CUT, FRIED, NS AS TO FAT EATEN	10000
PORK, NS AS TO CUT, FRIED, LEAN & FAT EATEN	10000
PORK, NS AS TO CUT, FRIED, LEAN ONLY EATEN	10000
PORK, NS AS TO CUT, BREADED, FRIED, NS AS TO FAT	10000
PORK, NS AS TO CUT, BREADED, FRIED, FAT EATEN	10000
PORK, NS AS TO CUT, BREADED, FRIED, LEAN ONLY	10000
PORK, GROUND OR PATTY, COOKED	10000
PORK, GROUND, GROUND OR PATTY, BREADED, COOKED	10000
PORK CHOP, NS AS TO COOKING METHOD, NS AS TO FAT	10000
PORK CHOP, NS AS TO COOKING METHOD, LEAN & FAT	10000
PORK CHOP, NS AS TO COOKING METHOD, LEAN ONLY	10000
PORK CHOP, BROILED OR BAKED, NS AS TO FAT	10000
PORK CHOP, BROILED OR BAKED, LEAN & FAT	10000
PORK CHOP, BROILED OR BAKED, LEAN ONLY	10000
PORK CHOP, BREADED, BROILED OR BAKED, NS AS TO FAT	10000
PORK CHOP, BREADED, BROILED OR BAKED, LEAN & FAT	10000
PORK CHOP, BREADED, BROILED OR BAKED, LEAN ONLY	10000
PORK CHOP, FRIED, NS AS TO FAT	10000
PORK CHOP, FRIED, LEAN & FAT	10000
PORK CHOP, FRIED, LEAN ONLY	10000
PORK CHOP, BREADED, FRIED, NS AS TO FAT	10000
PORK CHOP, BREADED, FRIED, LEAN & FAT	10000
PORK CHOP, BREADED, FRIED, LEAN ONLY	10000
PORK CHOP, BATTERED, FRIED, NS AS TO FAT	10000
PORK CHOP, BATTERED, FRIED, LEAN & FAT	10000
PORK CHOP, BATTERED, FRIED, LEAN ONLY	10000

Food Product	cfu/g
PORK CHOP, STEWED, NS AS TO FAT EATEN	10000
PORK CHOP, STEWED, LEAN & FAT EATEN	10000
PORK CHOP, STEWED, LEAN ONLY EATEN	10000
PORK CHOP, SMOKED OR CURED, COOKED, NS AS TO FAT	10000
PORK CHOP, SMOKED OR CURED, COOKED, LEAN & FAT	10000
PORK CHOP, SMOKED OR CURED, COOKED, LEAN ONLY	10000
PORK STEAK, NS AS TO COOKING METHOD, NS AS TO FAT	10000
PORK STEAK, NS AS TO COOKING METHOD, LEAN & FAT	10000
PORK STEAK, NS AS TO COOKING METHOD, LEAN ONLY	10000
PORK STEAK OR CUTLET, BATTERED, FRIED, NS AS TO FAT	10000
PORK STEAK OR CUTLET, BATTERED, FRIED, LEAN & FAT	10000
PORK STEAK OR CUTLET, BATTERED, FRIED, LEAN ONLY	10000
PORK STEAK OR CUTLET, BROILED OR BAKD, NS AS TO FAT	10000
PORK STEAK OR CUTLET, BROILED OR BAKED, LEAN & FAT	10000
PORK STEAK OR CUTLET, BROILED OR BAKED, LEAN ONLY	10000
PORK STEAK OR CUTLET, FRIED, NS AS TO FAT	10000
PORK STEAK OR CUTLET, FRIED, LEAN & FAT	10000
PORK STEAK OR CUTLET, FRIED, LEAN ONLY	10000
PORK CUTLET, BREADED, BROILED/BAKED, NS AS TO FAT	10000
PORK CUTLET, BREADED, BROILED/BAKED, LEAN & FAT	10000
PORK CUTLET, BREADED, BROILED/BAKED, LEAN ONLY	10000
PORK STEAK OR CUTLET, BREADED, FRIED, NS AS TO FAT	10000
PORK STEAK OR CUTLET, BREADED, FRIED, LEAN & FAT	10000
PORK STEAK OR CUTLET, BREADED, FRIED, LEAN ONLY	10000
PORK, TENDERLOIN, COOKED, NS AS TO METHOD	10000
PORK, TENDERLOIN, BREADED, FRIED	10000
PORK, TENDERLOIN, BRAISED	10000
PORK, TENDERLOIN, BAKED	10000
PORK, TENDERLOIN, BATTERED, FRIED	10000
HAM, FRIED, NS AS TO FAT	10000
HAM, FRIED, LEAN & FAT	10000
HAM, FRIED, LEAN ONLY	10000
HAM, BREADED, FRIED, NS AS TO FAT	10000
HAM, BREADED, FRIED, LEAN & FAT	10000
HAM, BREADED, FRIED, LEAN ONLY	10000
HAM, FRESH, COOKED, NS AS TO FAT	10000
HAM, FRESH, COOKED, LEAN & FAT	10000
HAM, FRESH, COOKED, LEAN ONLY	10000
HAM, SMOKED OR CURED, COOKED, NS AS TO FAT	1000000000
HAM, SMOKED OR CURED, COOKED, LEAN & FAT	1000000000
HAM, SMOKED OR CURED, COOKED, LEAN ONLY	1000000000
HAM, SMOKED OR CURED, LOW NA, NS AS TO FAT	1000000000
HAM, SMOKED OR CURED, LOW NA, LEAN & FAT	1000000000
HAM, SMOKED OR CURED, LOW NA, LEAN ONLY	1000000000
HAM, PROSCIUTTO	1000000000
HAM, SMOKED OR CURED, CANNED, NS AS TO FAT EATEN	10000
HAM, SMOKED OR CURED, CANNED, LEAN & FAT EATEN	10000

Food Product	cfu/g
HAM, SMOKED OR CURED, CANNED, LEAN ONLY EATEN	10000
HAM, SMOKED OR CURED, GROUND PATTY	1000000000
PORK ROAST, NS AS TO CUT, NS AS TO FAT	10000
PORK ROAST, NS AS TO CUT, COOKED, LEAN & FAT	10000
PORK ROAST, NS AS TO CUT, COOKED, LEAN ONLY	10000
PORK ROAST, LOIN, COOKED, NS AS TO FAT	10000
PORK ROAST, LOIN, COOKED, LEAN & FAT	10000
PORK ROAST, LOIN, COOKED, LEAN ONLY	10000
FRIED PORK CHUNKS, P.R. (CARNE DE CERDO FRITA)	10000
PORK ROAST, SHOULDER, COOKED, NS AS TO FAT	10000
PORK ROAST, SHOULDER, COOKED, LEAN & FAT	10000
PORK ROAST, SHOULDER, COOKED, LEAN ONLY	10000
PORK ROAST, SMOKED OR CURED, COOKED, NS AS TO FAT	10000
PORK ROAST, SMOKED OR CURED, COOKED, LEAN & FAT	10000
PORK ROAST, SMOKED OR CURED, COOKED, LEAN ONLY	10000
PORK ROLL, CURED, FRIED	10000
BACON, CANADIAN, COOKED	10000
BACON, NS AS TO TYPE OF MEAT, COOKED	10000
PORK BACON, NS AS TO FRESH/SMOKED/CURED, COOKED	10000
PORK BACON, SMOKED OR CURED, COOKED	10000
PORK BACON, SMOKED OR CURED, COOKED, LEAN ONLY	10000
BACON OR SIDE PORK, FRESH, COOKED	10000
PORK BACON, SMOKED OR CURED, LOWER SODIUM	10000
BACON, FORMED, LEAN MEAT ADDED, COOKED	10000
SALT PORK, COOKED	10000
FAT BACK, COOKED (INCLUDE HOG JOWL)	10000
PORK, SPARERIBS, COOKED, NS AS TO FAT EATEN	10000
PORK, SPARERIBS, COOKED, LEAN & FAT	10000
PORK, SPARERIBS, COOKED, LEAN ONLY	10000
PORK, SPARERIBS, BBQ, W/ SAUCE, NS FAT EATEN	10000
PORK, SPARERIBS, BBQ, W/ SAUCE, LEAN & FAT EATEN	10000
PORK, SPARERIBS, BBQ, W/ SAUCE, LEAN ONLY EATEN	10000
PORK, CRACKLINGS, COOKED	10000
PORK, EARS, TAIL, HEAD, SNOUT, MISC PARTS, COOKED	10000
PORK, NECK BONES, COOKED	10000
PORK, PIG'S FEET, COOKED	10000
PORK, PIG'S FEET, PICKLED	10000
PORK, PIG'S HOCKS, COOKED	10000
PORK SKIN, RINDS, DEEP-FRIED	10000
PORK SKIN, BOILED	10000
LAMB, NS AS TO CUT, COOKED	10000
LAMB CHOP, COOKED, NS AS TO CUT & FAT	10000
LAMB CHOP, NS AS TO CUT, COOKED, LEAN & FAT	10000
LAMB CHOP, NS AS TO CUT, COOKED, LEAN ONLY	10000
LAMB, LOIN CHOP, COOKED, NS AS TO FAT	10000
LAMB, LOIN CHOP, COOKED, LEAN & FAT	10000
LAMB, LOIN CHOP, COOKED, LEAN ONLY	10000

Food Product	cfu/g
LAMB, SHOULDER CHOP, COOKED, NS AS TO FAT	10000
LAMB, SHOULDER CHOP, COOKED, LEAN & FAT	10000
LAMB, SHOULDER CHOP, COOKED, LEAN ONLY	10000
LAMB, SHOULDER, COOKED, NS AS TO FAT	10000
LAMB, SHOULDER, COOKED, LEAN & FAT	10000
LAMB, SHOULDER, COOKED, LEAN ONLY	10000
LAMB, RIBS, COOKED, LEAN ONLY	10000
LAMB, RIBS, COOKED, NS AS TO FAT	10000
LAMB, RIBS, COOKED, LEAN & FAT	10000
LAMB HOCKS, COOKED	10000
LAMB, ROAST, COOKED, NS AS TO FAT EATEN	10000
LAMB, ROAST, COOKED, LEAN & FAT EATEN	10000
LAMB, ROAST, COOKED, LEAN ONLY EATEN	10000
LAMB, GROUND OR PATTY, COOKED	10000
GOAT, BOILED	10000
GOAT, FRIED	10000
GOAT, BAKED	10000
GOAT HEAD, COOKED	10000
GOAT RIBS, COOKED	10000
VEAL, COOKED, NS AS TO CUT & FAT	10000
VEAL, NS AS TO CUT, COOKED, LEAN & FAT	10000
VEAL, NS AS TO CUT, COOKED, LEAN ONLY	10000
VEAL CHOP, NS AS TO COOKING METHOD, NS AS TO FAT	10000
VEAL CHOP, NS AS TO COOKING METHOD, LEAN & FAT	10000
VEAL CHOP, NS AS TO COOKING METHOD, LEAN ONLY	10000
VEAL CHOP, FRIED, NS AS TO FAT	10000
VEAL CHOP, FRIED, LEAN & FAT	10000
VEAL CHOP, FRIED, LEAN ONLY	10000
VEAL CHOP, BROILED, NS AS TO FAT	10000
VEAL CHOP, BROILED, LEAN & FAT	10000
VEAL CHOP, BROILED, LEAN ONLY	10000
VEAL CUTLET, NS AS TO COOKING METHOD, NS AS TO FAT	10000
VEAL CUTLET, NS AS TO COOKING METHOD, LEAN & FAT	10000
VEAL CUTLET, NS AS TO COOKING METHOD, LEAN ONLY	10000
VEAL CUTLET OR STEAK, BROILED, NS AS TO FAT	10000
VEAL CUTLET OR STEAK, BROILED, LEAN & FAT	10000
VEAL CUTLET OR STEAK, BROILED, LEAN ONLY	10000
VEAL CUTLET OR STEAK, FRIED, NS AS TO FAT	10000
VEAL CUTLET OR STEAK, FRIED, LEAN & FAT	10000
VEAL CUTLET OR STEAK, FRIED, LEAN ONLY	10000
VEAL, ROASTED, NS AS TO FAT	10000
VEAL, ROASTED, LEAN & FAT	10000
VEAL, ROASTED, LEAN ONLY	10000
VEAL, GROUND OR PATTY, COOKED	10000
MOCK CHICKEN LEGS, COOKED	10000
VEAL PATTY, BREADED, COOKED	10000
CHICKEN, NS AS TO PART, NS METHOD, SKIN	10000

Food Product	cfu/g
CHICKEN, NS AS TO PART, NS METHOD, W/ SKIN	10000
CHICKEN, NS AS TO PART, NS METHOD, W/O SKIN	10000
CHICKEN, ROASTED/BROILED, NS PART, NS SKIN	10000
CHICKEN, ROASTED/BROILED, NS PART, W/ SKIN	10000
CHICKEN, ROASTED/BROILED, NS PART, W/O SKIN	10000
CHICKEN, STEWED, NS PART, NS SKIN	10000
CHICKEN, STEWED, NS PART, W/ SKIN	10000
CHICKEN, STEWED, NS PART, W/O SKIN	10000
CHICKEN, FRIED, NO COATING, NS PART, NS SKIN	10000
CHICKEN, FRIED, NO COATING, NS PART, W/ SKIN	10000
CHICKEN, FRIED, NO COATING, NS PART, W/O SKIN	10000
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, NS SKIN EATEN	10000
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, SKIN EATEN	10000
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, SKIN NOT EATEN	10000
CHICK, NS PART, COATED, BKD/FD, PREP SKINLES, NS COAT EAT	10000
CHICK, NS PART, COATED, BKD/FD, PREP SKINLESS, COAT EAT	10000
CHICKEN, COATED, BKD/FRD, PPD SKINLESS, COATING NOT EATEN	10000
CHICKEN, BREAST, NFS	10000
CHICKEN, BREAST, NS AS TO COOKING METHOD, W/SKIN	10000
CHICKEN, BREAST, NS AS TO COOKING METHOD, W/O SKIN	10000
CHICKEN, BREAST, ROASTED OR BROILED, NS AS TO SKIN	10000
CHICKEN, BREAST, ROASTED OR BROILED, W/SKIN	10000
CHICKEN, BREAST, ROASTED OR BROILED, W/O SKIN	10000
CHICKEN, BREAST, STEWED, NS AS TO SKIN	10000
CHICKEN, BREAST, STEWED, W/ SKIN	10000
CHICKEN, BREAST, STEWED, W/O SKIN	10000
CHICKEN, BREAST, FRIED, NO COATING, NS AS TO SKIN	10000
CHICKEN, BREAST, FRIED, NO COATING, W/ SKIN	10000
CHICKEN, BREAST, FRIED, NO COATING, W/O SKIN	10000
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN,NS SKIN EATEN	10000
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN, SKIN EATEN	10000
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN, SKIN NOT EATEN	10000
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	10000
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,COAT EATEN	10000
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,COAT NOT EATEN	10000
CHICKEN, LEG, NFS	10000
CHICKEN, LEG, NS AS TO COOKING METHOD, W/ SKIN	10000
CHICKEN, LEG, NS AS TO COOKING METHOD, W/O SKIN	10000
CHICKEN, LEG, BROILED OR ROASTED, NS AS TO SKIN	10000
CHICKEN, LEG, BROILED OR ROASTED, W/ SKIN	10000
CHICKEN, LEG, BROILED OR ROASTED, W/O SKIN	10000
CHICKEN, LEG, STEWED, NS AS TO SKIN	10000
CHICKEN, LEG, STEWED, W/ SKIN	10000
CHICKEN, LEG, STEWED, W/O SKIN	10000
CHICKEN, LEG, FRIED, NO COATING, NS AS TO SKIN	10000
CHICKEN, LEG, FRIED, NO COATING, W/ SKIN	10000
CHICKEN, LEG, FRIED, NO COATING, W/O SKIN	10000

Food Product	cfu/g
CHICKEN,LEG,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	10000
CHICKEN, LEG,COATED,BKD/FRD,PPD W/ SKIN, SKIN EATEN	10000
CHICKEN, LEG,COATED,BKD/FRD,PPD W/ SKIN, SKIN NOT EATEN	10000
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	10000
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,COAT EATEN	10000
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,COAT NOT EATEN	10000
CHICKEN, DRUMSTICK, NFS	10000
CHICKEN, DRUMSTICK, NS AS TO COOKING METHOD,W/ SKIN	10000
CHICKEN, DRUMSTICK, NS COOKING METHOD, W/O SKIN	10000
CHICKEN, DRUMSTICK, ROASTED OR BROILED, NS AS TO SKIN	10000
CHICKEN, DRUMSTICK, ROASTED OR BROILED, W/ SKIN	10000
CHICKEN, DRUMSTICK, ROASTED OR BROILED, W/O SKIN	10000
CHICKEN, DRUMSTICK, STEWED, NS AS TO SKIN	10000
CHICKEN, DRUMSTICK, STEWED, W/ SKIN	10000
CHICKEN, DRUMSTICK, STEWED, W/O SKIN	10000
CHICKEN, DRUMSTICK, FRIED, NO COATING,NS AS TO SKIN	10000
CHICKEN, DRUMSTICK, FRIED, NO COATING, W/ SKIN	10000
CHICKEN, DRUMSTICK, FRIED, NO COATING, W/O SKIN	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EAT	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN, SKIN EAT	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EAT	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS,NS COAT EAT	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS, COAT EAT	10000
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS, COAT NOT EAT	10000
CHICKEN, THIGH, NFS	10000
CHICKEN, THIGH, NS AS TO COOKING METHOD, W/ SKIN	10000
CHICKEN, THIGH, NS AS TO COOKING METHOD, W/O SKIN	10000
CHICKEN, THIGH, BROILED OR ROASTED, NS AS TO SKIN	10000
CHICKEN, THIGH, BROILED OR ROASTED, W/ SKIN	10000
CHICKEN, THIGH, BROILED OR ROASTED, W/O SKIN	10000
CHICKEN, THIGH, STEWED, NS AS TO SKIN	10000
CHICKEN, THIGH, STEWED, W/ SKIN	10000
CHICKEN, THIGH, STEWED, W/O SKIN	10000
CHICKEN, THIGH, FRIED, NO COATING, NS AS TO SKIN	10000
CHICKEN, THIGH, FRIED, NO COATING, W/ SKIN	10000
CHICKEN, THIGH, FRIED, NO COATING, W/O SKIN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN, SKIN EATEN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EATEN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS, COAT EATEN	10000
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS, COAT NOT EATEN	10000
CHICKEN, WING, NFS	10000
CHICKEN, WING, NS AS TO COOKING METHOD, W/ SKIN	10000
CHICKEN, WING, NS AS TO COOKING METHOD, W/O SKIN	10000
CHICKEN, WING, ROASTED OR BROILED, NS AS TO SKIN	10000
CHICKEN, WING, ROASTED OR BROILED, W/ SKIN	10000

Food Product	cfu/g
CHICKEN, WING, ROASTED OR BROILED, W/O SKIN	10000
CHICKEN, WING, STEWED, NS AS TO SKIN	10000
CHICKEN, WING, STEWED, W/ SKIN	10000
CHICKEN, WING, STEWED, W/O SKIN	10000
CHICKEN, WING, FRIED, NO COATING, NS AS TO SKIN	10000
CHICKEN, WING, FRIED, NO COATING, W/ SKIN	10000
CHICKEN, WING, FRIED, NO COATING, W/O SKIN	10000
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	10000
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN, SKIN EATEN	10000
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EATEN	10000
CHICKEN, BACK	10000
CHICKEN, NECK OR RIBS, NFS	10000
CHICKEN SKIN	10000
CHICKEN FEET	10000
CHICKEN ROLL, ROASTED, LIGHT & DARK MEAT	10000
CHICKEN PATTY/FILLET/TENDERS, BREADED, COOKED	10000
CHICKEN PATTY W/ CHEESE, BREADED, COOKED	10000
CHICKEN, GROUND	10000
CHICKEN NUGGETS	10000
CHICKEN NUGGETS, LOWFAT	10000
CHICKEN CRACKLING, P.R. (CHICHARRON DE POLLO)	10000
TURKEY, NFS	10000
TURKEY, LIGHT MEAT, COOKED, NS AS TO SKIN	10000
TURKEY, LIGHT MEAT, COOKED, W/O SKIN	10000
TURKEY, LIGHT MEAT, COOKED, W/ SKIN	10000
TURKEY, LIGHT, BREADED, BAKED/FRIED, NS AS TO SKIN	10000
TURKEY, LIGHT MEAT, BREADED, BAKED/FRIED, W/O SKIN	10000
TURKEY, LIGHT MEAT, BREADED, BAKED/FRIED, W/ SKIN	10000
TURKEY, LIGHT MEAT, ROASTED, NS AS TO SKIN	10000
TURKEY, LIGHT MEAT, ROASTED, W/O SKIN	10000
TURKEY, LIGHT MEAT, ROASTED, W/ SKIN	10000
TURKEY, DARK MEAT, ROASTED, NS AS TO SKIN	10000
TURKEY, DARK MEAT, ROASTED, W/O SKIN	10000
TURKEY, DARK MEAT, ROASTED, W/ SKIN	10000
TURKEY, LIGHT & DARK MEAT, ROASTED, NS AS TO SKIN	10000
TURKEY, LIGHT & DARK MEAT, ROASTED, W/O SKIN	10000
TURKEY, LIGHT & DARK MEAT, ROASTED, W/ SKIN	10000
TURKEY, LT/DK MEAT, BATTERED, FRIED, NS AS TO SKIN	10000
TURKEY, LIGHT/DARK MEAT, BATTERED, FRIED, W/O SKIN	10000
TURKEY, LIGHT/DARK MEAT, BATTERED, FRIED, W/ SKIN	10000
TURKEY, LIGHT/DARK MEAT, STEWED, NS AS TO SKIN	10000
TURKEY, LIGHT/DARK MEAT, STEWED, W/O SKIN	10000
TURKEY, LIGHT/DARK MEAT, STEWED, W/ SKIN	10000
TURKEY, SMOKED, NS AS TO SKIN	10000
TURKEY, SMOKED, SKIN EATEN	10000
TURKEY, SMOKED, SKIN NOT EATEN	10000
TURKEY, DRUMSTICK, COOKED, NS AS TO SKIN	10000

Food Product	cfu/g
TURKEY, DRUMSTICK, COOKED, W/O SKIN	10000
TURKEY, DRUMSTICK, COOKED, W/ SKIN	10000
TURKEY, DRUMSTICK, ROASTED, NS AS TO SKIN	10000
TURKEY, DRUMSTICK, ROASTED, W/O SKIN	10000
TURKEY, DRUMSTICK, ROASTED, W/ SKIN	10000
TURKEY, DRUMSTICK, SMOKED, SKIN EATEN	10000
TURKEY, THIGH, COOKED, NS AS TO SKIN	10000
TURKEY, THIGH, COOKED, W/ SKIN	10000
TURKEY, THIGH, COOKED, W/O SKIN	10000
TURKEY, NECK, COOKED	10000
TURKEY, WING, COOKED, NS AS TO SKIN	10000
TURKEY, WING, COOKED, W/O SKIN	10000
TURKEY, WING, COOKED, W/ SKIN	10000
TURKEY, WING, SMOKED, COOKED, SKIN EATEN	10000
TURKEY, ROLLED ROAST, LIGHT OR DARK MEAT, COOKED	10000
TURKEY, TAIL, COOKED	10000
TURKEY, BACK, COOKED	10000
TURKEY, GROUND	10000
TURKEY NUGGETS	10000
TURKEY BACON, COOKED	10000
DUCK, COOKED, NS AS TO SKIN	10000
DUCK, COOKED, W/ SKIN	10000
DUCK, COOKED, W/O SKIN	10000
DUCK, ROASTED, NS AS TO SKIN	10000
DUCK, ROASTED, W/ SKIN	10000
DUCK, ROASTED, W/O SKIN	10000
DUCK, BATTERED, FRIED	10000
DUCK, PRESSED, CHINESE	10000
GOOSE, WILD, ROASTED	10000
CORNISH GAME HEN, COOKED, NS AS TO SKIN	10000
CORNISH GAME HEN, COOKED, W/ SKIN	10000
CORNISH GAME HEN, COOKED, W/O SKIN	10000
CORNISH GAME HEN, ROASTED, NS AS TO SKIN	10000
CORNISH GAME HEN, ROASTED, W/ SKIN	10000
CORNISH GAME HEN, ROASTED, W/O SKIN	10000
DOVE, COOKED, NS AS TO COOKING METHOD	10000
DOVE, FRIED	10000
QUAIL, COOKED	10000
PHEASANT, COOKED	10000
BEEF LIVER, BRAISED	10000
BEEF LIVER, FRIED	10000
CHICKEN LIVER, BRAISED	10000
CHICKEN LIVER, FRIED	10000
LIVER PASTE OR PATE, CHICKEN (INCLUDE PATE, NFS)	10000
HEART, COOKED	10000
KIDNEY, COOKED	10000
SWEETBREADS, COOKED	10000

Food Product	cfu/g
BRAINS, COOKED	10000
TONGUE, COOKED	10000
TONGUE, SMOKED,CURED OR PICKLED, COOKED	10000
TONGUE POT ROAST, P.R. (LENGUA AL CALDERO)	10000
TRIPE, COOKED	10000
CHITTERLINGS, COOKED	10000
HOG MAWS (STOMACH) COOKED	10000
GIZZARD, COOKED	10000
FRANKFURTER, WIENER OR HOT DOG, NFS	1000000000
FRANKFURTER OR HOT DOG, BREADED, BAKED	1000000000
FRANKFURTER OR HOT DOG, CHEESE-FILLED	1000000000
FRANKFURTER OR HOT DOG, BACON & CHEESE-FILLED	1000000000
FRANKFURTER OR HOT DOG, CHILI-FILLED	1000000000
FRANKFURTER OR HOT DOG, BEEF	1000000000
FRANKFURTER OR HOT DOG, BEEF & PORK	1000000000
FRANKFURTER OR HOT DOG, BEEF AND PORK, LOWFAT	1000000000
FRANKFURTER OR HOT DOG, MEAT & POULTRY, FAT FREE	1000000000
FRANKFURTER OR HOT DOG, MEAT & POULTRY	1000000000
FRANKFURTER OR HOT DOG, CHICKEN	1000000000
FRANKFURTER OR HOT DOG, TURKEY	1000000000
FRANKFURTER OR HOT DOG, LOW SALT	1000000000
FRANKFURTER OR HOT DOG, BEEF, LOWFAT	1000000000
FRANKFURTER OR HOT DOG, MEAT & POULTRY, LOWFAT	1000000000
COLD CUT, NFS	1000000000
BEEF SAUSAGE, NFS	1000000000
BEEF SAUSAGE, BROWN & SERVE, LINKS, COOKED	1000000000
BEEF SAUSAGE, SMOKED, STICK (INCLUDE BEEF JERKY)	1000000000
BEEF SAUSAGE, SMOKED	1000000000
BEEF SAUSAGE, FRESH, BULK, PATTY OR LINK, COOKED	1000000000
BEEF SAUSAGE W/ CHEESE, SMOKED	1000000000
BLOOD SAUSAGE	1000000000
BOCKWURST	1000000000
BRATWURST, COOKED	1000000000
BRATWURST W/ CHEESE	1000000000
BOLOGNA, BEEF, LOW FAT	1000000000
BOLOGNA, PORK AND BEEF	1000000000
BOLOGNA, NFS	1000000000
BOLOGNA, LEBANON	1000000000
BOLOGNA, BEEF	1000000000
BOLOGNA, TURKEY	1000000000
BOLOGNA RING, SMOKED	1000000000
BOLOGNA, PORK	1000000000
BOLOGNA, BEEF, LOWER SODIUM	1000000000
BOLOGNA, CHICKEN, BEEF, & PORK	1000000000
BOLOGNA, W/ CHEESE	1000000000
BOLOGNA, BEEF & PORK, LOWFAT	1000000000
CAPICOLA	1000000000

Food Product	cfu/g
CERVELAT	1000000000
CHICKEN & BEEF SAUSAGE, SMOKED	1000000000
CHORIZOS	1000000000
HEAD CHEESE	1000000000
KNOCKWURST	1000000000
MORTADELLA	1000000000
PEPPERONI	1000000000
POLISH SAUSAGE	1000000000
ITALIAN SAUSAGE	1000000000
SAUSAGE (NOT COLD CUT), NFS	10000
PORK SAUSAGE, FRESH, BULK, PATTY OR LINK, COOKED	10000
PORK SAUSAGE, BROWN & SERVE, COOKED	10000
PORK SAUSAGE, COUNTRY STYLE, FRESH, COOKED	10000
PORK SAUSAGE RICE LINKS,BROWN & SERVE, COOKED	10000
PORK & BEEF SAUSAGE	10000
PORK & BEEF SAUSAGE, BROWN & SERVE, COOKED	10000
METTWURST	1000000000
SALAMI, NFS	1000000000
SALAMI, SOFT, COOKED	1000000000
SALAMI, DRY OR HARD	1000000000
SALAMI, BEEF	1000000000
SCRAPPLE, COOKED	1000000000
SMOKED LINK SAUSAGE, PORK	1000000000
SMOKED LINK SAUSAGE, PORK & BEEF	1000000000
SMOKED SAUSAGE, PORK	1000000000
SOUSE	1000000000
THURINGER (INCLUDE SUMMER SAUSAGE)	1000000000
TURKEY BREAKFAST SAUSAGE, BULK	1000000000
TURKEY SAUSAGE, SMOKED	1000000000
TURKEY SAUSAGE, REDUCED FAT, BROWN & SERVE, COOKED	1000000000
TURKEY&PORK SAUSAGE,FRESH,BULK,PATTY OR LINK,COOKED	1000000000
TURKEY, PORK, & BEEF SAUSAGE, REDUCED FAT, SMOKED	1000000000
TURKEY, PORK, & BEEF SAUSAGE, LOWFAT, SMOKED	1000000000
LUNCHEON MEAT, NFS	1000000000
HAM, SLICED, PREPACKAGED OR DELI, LUNCHEON MEAT	1000000000
HAM, SLICED, LOW SALT, PREPACKAGED/DELI, LUNCH MEAT	1000000000
HAM, SLICED, EXTRA LEAN, PREPACKAGED/DELI	1000000000
CHICKEN/TURKEY LOAF, PREPACK/DELI, LUNCHEON MEAT	1000000000
HAM LOAF, LUNCHEON MEAT	1000000000
HAM & CHEESE LOAF	1000000000
HONEY LOAF	1000000000
HAM,LUNCH MEAT,CHOP,MINCED,PRESSD,MINCED,NOT CANNED	1000000000
HAM, LUNCHEON MEAT, CHOPPED, SPICED,LOWFAT, NOT CAN	1000000000
LIVERWURST	1000000000
LUNCHEON LOAF (OLIVE, PICKLE OR PIMIENTO)	1000000000
SANDWICH LOAF, LUNCHEON MEAT	1000000000
TURKEY HAM, SLICED, XTRA LEAN, PKG'D, DELI	1000000000

Food Product	cfu/g
TURKEY HAM	1000000000
VEAL LOAF	1000000000
TURKEY PASTRAMI	1000000000
TURKEY SALAMI	1000000000
TURKEY OR CHICKEN BREAST, PKG'D/DELI, LUNCHEON MEAT	1000000000
BEEF, SLICED, PREPACKAGED/DELI, LUNCHEON MEAT	1000000000
CORNED BEEF, PRESSED	1000000000
MEAT SPREAD OR POTTED MEAT, NFS	1000000000
CHICKEN SALAD SPREAD	1000000000
HAM, DEVILED OR POTTED	1000000000
HAM SALAD SPREAD	1000000000
ROAST BEEF SPREAD	1000000000
CORNED BEEF SPREAD	1000000000
FISH, NS AS TO TYPE, RAW	1000000000
FISH, COOKED, NS AS TO TYPE & COOKING METHOD	10000
FISH, NS AS TO TYPE, BAKED OR BROILED	10000
FISH, NS AS TO TYPE, BREADED OR BATTERED, BAKED	10000
FISH, NS AS TO TYPE, FLOURED OR BREADED, FRIED	10000
FISH, NS AS TO TYPE, BATTERED, FRIED	10000
FISH, NS AS TO TYPE, STEAMED	10000
FISH, NS AS TO TYPE, DRIED	1000000000
FISH, NS AS TO TYPE, SMOKED	1000000000
FISH STICK/FILLET, COOKED, NS TYPE & COOKING METHOD	10000
FISH STICK/FILLET, NS AS TO TYPE, BAKED OR BROILED	10000
FISH STICK/FILLET, NS TYPE, BREADED/BATTERED, BAKED	10000
FISH STICK/FILLET, NS TYPE, FLOURED/BREADED, FRIED	10000
FISH STICK OR FILLET, NS AS TO TYPE, BATTERED, FRIED	10000
ANCHOVY, COOKED, NS AS TO COOKING METHOD	10000
BARRACUDA, COOKED, NS AS TO COOKING METHOD	10000
BARRACUDA, BAKED OR BROILED	10000
BARRACUDA, FLOURED OR BREADED, FRIED	10000
BARRACUDA, STEAMED OR POACHED	10000
CARP, COOKED, NS AS TO COOKING METHOD	10000
CARP, BAKED OR BROILED	10000
CARP, FLOURED OR BREADED, FRIED	10000
CARP, STEAMED OR POACHED	10000
CARP, SMOKED	1000000000
CATFISH, COOKED, NS AS TO COOKING METHOD	10000
CATFISH, BAKED OR BROILED	10000
CATFISH, BREADED OR BATTERED, BAKED	10000
CATFISH, FLOURED OR BREADED, FRIED	10000
CATFISH, BATTERED, FRIED (INCLUDE BULLHEAD)	10000
CATFISH, STEAMED OR POACHED	10000
COD, COOKED, NS AS TO COOKING METHOD	10000
COD, BAKED OR BROILED	10000
COD, BREADED OR BATTERED, BAKED	10000
COD, FLOURED OR BREADED, FRIED	10000

Food Product	cfu/g
COD, BATTERED, FRIED	10000
COD, STEAMED OR POACHED	10000
COD, DRIED, SALTED	1000000000
COD, DRIED, SALTED, SALT REMOVED IN WATER	1000000000
COD, SMOKED	1000000000
CROAKER, COOKED, NS AS TO COOKING METHOD	10000
CROAKER, BAKED OR BROILED	10000
CROAKER, BREADED OR BATTERED, BAKED	10000
CROAKER, FLOURED OR BREADED, FRIED	10000
CROAKER, STEAMED OR POACHED	10000
EEL, COOKED, NS AS TO COOKING METHOD	10000
EEL, STEAMED OR POACHED	10000
EEL, SMOKED	1000000000
FLOUNDER, RAW	1000000000
FLOUNDER, COOKED, NS AS TO COOKING METHOD	10000
FLOUNDER, BAKED OR BROILED	10000
FLOUNDER, BREADED OR BATTERED, BAKED	10000
FLOUNDER, FLOURED OR BREADED, FRIED	10000
FLOUNDER, BATTERED, FRIED	10000
FLOUNDER, STEAMED OR POACHED	10000
FLOUNDER, SMOKED	1000000000
HADDOCK, COOKED, NS AS TO COOKING METHOD	10000
HADDOCK, BAKED OR BROILED	10000
HADDOCK, BREADED OR BATTERED, BAKED	10000
HADDOCK, FLOURED OR BREADED, FRIED	10000
HADDOCK, BATTERED, FRIED	10000
HADDOCK, STEAMED OR POACHED	10000
HADDOCK, SMOKED	1000000000
HERRING, RAW	1000000000
HERRING, COOKED, NS AS TO COOKING METHOD	10000
HERRING, BAKED OR BROILED	10000
HERRING, FLOURED OR BREADED, FRIED	10000
HERRING, PICKLED, IN CREAM SAUCE	1000000000
HERRING, PICKLED	1000000000
HERRING, SMOKED, KIPPERED	1000000000
MACKEREL, RAW	1000000000
MACKEREL, COOKED, NS AS TO COOKING METHOD	10000
MACKEREL, BAKED OR BROILED	10000
MACKEREL, SALTED	1000000000
MACKEREL, FLOURED OR BREADED, FRIED	10000
MACKEREL, PICKLED	1000000000
MACKEREL, SMOKED	1000000000
MULLET, RAW	1000000000
MULLET, COOKED, NS AS TO COOKING METHOD	10000
MULLET, BAKED OR BROILED	10000
MULLET, FLOURED OR BREADED, FRIED	10000
MULLET, STEAMED OR POACHED	10000

Food Product	cfu/g
OCEAN PERCH, RAW	1000000000
OCEAN PERCH, COOKED, NS AS TO COOKING METHOD	10000
OCEAN PERCH, BAKED OR BROILED	10000
OCEAN PERCH, BREADED OR BATTERED, BAKED	10000
OCEAN PERCH, FLOURED OR BREADED, FRIED	10000
OCEAN PERCH, BATTERED, FRIED	10000
OCEAN PERCH, STEAMED OR POACHED	10000
PERCH, COOKED, NS AS TO COOKING METHOD	10000
PERCH, BAKED OR BROILED	10000
PERCH, BREADED OR BATTERED, BAKED	10000
PERCH, FLOURED OR BREADED, FRIED	10000
PERCH, BATTERED, FRIED	10000
PERCH, STEAMED OR POACHED	10000
PIKE, COOKED, NS AS TO COOKING METHOD	10000
PIKE, BAKED OR BROILED	10000
PIKE, FLOURED OR BREADED, FRIED	10000
PIKE, BATTERED, FRIED	10000
PIKE, STEAMED OR POACHED	10000
POMPANO, RAW	1000000000
POMPANO, COOKED, NS AS TO COOKING METHOD	10000
POMPANO, BAKED OR BROILED	10000
POMPANO, FLOURED OR BREADED, FRIED	10000
POMPANO, BATTERED, FRIED	10000
POMPANO, STEAMED OR POACHED	10000
POMPANO, SMOKED	1000000000
PORGY, RAW	1000000000
PORGY, COOKED, NS AS TO COOKING METHOD	10000
PORGY, BAKED OR BROILED	10000
PORGY, BREADED OR BATTERED, BAKED	10000
PORGY, FLOURED OR BREADED, FRIED	10000
PORGY, BATTERED, FRIED	10000
PORGY, STEAMED OR POACHED	10000
RAY, COOKED, NS AS TO COOKING METHOD	10000
RAY, BAKED OR BROILED	10000
RAY, FLOURED OR BREADED, FRIED	10000
RAY, STEAMED OR POACHED	10000
SALMON, RAW	1000000000
SALMON, COOKED, NS AS TO COOKING METHOD	10000
SALMON, BAKED OR BROILED	10000
SALMON, FLOURED OR BREADED, FRIED	10000
SALMON, BATTERED, FRIED	10000
SALMON, STEAMED OR POACHED	10000
SALMON, DRIED	1000000000
SALMON, SMOKED (INCLUDE LOX)	1000000000
SARDINES, COOKED	10000
SARDINES, SKINLESS, BONELESS, PACKED IN WATER	1000000000
SEA BASS, COOKED, NS AS TO COOKING METHOD	10000

Food Product	cfu/g
SEA BASS, BAKED OR BROILED	10000
SEA BASS, BREADED, BAKED	10000
SEA BASS, FLOURED OR BREADED, FRIED	10000
SEA BASS, STEAMED OR POACHED	10000
SEA BASS, PICKLED (MERO EN ESCABECHE)	1000000000
SHARK, COOKED, NS AS TO COOKING METHOD	10000
SHARK, BAKED OR BROILED	10000
SHARK, STEAMED OR POACHED	10000
SMELT, COOKED, NS AS TO COOKING METHOD	10000
SMELT, BAKED OR BROILED	10000
SMELT, FLOURED OR BREADED, FRIED	10000
SMELT, BATTERED, FRIED	10000
SMELT, STEAMED OR POACHED	10000
STURGEON, COOKED, NS AS TO COOKING METHOD	10000
STURGEON, BAKED OR BROILED	10000
STURGEON, STEAMED	10000
STURGEON, FLOURED OR BREADED, FRIED	10000
STURGEON, SMOKED	1000000000
SWORDFISH, COOKED, NS AS TO COOKING METHOD	10000
SWORDFISH, BAKED OR BROILED	10000
SWORDFISH, FLOURED OR BREADED, FRIED	10000
SWORDFISH, STEAMED OR POACHED	10000
TROUT, COOKED, NS AS TO COOKING METHOD	10000
TROUT, BAKED OR BROILED	10000
TROUT, BREADED OR BATTERED, BAKED	10000
TROUT, FLOURED OR BREADED, FRIED	10000
TROUT, BATTERED, FRIED	10000
TROUT, STEAMED OR POACHED	10000
TROUT, SMOKED	1000000000
TUNA, FRESH, RAW	1000000000
TUNA, FRESH, COOKED, NS AS TO COOKING METHOD	10000
TUNA, FRESH, BAKED OR BROILED	10000
TUNA, FRESH, FLOURED OR BREADED, FRIED	10000
TUNA, FRESH, STEAMED OR POACHED	10000
TUNA, FRESH, DRIED	1000000000
TUNA, FRESH, SMOKED	1000000000
WHITING, COOKED, NS AS TO COOKING METHOD	10000
WHITING, BAKED OR BROILED	10000
WHITING, BREADED OR BATTERED, BAKED	10000
WHITING, FLOURED OR BREADED, FRIED	10000
WHITING, BATTERED, FRIED	10000
WHITING, STEAMED OR POACHED	10000
FROG LEGS, NS AS TO COOKING METHOD	10000
FROG LEGS, STEAMED	10000
OCTOPUS, COOKED, NS AS TO COOKING METHOD	10000
OCTOPUS, STEAMED	10000
OCTOPUS, DRIED	1000000000

Food Product	cfu/g
OCTOPUS, DRIED, BOILED	1000000000
OCTOPUS, SMOKED	1000000000
ROE, SHAD, COOKED (INCL COD ROE)	10000
ROE, HERRING	1000000000
ROE, STURGEON (INCLUDE CAVIAR)	1000000000
SQUID, RAW	1000000000
SQUID, BAKED OR BROILED	10000
SQUID, BREADED, FRIED	10000
SQUID, STEAMED OR BOILED	10000
SQUID, DRIED	1000000000
ABALONE, COOKED, NS AS TO COOKING METHOD	10000
ABALONE, FLOURED OR BREADED, FRIED	10000
ABALONE, STEAMED OR POACHED	10000
CLAMS, RAW	1000000000
CLAMS, COOKED, NS AS TO COOKING METHOD	10000
CLAMS, BAKED OR BROILED	10000
CLAMS, FLOURED OR BREADED, FRIED	10000
CLAMS, BATTERED, FRIED	10000
CLAMS, STEAMED OR BOILED	10000
CLAMS, SMOKED, IN OIL	1000000000
CONCH, BATTERED, FRIED	10000
CONCH, BAKED OR BROILED	10000
CRAB, COOKED, NS AS TO COOKING METHOD	10000
CRAB, BAKED OR BROILED (INCL SAUTEED)	10000
CRAB, HARD SHELL, STEAMED	10000
CRAB, SOFT SHELL, FLOURED OR BREADED, FRIED	10000
CRAYFISH, FLOURED OR BREADED, FRIED	10000
CRAYFISH, BOILED OR STEAMED	10000
LOBSTER, COOKED, NS AS TO METHOD	10000
LOBSTER, BAKED OR BROILED	10000
LOBSTER, W/O SHELL, STEAMED OR BOILED	10000
LOBSTER, FLOURED OR BREADED, FRIED	10000
LOBSTER, BATTERED, FRIED	10000
LOBSTER, STEAMED OR BOILED	10000
MUSSELS, RAW	1000000000
MUSSELS, COOKED, NS AS TO COOKING METHOD	10000
MUSSELS, STEAMED	10000
OYSTERS, RAW	1000000000
OYSTERS, COOKED, NS AS TO COOKING METHOD	10000
OYSTERS, BAKED OR BROILED (INCLUDE SAUTEED)	10000
OYSTERS, STEAMED	10000
OYSTERS, FLOURED OR BREADED, FRIED	10000
OYSTERS, BATTERED, FRIED	10000
OYSTERS, SMOKED	1000000000
SCALLOPS, COOKED, NS AS TO COOKING METHOD	10000
SCALLOPS, BAKED OR BROILED	10000
SCALLOPS, STEAMED OR BOILED	10000

Food Product	cfu/g
SCALLOPS, FLOURED OR BREADED, FRIED	10000
SCALLOPS, BATTERED, FRIED	10000
SHRIMP, COOKED, NS AS TO COOKING METHOD	10000
SHRIMP, BAKED OR BROILED (INCL SAUTEED; PRAWN)	10000
SHRIMP, STEAMED OR BOILED	10000
SHRIMP, BREADED OR BATTERED, FRIED	10000
SHRIMP, DRIED	1000000000
SNAILS, COOKED, NS AS TO METHOD	10000
SNAILS, STEAMED	10000
MEXICAN BEEF STEW, NO POTATOES, TOMATO SAUCE	10000
MEXICAN BEEF STEW, NO POTATOES, W/ CHILI PEPPERS, TOMATO SCE	10000
CHILI CON CARNE, NS AS TO BEANS	10000
CHILI CON CARNE W/ BEANS	10000
CHILI CON CARNE W/O BEANS	10000
CHILI CON CARNE, NS AS TO BEANS, W/ CHEESE	10000
CHILI CON CARNE W/ BEANS & CHEESE	10000
BEEF SLOPPY JOE (NO BUN)	10000
BEEF W/ GRAVY (MIXTURE) (INCLUDE COUNTRY STYLE)	10000
SALISBURY STEAK W/ GRAVY (MIXTURE)	10000
BEEF W/ CREAM OR WHITE SAUCE (MIXTURE)	10000
BEEF STROGANOFF	10000
SWEDISH MEATBALLS W/ CREAM OR WHITE SAUCE (MIXTURE)	10000
BEEF W/ (MUSHROOM) SOUP (MIXTURE)	10000
BEEF W/ SOY-BASED SAUCE (MIXTURE)	10000
STEAK TERIYAKI W/ SAUCE (MIXTURE)	10000
BEEF CURRY	10000
BEEF W/ BARBECUE SAUCE (MIXTURE)	10000
BEEF W/ SWEET & SOUR SAUCE (MIXTURE)	10000
STEWED, SEASONED GROUND BEEF, MEXICAN	10000
STEWED,SEASONED GROUND BEEF,PUERTO RICAN STYLE	10000
STEWED DRIED BEEF, P.R. (TASAJO GUISADO)	10000
STUFFED POT ROAST, P.R.,NFS(ASSUME GRAVY,STUFFING)	10000
BEEF STEW, P.R., MEAT W/ GRAVY (POTATO SEPARATE)	10000
HAM/PORK W/ GRAVY (MIXTURE)	10000
HAM/PORK W/ BARBECUE SAUCE	10000
SWEET & SOUR PORK	10000
HAM STROGANOFF (INCL HAM W/ CREAM OR WHITE SAUCE)	10000
HAM/PORK W/ (MUSHROOM) SOUP-BASE SAUCE (MIXTURE)	10000
HAM/PORK W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SAUSAGE W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SAUSAGE GRAVY	10000
MEXICAN STYLE PORK STEW,NO POT,TOM-BASE SCE(MIXTUR	10000
PORK OR HAM W/ SOY-BASED SAUCE (MIXTURE)	10000
FRANKFURTER /HOT DOG,W/CHILI,NO BUN (INCL CHILI DOG,NO BUN)	10000
FRANKFURTERS/HOT DOGS W/ TOM-BASED SCE (MIXTURE)	10000
PORK W/ CHILE & TOM (MIXTURE) (PUERCO CON CHILE)	10000
STEWED PORK, P.R.	10000

Food Product	cfu/g
CHILI CON CARNE W/ BEANS, MADE W/ PORK	10000
LAMB W/ GRAVY (MIXTURE)	10000
SPAGHETTI SAUCE W/ LAMB, HOMEMADE-STYLE	10000
LAMB GOULASH	10000
LAMB CURRY	10000
STEWED GOAT, P.R. (CABRITO EN FRICASE)	10000
VEAL W/ GRAVY (MIXTURE)	10000
VEAL W/ CREAM SAUCE (INCLUDE VEAL PAPRIKASH)	10000
VEAL W/ BUTTER SAUCE	10000
VEAL MARSALA	10000
VEAL PARMIGIANA	10000
VEAL CORDON BLEU	10000
VENISON/DEER W/ TOMATO-BASED SAUCE (MIXTURE)	10000
VENISON/DEER W/ GRAVY	10000
CHILI CON CARNE W/ VENISON/DEER & BEANS	10000
CHICKEN CACCIATORE (INCLUDE CHICKEN W/TOMATO SAUCE)	10000
SPAGHETTI SAUCE W/ POULTRY, HOMEMADE	10000
STEWED CHICKEN W/ TOMATO SAUCE, MEXICAN STYLE	10000
CHILI CON CARNE W/ CHICKEN & BEANS	10000
CHICKEN W/ GRAVY (MIXTURE)	10000
CHICKEN FRICASSEE	10000
TURKEY W/ GRAVY (MIXTURE)	10000
CHICKEN OR TURKEY W/ CREAM SAUCE (MIXTURE)	10000
CHICKEN W/ (MUSHROOM) SOUP-BASED SAUCE (MIXTURE)	10000
CHICKEN TERIYAKI	10000
CHICKEN OR TURKEY WITH BARBECUE SAUCE (MIXTURE), SKIN EATEN	10000
CHICKEN OR TURKEY W/ BBQ SAUCE (MIXTURE), SKIN NOT EATEN	10000
CHICKEN WING W/ HOT PEPPER SCE (INCL BUFFALO WING)	10000
SWEET & SOUR CHICKEN	10000
CHICKEN CURRY	10000
CHICKEN W/ CHEESE SAUCE (MIXTURE)	10000
CHICKEN CORDON BLEU	10000
CHICKEN PARMIGIANA	10000
LEMON CHICKEN, CHINESE STYLE	10000
CHICKEN KIEV	10000
STUFFED CHICKEN, DRUMSTICK OR BREAST, P.R.	10000
FISH W/ CREAM OR WHITE SAUCE, NOT TUNA OR LOBSTER	10000
CRAB, DEVILED	10000
CRAB IMPERIAL (INCLUDE STUFFED CRAB)	10000
FISH TIMBALE OR MOUSSE	10000
LOBSTER NEWBURG (INCLUDE LOBSTER THERMIDOR)	10000
SHRIMP COCKTAIL (SHRIMP W/ COCKTAIL SAUCE)	10000
TUNA W/ CREAM OR WHITE SAUCE (MIXTURE)	10000
SEAFOOD NEWBURG (INCLUDE CRABMEAT THERMIDOR)	10000
CLAM SAUCE, WHITE	10000
SHRIMP W/ LOBSTER SAUCE (MIXTURE)	10000
LOBSTER SAUCE (BROTH-BASED)	10000

Food Product	cfu/g
OYSTER SCE (WHITE SCE-BASED)	10000
FISH SAUCE (BAGOONG)	10000
FISH W/ TOMATO-BASED SAUCE (MIXTURE)	10000
MUSSELS W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SARDINES W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SARDINES W/ MUSTARD SAUCE (MIXTURE)	10000
SCALLOPS W/ CHEESE SAUCE (MIXTURE)	10000
CRABS IN TOMATO-BASED SAUCE, PUERTO RICAN STYLE	10000
SHRIMP IN GARLIC SAUCE, P.R. (CAMARONES AL AJILLO)	10000
MEAT W/ BARBECUE SAUCE, NS AS TO TYPE OF MEAT	10000
MEATBALLS, NS AS TO TYPE OF MEAT, W/ SAUCE	10000
MEAT W/ TOMATO-BASED SAUCE	10000
SPAGHETTI SAUCE W/ COMBINATION OF MEATS, HOMEMADE	10000
SPAGHETTI SAUCE W/ MEAT & VEGGIE, HOMEMADE-STYLE	10000
STEWED SEASONED GROUND BEEF & PORK, MEXICAN	10000
MEAT W/ GRAVY, NS AS TO TYPE OF MEAT (MIXTURE)	10000
BEEF & POTATOES, NO SAUCE (MIXTURE)	10000
BEEF STEW W/ POTATOES, TOMATO-BASED SAUCE	10000
MEXICAN BEEF STEW W/POT,TOM SCE (CARNE GUISADA CON)	10000
BEEF GOULASH W/ POTATOES (INCL BEEF GOULASH, NFS)	10000
BEEF & POTATOES W/ CREAM, WHITE, MUSHROOM SOUP SCE (MIXTURE)	10000
BEEF STEW W/ POTATOES, GRAVY	10000
BEEF & POTATOES W/ CHEESE SAUCE (MIXTURE)	10000
STEWED SEASONED GROUND BEEF W/ POTATOES, MEXICAN	10000
BEEF & MACARONI WITH CHEESE SAUCE (MIXTURE)	10000
BEEF & NOODLES W/ TOMATO-BASED SAUCE (MIXTURE)	10000
BEEF & NOODLES W/ GRAVY (MIXTURE)	10000
BEEF & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	10000
BEEF STROGANOFF W/ NOODLES	10000
BEEF & NOODLES W/ (MUSHROOM) SOUP (MIXTURE)	10000
BEEF & RICE, NO SAUCE (MIXTURE)	10000
BEEF & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	10000
PORCUPINE BALLS W/ TOMATO-BASED SAUCE (MIXTURE)	10000
CHILI CON CARNE W/ BEANS & RICE	10000
BEEF & RICE W/ GRAVY (MIXTURE)	10000
BEEF & RICE W/ CREAM SAUCE (MIXTURE)	10000
BEEF & RICE W/ (MUSHROOM) SOUP (MIXTURE)	10000
BEEF & RICE W/ SOY-BASED SAUCE (MIXTURE)	10000
MEAT LOAF MADE W/ BEEF	10000
MEAT LOAF W/ BEEF, W/ TOMATO SAUCE	10000
BEEF WELLINGTON	10000
STUFFED POT ROAST (LARDED MEAT), P.R. (MIXTURE)	10000
BEEF STEW, P.R. (CARNE GUISADA CON PAPAS)	10000
STEWED CORNED BEEF, P.R. ("CORNED BEEF" GUISADO)	10000
MEAT LOAF MADE W/ HAM (NOT LUNCHEON MEAT)	10000
HAM & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	10000

Food Product	cfu/g
HAM & RICE W/ (MUSHROOM) SOUP (MIXTURE)	10000
HAM OR PORK W/ STUFFING	10000
PORK & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SAUSAGE & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	10000
SAUSAGE & RICE W/ (MUSHROOM) SOUP (MIXTURE)	10000
SAUSAGE & RICE W/ CHEESE SAUCE (MIXTURE)	10000
SAUSAGE & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	10000
HAM & NOODLES, NO SAUCE (MIXTURE)	10000
HAM & RICE, NO SAUCE (MIXTURE)	10000
HAM/PORK & POTATOES W/ GRAVY (MIXTURE)	10000
PORK & POTATOES W/ CHEESE SAUCE	10000
PORK ROAST, STUFFED, P.R.	10000
MEXICAN STYLE PORK STEW W/POT,TOM-BASE SCE(MIXTURE)	10000
LAMB LOAF	10000
LAMB OR MUTTON & POTATOES W/ GRAVY (MIXTURE)	10000
LAMB & POTATOES W/ TOMATO-BASED SAUCE (MIXTURE)	10000
LAMB OR MUTTON & NOODLES W/ GRAVY (MIXTURE)	10000
VEAL & NOODLES W/ CREAM/WHITE SCE (MIXTURE)	10000
VENISON/DEER & NOODLE MIXTURE W/ CREAM/WHITE SAUCE	10000
CHICKEN OR TURKEY & POTATOES W/ GRAVY (MIXTURE)	10000
CHICKEN OR TURKEY & NOODLES, NO SAUCE (MIXTURE)	10000
CHICKEN OR TURKEY & NOODLES W/ GRAVY (MIXTURE)	10000
CHICKEN OR TURKEY & NOODLES W/ (MUSHROOM) SOUP	10000
CHICKEN OR TURKEY & NOODLES W/ CREAM OR WHITE SAUCE	10000
CHICKEN & NOODLES W/ CHEESE SAUCE	10000
CHICKEN & NOODLES, TOMATO-BASED SAUCE (MIXTURE)	10000
CHICKEN & RICE, NO SAUCE (MIXTURE)	10000
CHICKEN & RICE W/ CREAM SAUCE (MIXTURE)	10000
CHICKEN & RICE W/ (MUSHROOM) SOUP-BASED SAUCE	10000
CHICKEN & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	10000
CHICKEN & RICE W/ SOY-BASED SAUCE (MIXTURE)	10000
CHICKEN IN CHEESE SCE W/ SPANISH RICE	10000
CHICKEN W/ DUMPLINGS (MIXTURE)	10000
CHICKEN W/ STUFFING (MIXTURE)	10000
CHICKEN SOUFFLE	10000
MEAT LOAF MADE W/ CHICKEN OR TURKEY	10000
CLAMS, STUFFED	10000
CODFISH BALL OR CAKE	10000
SCALLOPS & NOODLES W/ CHEESE SAUCE (MIXTURE)	10000
SHRIMP & NOODLES W/ CHEESE SAUCE	10000
TUNA LOAF	10000
SEAFOOD, RESTRUCTURED (INCL IMITATION CRABMEAT)	10000
TUNA NOODLE CASSEROLE W/ CREAM OR WHITE SAUCE	10000
TUNA NOODLE CASSEROLE W/ (MUSHROOM) SOUP	10000
TUNA & RICE W/ (MUSHROOM) SOUP (MIXTURE)	10000
FISH & RICE W/ TOMATO-BASED SAUCE	10000
FISH & RICE W/ CREAM SAUCE	10000

Food Product	cfu/g
FISH & RICE W/ (MUSHROOM) SOUP	10000
FISH & NOODLES W/ (MUSHROOM) SOUP (MIXTURE)	10000
SHELLFISH & NOODLES, TOMATO-BASED SAUCE	10000
STEWED SALMON, P.R. (SALMON GUISADO)	10000
MEATLOAF, NS AS TO TYPE OF MEAT	10000
MEATBALLS, W/ BREADING, W/ GRAVY	10000
MEAT LOAF MADE W/ BEEF & PORK	10000
MEAT LOAF W/ BEEF, VEAL & PORK	10000
MEAT LOAF W/ BEEF & PORK, W/ TOMATO SAUCE	10000
VIENNA SAUSAGES STEWED W/ POTATOES, P.R.	10000
STEWED SEASONED GROUND BEEF&PORK,W/POT, MEXICAN	10000
BEEF, POTATOES, & VEG (W/ CAR/DK GREEN), NO SAUCE	10000
BEEF, POTATOES, & VEG (NO CAR/DK GREEN), NO SAUCE	10000
CORNED BEEF, POT & VEG(W/ CAR/DK GREEN), NO SAUCE	10000
CORNED BEEF, POTATO & VEG (NO CAR/DK GRN), NO SAUCE	10000
BEEF STEW W/ POT & VEG(W/ CAR/DK GRN), TOMATO SAUCE	10000
BEEF STEW W/ POT & VEG (NO CAR/DK GREEN), TOM SAUCE	10000
BEEF STEW W/ POT & VEG (W/ CAR, DK GREEN), GRAVY	10000
BEEF STEW W/ POT & VEG (NO CAR, DK GREEN), GRAVY	10000
SHEPHERD'S PIE W/ BEEF	10000
BEEF, POT, & VEG (INCL CAR/DK GRN), (MUSHROOM) SOUP	10000
BEEF, POT, & VEG (NO CAR/DK GREEN), (MUSHROOM) SOUP	10000
BEEF, NOODLES & VEG (W/ CARROTS/DK GREEN), NO SAUCE	10000
BEEF, NOODLES & VEG (NO CARROTS/DK GREEN), NO SAUCE	10000
BEEF CHOW MEIN OR CHOP SUEY W/ NOODLES	10000
BEEF, NOODLES & VEG (W/ CAR/DK GREEN), SOY SAUCE	10000
BEEF, NOODLES & VEG (NO CAR/DK GREEN), SOY SAUCE	10000
BEEF, NOODLES & VEG (W/ CAR/DK GREEN), TOMATO SAUCE	10000
BEEF, NOODLES & VEG (NO CAR/DK GREEN), TOMATO SAUCE	10000
BEEF, NOODLES, VEG(INCL CARROTS/DK GREEN), SOUP	10000
BEEF, NOODLES, VEG (NO CARROTS/DK GREEN), SOUP	10000
BEEF, NOODLES, & VEG (INCL CAR/DK GRN), GRAVY	10000
BEEF, NOODLES, & VEG (NO CAR/DK GRN), GRAVY	10000
BEEF, RICE & VEG (W/ CARROTS/DK GREEN), NO SAUCE	10000
BEEF, RICE & VEG (NO CARROTS/DK GREEN), NO SAUCE	10000
BEEF, RICE & VEG (W/ CAR/DK GREEN), TOMATO SAUCE	10000
BEEF, RICE & VEG (NO CAR/DK GREEN), TOMATO SAUCE	10000
STUFFED CABBAGE ROLLS W/ BEEF AND RICE	10000
BEEF, RICE & VEGETABLES (W/ CARROTS/DK GREEN), SOUP	10000
BEEF, RICE & VEGETABLES (NO CARROTS/DK GREEN), SOUP	10000
BEEF, RICE & VEG (INCL CAR/DK GRN), GRAVY, MIXTURE	10000
BEEF, RICE & VEG (NO CAR/DK GRN), GRAVY, MIXTURE	10000
BEEF, RICE & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	10000
BEEF, RICE & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	10000
BEEF POT PIE (INCLUDE GREEK MEAT PIE)	10000
BEEF, DUMPLINGS & VEG (INCL CAR/DK GRN), GRAVY	10000
BEEF, DUMPLINGS & VEG (NO CAR/DK GRN), GRAVY	10000

Food Product	cfu/g
STUFFED GREEN PEPPER, P.R. (PIMIENTO RELLENO)	10000
HAM POT PIE	10000
HAM/PORK, NOODLES & VEG (NO CAR/DK GR), CHEESE SCE	10000
PORK, POTATOES & VEG (W/ CAR, DK GREEN), NO SAUCE	10000
PORK, NOODLES, VEG (INCL CAR/DK GRN), TOMATO SAUCE	10000
SAUSAGE, NOODLES, VEG (NO CAR/DK GRN), TOMATO SAUCE	10000
SAUSAGE, NOODLES, VEG (W/ CAR/DK GRN), TOMATO SAUCE	10000
PORK, POTATOES & VEG (W/ CAR, DK GREEN), TOMATO SCE	10000
PORK, POTATOES & VEG (NO CAR, DK GREEN), TOMATO SCE	10000
SAUSAGE, POT, & VEG (INCL CAR/BROC/DK GREEN), GRAVY	10000
SAUSAGE, POT, & VEG (NO CAR/BROC/DK GREEN), GRAVY	10000
PORK, POT, & VEG (INCL CAR/DK GRN), GRAVY, MIXTURE	10000
PORK, POT, & VEG (NO CAR/DK GRN), GRAVY, MIXTURE	10000
PORK, POTATOES & VEG (NO CAR, DK GREEN), NO SAUCE	10000
PORK CHOW MEIN OR CHOP SUEY W/ NOODLES	10000
PORK, RICE & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	10000
PORK, RICE & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	10000
PORK, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	10000
PORK, RICE & VEG (NO CAR/DK GRN), TOMATO SAUCE	10000
HAM, POTATOES & VEG (NO CARROTS/DK GREEN), NO SAUCE	10000
HAM, POTATOES & VEG (W/ CARROTS/DK GREEN), NO SAUCE	10000
SWEET & SOUR PORK W/ RICE	10000
SHEPHERD'S PIE W/ LAMB	10000
LAMB STEW W/ POT & VEG (INCL CAR/DK GREEN), GRAVY	10000
LAMB, RICE & VEGETABLES (NO CARROT/DK GREEN), GRAVY	10000
LAMB, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	10000
LAMB, RICE, & VEGETABLES (INCL CAR, DK GRN), GRAVY	10000
LAMB STEW W/ POT & VEG (NO CAR/DK GREEN), GRAVY	10000
STUFFED GRAPE LEAVES W/ LAMB & RICE	10000
LAMB STEW W/ POT & VEG (INCL CAR/DK GRN), TOM SAUCE	10000
LAMB STEW W/ POT & VEG (NO CAR/DK GRN), TOMATO SCE	10000
VEAL FRICASSEE, P.R. (TERNERA EN FRICASE)	10000
VEAL STEW W/ POT, VEG (INCL CAR/DK GRN) TOM SAUCE	10000
VEAL STEW W/ POT, VEG (NO CAR,DK GRN), TOMATO SAUCE	10000
CHICKEN, POT & VEG (INCL CAR/DK GRN), NO SAUCE	10000
CHICKEN, POT & VEG (NO CAR/DK GRN), NO SAUCE	10000
CHICKEN STEW W/ POT, VEG (INCL CAR/DK GRN), GRAVY	10000
CHICKEN STEW W/ POT & VEG (NO CAR/DK GRN), GRAVY	10000
CHICKEN STEW W/ POT & VEG(INCL CAR/DK GRN), TOM SCE	10000
CHICKEN STEW W/ POT & VEG(NO CAR/DK GRN), TOM SAUCE	10000
CHICKEN, NOODLES & VEG (INCL CAR/DK GRN), NO SAUCE	10000
CHICKEN, NOODLES & VEG (NO CAR/DK GRN), NO SAUCE	10000
CHICKEN, NOODLES & VEG (INCL CAR/DK GRN), GRAVY	10000
CHICKEN, NOODLES & VEG (NO CAR/DK GRN), GRAVY	10000
CHICKEN OR TURKEY, NOODLES, AND VEGETABLES (INCLUDING CARR	10000
CHIX, NDL, VEG(NO CAR/DK GRN), CR/SOUP-BASED SAUCE	10000
CHICKEN, NOODLES, VEG (INCL CAR/DK GRN), TOMATO SCE	10000

Food Product	cfu/g
CHICKEN, NOODLES, VEG (NO CAR/DK GRN), TOMATO SAUCE	10000
CHICKEN CHOW MEIN/CHOP SUEY W/ NOODLES	10000
CHICKEN, NOODLES & VEG(INCL CAR/DK GRN), CHEESE SCE	10000
CHICKEN, NOODLES & VEG(NO CAR/DK GRN), CHEESE SAUCE	10000
CHICKEN, RICE & VEG (INCL CAR/DK GRN), NO SAUCE	10000
CHICKEN, RICE & VEG (NO CAR/DK GRN), NO SAUCE	10000
CHICKEN, RICE & VEG (INCL CAR/DK GRN), GRAVY	10000
CHICKEN, RICE & VEG (NO CAR/DK GRN), GRAVY	10000
CHICKEN, RICE & VEG (INCL CAR/DK GRN), SOY SAUCE	10000
CHICKEN, RICE & VEG (NO CAR/DK GRN), SOY SAUCE	10000
CHIX, RICE, & VEG(INCL CAR/DK GRN), CR/SOUP-BASED SAU	10000
CHIX, RICE, AND VEG(NO CAR/DK GRN), CR/SOUP-BASED SAU	10000
CHICKEN, RICE & VEG (INCL CAR/DK GRN), CHEESE SAUCE	10000
CHICKEN, RICE, VEG (NO CAR/DK GRN), CHEESE SAUCE	10000
CHICKEN, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	10000
CHICKEN, RICE & VEG (NO CAR/DK GRN), TOMATO SAUCE	10000
CHICKEN OR TURKEY POT PIE	10000
CHICKEN, STUFFING & VEG (INCL CAR/DK GRN), NO SAUCE	10000
CHICKEN, STUFFING, VEG (NO CAR/DK GRN), NO SAUCE	10000
CHICKEN, STUFFING & VEG (INCL CAR/DK GRN), GRAVY	10000
CHICKEN, STUFFING & VEG (NO CAR/DK GRN), GRAVY	10000
CHICKEN, DUMPLINGS, VEG (INCL CAR/DK GRN), GRAVY	10000
CHICKEN, DUMPLINGS, VEG (NO CAR/DK GRN), GRAVY	10000
CHICKEN FRICASSEE, P.R. (FRICASE DE POLLO)	10000
PAELLA WITH SEAFOOD	10000
SEAFOOD STEW W/ POT & VEG (NO CAR/DK GREEN),TOM SCE	10000
TUNA POT PIE	10000
TUNA NOODLE CASSEROLE W/ VEG, CREAM OR WHITE SAUCE	10000
FISH, NOODLES, VEG (INCL CAR/DK GRN), CHEESE SAUCE	10000
FISH, NOODLES, VEG (NO CAR/DK GRN), CHEESE SAUCE	10000
BOUILLABAISSE	10000
OYSTER PIE (INCLUDE OYSTER POT PIE)	10000
SEAFOOD STEW W/ POT & VEG (W/ CAR/DK GREEN),TOM SCE	10000
TUNA NOODLE CASSEROLE W/ VEG & (MUSHROOM) SOUP	10000
CODFISH SALAD, P.R. (GAZPACHO DE BACALAO)	10000
STEWED CODFISH, P.R. (BACALAO GUISADO)	10000
BISCAYNE CODFISH, P.R. (BACALAO A LA VIZCAINA)	10000
CODFISH SALAD, P.R. (ENSALADA DE BACALAO)	10000
SHRIMP & PASTA GARDEN SALAD W/ TOM/CAR, NO DRESSING	10000
STEW, NFS	10000
GOULASH, NFS	10000
MEAT PIE, NFS	10000
CHOW MEIN, NS AS TO TYPE OF MEAT, W/ NOODLES	10000
PAELLA, NFS	10000
BRUNSWICK STEW	10000
CHOW MEIN/CHOP SUEY,VARIOUS MEATS, W/ NOODLES	10000
STEWED VARIETY MEATS (MOSTLY LIVER), P.R.(GANDINGA)	10000

Food Product	cfu/g
STEWED TRIPE W/ POTATOES, P.R. (MONDONGO)	10000
JAMBALAYA W/ MEAT & RICE	10000
BEEF & VEG (W/ CAR/DK GREEN, NO POTATO), NO SAUCE	10000
BEEF & VEG (NO CAR/DK GREEN, NO POTATO), NO SAUCE	10000
BEEF SHISH KABOB W/ VEGETABLES, EXCLUDING POTATOES	10000
BEEF & VEG(W/ CAR/DK GREEN, NO POTATO), TOMATO SCE	10000
SWISS STEAK	10000
BEEF ROLL,STUFFED W/VEG/MEAT MIXTURE,TOM-BASE SAUCE	10000
BEEF W/ VEG (NO CAR/DK GREEN, NO POTATO),TOMATO SCE	10000
BEEF W/ VEG (INCL CAR/DK GRN, NO POT), SOUP	10000
BEEF W/ VEG (NO CAR/DK GRN, NO POT), SOUP	10000
BEEF & VEG (W/ CAR/DK GREEN, NO POTATO), SOY SAUCE	10000
BEEF, TOFU & VEG(W/ CAR/DK GRN, NO POTATO),SOY SCE	10000
BEEF, CHOW MEIN OR CHOP SUEY, NO NOODLES	10000
KUNG PAO BEEF	10000
BEEF & VEG (NO CAR/DK GREEN, NO POTATO), SOY SAUCE	10000
BEEF, TOFU & VEG(NO CAR/DK GRN, NO POTATO), SOY SCE	10000
BEEF & VEGETABLES, HAWAIIAN STYLE (MIXTURE)	10000
PEPPER STEAK	10000
BEEF, GROUND, W/ EGG & ONION (MIXTURE)	10000
BEEF SALAD	10000
BEEF TACO FILLING: BEEF, CHEESE, TOMATO, TACO SAUCE	10000
SUKIYAKI (STIR FRIED BEEF & VEGS IN SOY SAUCE)	10000
BEEF & VEG (INCL CAR/DK GRN, NO POTATOES), GRAVY	10000
BEEF & VEG (NO CAR/DK GREEN, NO POT), GRAVY	10000
SEASONED SHREDDED SOUP MEAT	10000
BEEF STEW, P.R. (CARNE A LA JUDIA)	10000
CORNED BEEF W/ TOMATO SAUCE & ONION, P.R. STYLE	10000
BEEF STEAK W/ ONIONS, P.R. (BIFTEC ENCEBOLLADO)	10000
CABBAGE W/ HAM HOCKS (MIXTURE)	10000
HAM OR PORK SALAD	10000
FRANKFURTERS OR HOT DOGS & SAUERKRAUT (MIXTURE)	10000
PORK & VEG (W/ CAR/DK GREEN, NO POTATO), NO SAUCE	10000
GREENS W/ HAM OR PORK (MIXTURE)	10000
PORK, TOFU & VEG (W/ CAR/DK GRN,NO POTATO), SOY SCE	10000
PORK & VEGETABLES, HAWAIIAN STYLE (MIXTURE)	10000
PORK & WATERCRESS W/ SOY-BASED SAUCE (MIXTURE)	10000
KUNG PAO PORK	10000
MOO SHU (MU SHI) PORK, W/O PANCAKE	10000
PORK AND ONIONS W/ SOY-BASED SAUCE	10000
PORK HASH,HAWAIIAN--PORK,VEG(NO CAR/DK GRN),SOY SCE	10000
HAM & VEG (W/ CARROT/DK GREEN, NO POTATO), NO SAUCE	10000
HAM & VEG (NO CARROT/DK GREEN, NO POTATO), NO SAUCE	10000
PORK & VEG (NO CAR/DK GREEN, NO POTATO), NO SAUCE	10000
PORK,TOFU & VEG(NO CAR/DK GREEN,NO POTATO)SOY SAUCE	10000
PORK CHOW MEIN OR CHOP SUEY, NO NOODLES	10000
PORK & VEG (INCL CAR/DK GRN, NO POT), TOMATO SAUCE	10000

Food Product	cfu/g
PORK & VEG (NO CAR/DK GRN, NO POT), TOMATO SAUCE	10000
SAUSAGE & VEG (INCL CAR/DK GRN)(NO POT), TOM SAUCE	10000
SAUSAGE & VEG (NO CAR/DK GRN/POT), TOMATO SAUCE	10000
SAUSAGE & PEPPERS, NO SAUCE	10000
PORK & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	10000
PORK & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	10000
STUFFED CHRISTOPHINE, P.R. (CHAYOTE RELLENO)	10000
PORK CHOPS STEWED W/VEG, P.R. (CHULETAS A LA JARD.)	10000
LAMB STEW W/ VEG (INCL CAR/DK GRN, NO POT), GRAVY	10000
LAMB STEW W/ VEG (NO CAR/DK GRN, NO POT), GRAVY	10000
VEAL GOULASH W/VEG(NO CAR/DK GREEN, NO POT),TOM SCE	10000
VEAL GOULASH W/VEG(W/ CAR/DK GREEN, NO POT),TOM SCE	10000
VEAL W/ VEG (INCL CAR/DK GRN), NO POT, CREAM SAUCE	10000
VEAL W/ VEG (NO CAR/DK GRN), NO POT, CREAM SAUCE	10000
LAMB SHISH KABOB W/ VEGETABLES, EXCLUDING POTATOES	10000
CHICK/TURK & VEG (W/ CAR/DK GRN, NO POT), NO SAUCE	10000
CHICK/TURK & VEG (NO CAR/DK GRN, NO POT), NO SAUCE	10000
CHICKEN PATE W/ VEGETABLES, DIET	10000
CHICKEN CREOLE W/O RICE	10000
CHICKEN/TURKEY & VEG (W/ CAR/DK GREEN,NO POT),GRAVY	10000
CHICKEN/TURKEY & VEG(NO CAR/DK GREEN,NO POT), GRAVY	10000
CHICKEN A LA KING W/VEG(INCL CAR/DK GRN),WHITE SCE	10000
CHICKEN A LA KING W/ VEG(NO CAR/DK GRN),WHITE SAUCE	10000
CHICKEN DIVAN	10000
CHICKEN & VEG (INCL CAR/DK GRN, NO POT), SOY SAUCE	10000
CHICKEN & VEG (NO CAR/DK GRN, NO POT), SOY SAUCE	10000
GENERAL TSO CHICKEN	10000
MOO GOO GAI PAN	10000
KUNG PAO CHICKEN	10000
ALMOND CHICKEN	10000
CHICKEN CHOW MEIN/CHOP SUEY, NO NOODLES	10000
CHICKEN OR TURKEY SALAD	10000
CHICKEN SALAD W/ EGG	10000
CHICKEN GARDEN SALAD W/ TOMATO/CARROT, NO DRESSING	10000
CHICKEN GARDEN SALAD W/VEG, NO CAR/TOM, NO DRESSING	10000
ORIENTAL CHICKEN GARDEN SALAD, NO DRESSING	10000
CHICKEN & VEG (INCL CAR/DK GRN)(NO POT), CHEESE SCE	10000
CHICKEN & VEG (NO CAR/DK GRN)(NO POT), CHEESE SAUCE	10000
CHICKEN FRICASSEE, NO POT, PUERTO RICAN STYLE	10000
CHICKEN FRICASSEE W/SAUCE,NO POT,PUERTO RICAN STYLE	10000
CHICKEN FRICASSEE, NO SCE OR POT,PUERTO RICAN STYLE	10000
CRAB SALAD	10000
LOBSTER SALAD	10000
SALMON SALAD	10000
SHRIMP CHOW MEIN OR CHOP SUEY, NO NOODLES	10000
TUNA SALAD	10000
SHRIMP SALAD	10000

Food Product	cfu/g
SEAFOOD SALAD	10000
TUNA SALAD W/ CHEESE	10000
TUNA SALAD W/ EGG	10000
SHRIMP GARDEN SALAD W/ TOMATO/CARROT, NO DRESSING	10000
SHRIMP GARDEN SALAD (NO TOMATO/CARROT, NO DRESSING)	10000
CRAB SALAD MADE W/ IMITATION CRAB	10000
FISH, TOFU, & VEGETABLES, TEMPURA, HAWAIIAN	10000
SEAFOOD GARDEN SALAD W/VEG(NO TOM/CAR),NO DRESSING	10000
SEAFOOD GARDEN SALAD W/ TOM/CAR, NO DRESSING	10000
SEAFOOD GARDEN SALAD W/ EGG, VEG, (NO CAR/TOM), NO	10000
SEAFOOD GARDEN SALAD W/ EGG, TOM/CAR, NO DRESSING	10000
OYSTERS ROCKEFELLER	10000
LOMI SALMON	10000
SHRIMP & VEG (W/ CAR/DK GREEN, NO POT), SOY SAUCE	10000
SHRIMP & VEG (NO CARROT/DK GREEN, NO POT),SOY SAUCE	10000
SHRIMP CREOLE, NO RICE	10000
KUNG PAO SHRIMP	10000
TUNA CASSEROLE W/ VEG & SOUP, NO NOODLES	10000
SHELLFISH MIXTURE & VEG (INCL CAR/DK GRN), SOY SCE	10000
SHELLFISH MIXTURE & VEG (NO CAR/DK GRN), SOY SAUCE	10000
SHELLFISH & VEG(INCL CAR/DK GRN)(NO POT),SOUP SAUCE	10000
SHELLFISH & VEG(NO CAR/DK GRN/POT),SOUP-BASED SAUCE	10000
FISH & VEG (INCL CAR/DK GRN, NO POT), TOMATO SAUCE	10000
FISH & VEG (NO CAR/DK GRN, NO POT), TOMATO SAUCE	10000
FISH & VEGETABLES (W/ CAR/DK GRN), SOY-BASED SAUCE	10000
FISH & VEGETABLES (NO CAR/DK GRN), SOY-BASED SAUCE	10000
FISH A LA CREOLE, P.R. (PESCADO FRITO CON MOJO)	10000
LOBSTER CREOLE, P.R. (LANGOSTA A LA CROILLA)	10000
OCTOPUS SALAD, P.R. (ENSALADA DE PULPO)	10000
CODFISH SALAD, P.R. (SERENATA)	10000
CHOW MEIN, NS AS TO TYPE OF MEAT, NO NOODLES	10000
LAU LAU(PORK & FISH WRAPPED IN TARO/SPINACH LEAVES)	10000
JULIENNE SALAD (MEAT, CHEESE, EGG, VEG) NO DRESSING	10000
ANTIPASTO W/ HAM, FISH, CHEESE, VEGETABLES	10000
LIVERS, CHICKEN, CHOPPED, W/ EGGS & ONION (MIXTURE)	10000
LIVER, BEEF OR CALVES, & ONIONS	10000
STEWED SEASONED GROUND BEEF, P.R.	10000
STEWED CHITTERLINGS, P.R. (CUAJO GUISADO)	10000
STEWED GIZZARDS, P.R. (MOLLEJITAS GUISADAS)	10000
GUMBO, NO RICE (NEW ORLEANS TYPE W/MEAT, TOM, OKRA)	10000
SANDWICH, NFS	10000
MEAT SANDWICH, NFS	10000
WRAP SAND, FILL MEAT, POULTRY, FISH, VEG, & CHEESE	10000
WRAP SAND, FILL W/ MEAT, POULTRY, FISH, AND VEG	10000
BEEF SANDWICH, NFS	10000
BEEF BARBECUE SANDWICH OR SLOPPY JOE, ON BUN	10000
BEEF BARBECUE SUBMARINE SANDWICH, ON BUN	10000

Food Product	cfu/g
DOUBLE HAMBURGER W/ MAYO & TOMATO, DBL-DECKER BUN	10000
MEATBALL & SPAG SAU SUB SAND	10000
CORNED BEEF SANDWICH	10000
REUBEN(CORN BEEF W/ SAUERKRAUT & CHEESE) W/ SPREAD	10000
PASTRAMI SANDWICH	10000
ROAST BEEF SANDWICH	10000
ROAST BEEF SANDWICH, W/ GRAVY	10000
ROAST BEEF SANDWICH, DIPPED IN EGG, FRIED, W/ GRAVY	10000
ROAST BEEF SUB SAND, W/ LETT, TOM, SPRD	10000
ROAST BEEF SANDWICH W/ CHEESE	10000
ROAST BEEF SANDWICH W/ BACON & CHEESE SAUCE	10000
ROAST BEEF SUBMARINE SANDWICH, ON ROLL, AU JUS	10000
STEAK SUBMARINE SANDWICH WITH LETTUCE AND TOMATO	10000
STEAK SANDWICH, PLAIN, ON ROLL	10000
STEAK , CHEESE SUB SAND, W/ LETT, TOM	10000
STEAK & CHEESE SANDWICH, PLAIN, ON ROLL	10000
STEAK & CHEESE SUBMARINE SANDWICH, PLAIN, ON ROLL	10000
FAJITA-STYLE BEEF SAND W/ CHEESE,PITA BRD,W/LET+TOM	10000
STEAK & CHEESE SUB, FRIED PEP & ONIONS, ON ROLL	10000
STEAK SANDWICH, PLAIN, ON BISCUIT	10000
STEAK PATTY(BREADED,FRIED)SANDWICH,W/MAYO,TOM,BUN	10000
GYRO SANDWICH W/ TOMATO & SPREAD	10000
BACON SANDWICH W/ SPREAD	10000
BACON & CHEESE SANDWICH, W/ SPREAD	10000
BACON, CHICK, & TOM CLUB SANDWICH W/ LETTUCE+SPREAD	10000
BACON & EGG SANDWICH	10000
BACON, LETTUCE, & TOMATO SANDWICH W/ SPREAD	10000
BACON,CHICK,&TOMATO CLUB SANDWICH,MULTIGR W/ SPREAD	10000
BACON ON BISCUIT	10000
HAM ON BISCUIT	10000
HAM SANDWICH W/ SPREAD	10000
HAM SANDWICH W/ LETTUCE & SPREAD	10000
HAM & CHEESE SANDWICH, W/ LETTUCE & SPREAD	10000
HAM & EGG SANDWICH	10000
HAM SALAD SANDWICH	10000
HAM & CHEESE SANDWICH W/ SPREAD, GRILLED	10000
HAM & CHEESE SANDWICH ON BUN W/ LETTUCE & SPREAD	10000
HOT HAM & CHEESE SANDWICH, ON BUN	10000
HAM & CHEESE ON ENGLISH MUFFIN	10000
HAM & CHEESE SUB,MULTIGR ROLL, W/ LET, TOM & SPREAD	10000
CUBAN SAND, P.R STYLE(SANDWICH CUBANA), W/ SPREAD	10000
MIDNIGHT SAND,P.R. STYLE (MEDIA NOCHE), W/ SPREAD	10000
PORK SANDWICH, ON WHITE ROLL, W/ ONIONS, PICKLES & BBQ SAUCE	10000
PORK BARBECUE SANDWICH OR SLOPPY JOE, ON BUN	10000
PORK SANDWICH	10000
PORK SANDWICH W/ GRAVY	10000
HAM & TOMATO CLUB SAND, W/ SPREAD	10000

Food Product	cfu/g
CHICKEN SANDWICH, W/ SPREAD	10000
CHICKEN SALAD OR CHICKEN SPREAD SANDWICH	10000
CHICKEN BARBECUE SANDWICH	10000
CHICKEN FILLET (BREADED, FRIED) SANDWICH	10000
CHICKEN FILLET(BR FRIED) SAND W/ LET, TOM & SPREAD	10000
CHICKEN PATTY SANDWICH, MINI, W/ SPREAD	10000
CHICKEN PATTY SANDWICH ON BISCUIT	10000
FAJITA-STYLE CHICKEN SANDWICH W/ CHEESE, LETTUC,TOM	10000
CHICKEN PATTY SAND W/ CHEES,WHEAT BUN,LET,TOM, SPRE	10000
CHICKEN FILLET,(BROIL) SAND W/ LET, TOM, & SPREAD	10000
CHICK FILLET,BROIL,SANDWICH,W/CHEESE,WW ROLL	10000
CHICK FILLET, BROILED,SANDWICH,ON OAT BRAN BUN(LTS)	10000
CHICKEN FILLET,SANDWICH,W/LETT,TOM,&NON-MAYO SPREAD	10000
CHICKEN FILLET,BROILED,SANDWICH,W/CHEESE,ON BUN	10000
TURKEY SANDWICH W/ SPREAD	10000
TURKEY SALAD SANDWICH	10000
TURKEY SANDWICH W/ GRAVY	10000
TURKEY SUB SAND, W/ CHEESE, LETT, TOM, SPRD	10000
FISH SANDWICH, ON BUN, W/ SPREAD	10000
FISH SANDWICH, ON BUN, W/ CHEESE AND SPREAD	10000
CRAB CAKE SANDWICH, ON BUN	10000
SARDINE SANDWICH, W/ LETTUCE & SPREAD	10000
TUNA SALAD SANDWICH W/ LETTUCE	10000
TUNA SALAD SANDWICH	10000
TUNA MELT SANDWICH	10000
TUNA SALSUB SAND, W/ LETT & TOMATO	10000
LUNCHEON MEAT SANDWICH, NFS, W/ SPREAD	10000
BOLOGNA SANDWICH, W/ SPREAD	10000
BOLOGNA & CHEESE SANDWICH W/ SPREAD	10000
CORN DOG (FRANKFURTER/HOT DOG W/ CORNBREAD COATING)	10000
CORNY DOG, W/ CHILI, ON BUN	10000
FRANKFURTER OR HOT DOG, PLAIN, ON BUN	10000
FRANKFURTER OR HOT DOG, W/ CHEESE, PLAIN, ON BUN	10000
FRANKFURTER/HOT DOG, W/ CATSUP &/ MUSTARD, ON BUN	10000
PIG IN A BLANKET (FRANKFURTER OR HOT DOG WRAPPED IN DOUGH)	10000
FRANKFURTER/HOT DOG ,W/ CHILI, ON BUN (INCL CHILI DOG)	10000
FRANKFURTER /DOG CHILI & CHEESE,BUN (CHILI CHEESE DOG)	10000
POCHITO(FRANKFURTER/HOT DOG&BEEF CHILI IN TORTILLA)	10000
CHICKEN FRANKFURTER OR HOT DOG, PLAIN, ON BUN	10000
PUERTO RICAN SANDWICH, P.R. (SANDWICH CRIOLLO)	10000
SALAMI SANDWICH W/ SPREAD	10000
SAUSAGE ON BISCUIT(INCL JIMMY DEAN SAUSAGE BISCUIT)	10000
SAUSAGE & CHEESE ON ENGLISH MUFFIN	10000
SAUSAGE ON BISCUIT, DIET	10000
SAUSAGE BALLS (MADE W/ BISCUIT MIX & CHEESE)	10000
SAUSAGE SANDWICH	10000
SAUSAGE & SPAGH SAUCE SANDWICH	10000

Food Product	cfu/g
SUB, COLD CUT SAND, W/ LETT, TOM	10000
MEAT SPREAD OR POTTED MEAT SANDWICH	10000
HORS D'OEUVRES, W/ SPREAD	10000
FROZEN DINNER, NFS	10000
BEEF DINNER, NFS (FROZEN)	10000
BEEF W/ POTATOES (FROZEN MEAL, LARGE MEAT PORTION)	10000
BEEF W/ VEGETABLE (DIET FROZEN MEAL)	10000
SIRLOIN, CHOPPED, DINNER, NFS (FROZEN)	10000
SIRLOIN, CHOPPED, W/ GRAVY, POT, VEG (FROZEN MEAL)	10000
SIRLOIN TIPS W/ GRAVY, POTATOES, VEG (FROZEN MEAL)	10000
SIRLOIN BEEF W/ GRAVY, POTATOES, VEG (FROZ MEAL)	10000
SALISBURY STEAK DINNER, NFS (FROZEN)	10000
SALISBURY STEAK W/ GRAVY, POTATOES, VEG (FROZ MEAL)	10000
SALISBURY STEAK, GRAVY, POT, VEG, DESSERT(FRZ MEAL)	10000
SALISBURY STK, GRAVY,POT,VEG,SOUP,DESSERT(FRZ MEAL)	10000
SALISBURY STEAK, POT,VEG,DESSERT(FROZ MEAL,LG MEAT)	10000
SALISBURY STEAK, GRAVY, MAC&CHEESE, VEG (FROZ MEAL)	10000
SALISBURY STEAK W/GRAV,MACARONI & CHEESE (FRZ MEAL)	10000
SALISBURY STEAK, POT, VEG, DESSERT (DIET FZN MEAL)	10000
BEEF, SLICED, W/ GRAVY, POTATOES, VEG (FROZEN MEAL)	10000
SHORTRIBS W/ BBQ SAUCE, POTATOES & VEG (FROZ MEAL)	10000
MEATBALLS, SWEDISH, IN SAUCE W/ NOODLES (FROZ MEAL)	10000
MEATBALLS,SWEDISH,W/GRAVY & NOODLES (DIET FRZ MEAL)	10000
CORNED BEEF HASH W/ APPLE SLICES, VEG (FROZEN MEAL)	10000
SALISBURY STEAK W/ TOM SAUCE, VEG (DIET FROZ MEAL)	10000
BEEF W/ SPAETZLE OR RICE, VEGETABLE (FROZEN MEAL)	10000
PORK W/ RICE, VEG, IN SOY-BASE SCE (DIET FROZ MEAL)	10000
VEAL DINNER, NFS (FROZEN)	10000
VEAL, BREADED, W/ SPAGHETTI, TOM SAUCE (FROZ MEAL)	10000
VEAL PARMIGIANA W/ VEGETABLE (DIET FROZEN MEAL)	10000
VEAL W/ PEPPERS IN SAUCE, RICE (DIET FROZEN MEAL)	10000
VEAL PARMIGIANA, VEG, FETTUCCINE,DESSERT(FROZ MEAL)	10000
CHICKEN DINNER, NFS (FROZEN)	10000
CHICKEN DIVAN (FROZEN MEAL)	10000
CHICKEN,GRAVY,DRESS,RICE,VEG,DESSRT(Z MEAL,LG MEAT)	10000
CHICKEN & NOODLES W/ VEG, DESSERT (FROZEN MEAL)	10000
CHICKEN, FRIED, W/ POTATOES, VEGETABLE (FROZ MEAL)	10000
CHICKEN PATTY, POTATOES, VEGETABLE (FROZEN MEAL)	10000
CHICKEN PATTY, TOM SCE, FETTUCCINE, VEG (FROZ MEAL)	10000
CHICKEN PATTY/NUGGET,PASTA,FRUIT,DESSERT(FROZ MEAL)	10000
CHICKEN, FRIED, W/ POT, VEG, DESSERT (FROZEN MEAL)	10000
CHICKEN, FRIED,POT,VEG,CORNBREAD,DESSERT(FROZ MEAL)	10000
CHICKEN, FRIED, POT, VEG, SOUP, DESSERT (FROZ MEAL)	10000
CHICKEN, FRIED, POT,VEG, DESSERT(FROZ MEAL,LG MEAT)	10000
CHICKEN PATTY PARMIGIANA, W/ VEG (DIET FROZ MEAL)	10000
CHICKEN W/ RICE-VEGETABLE MIXTURE (DIET FROZ MEAL)	10000
CHICKEN W/RICE & VEG, REDUCED FAT&SODIUM(DIET FROZ)	10000

Food Product	cfu/g
CHICKEN A LA KING W/ RICE (FROZEN MEAL)	10000
CHICKEN & VEGETABLES IN CREAM SCE (DIET FROZ MEAL)	10000
CHICKEN CORDON BLEU W/ VEGETABLE, RICE (FROZ MEAL)	10000
CHICKEN KIEV W/ RICE-VEGETABLE MIXTURE (FROZ MEAL)	10000
CHICKEN & VEGETABLES AU GRATIN (DIET FROZEN MEAL)	10000
CHICKEN & VEGETABLE ENTREE W/ RICE, ORIENTAL (FRZ)	10000
CHICKEN & VEG W/ RICE, ORIENTAL (DIET FROZEN MEAL)	10000
CHICKEN & VEG ENTREE, ORIENTAL (DIET FRZ MEAL)	10000
CHICKEN CHOW MEIN W/ RICE (DIET FROZEN MEAL)	10000
CHICK CHOWMEIN W/RICE,REDUCED FAT&SODIUM(DIET FROZ)	10000
CHICKEN W/NOODLES & CHEESE SAUCE (DIET FROZEN MEAL)	10000
CHICKEN CACCIATORE W/ NOODLES (DIET FROZEN MEAL)	10000
CHICKEN & VEG ENTREE W/ NOODLES (FROZEN MEAL)	10000
CHICK & VEG ENTREE W/ NOODLES, (DIET FROZEN MEAL)	10000
CHICKEN IN CREAM SAUCE W/ NOODLES & VEG (FROZ MEAL)	10000
CHICKEN,BUTTER SCE,W/POT & VEG (FRZ, DIET MEAL)	10000
CHICKEN, MUSHROOM SAUCE, WILD RICE, VEG (FROZ MEAL)	10000
CHICKEN IN SOY-BASED SAUCE,RICE&VEG (FROZEN MEAL)	10000
CHICKEN IN ORANGE SAUCE W/ RICE (DIET FROZEN MEAL)	10000
CHICKEN IN BBQ SCE,W/RICE,VEG&DES,RED FAT&SODIUM,FRZ,DIET	10000
CHICKEN & VEG W/ NOODLES & CREAM SCE (FROZEN MEAL)	10000
TURKEY DINNER, NFS (FROZEN)	10000
TURKEY W/DRESSING, GRAVY,VEG, FRUIT (DIET FRZ MEAL)	10000
TURKEY W/ VEGETABLE, STUFFING (DIET FROZEN MEAL)	10000
TURKEY W/ GRAVY, DRESSING, POT, VEG (FROZEN MEAL)	10000
TURKEY, DRESSING,POT,VEG,DESSERT(FROZ MEAL,LG MEAT)	10000
TURKEY TETRAZZINI (FROZEN MEAL)	10000
FISH DINNER, NFS (FROZEN)	10000
FISH PARMESAN (FROZEN)	10000
HADDOCK W/ CHOPPED SPINACH (DIET FROZEN MEAL)	10000
FLOUNDER W/ CHOPPED BROCCOLI (DIET FROZEN MEAL)	10000
TURBOT W/ VEGETABLE (DIET FROZEN MEAL)	10000
SOLE W/ VEGETABLE (DIET FROZEN MEAL)	10000
FLOUNDER, CREAM SAUCE, POT, CAR (DIET FROZEN MEAL)	10000
FISH IN LEMON SAUCE W/ STARCH ITEM, VEG (FROZ MEAL)	10000
FISH,BREADED/FISH STICKS,W/PASTA,VEG,DES (FRZ MEAL)	10000
SCALLOPS W/ POTATOES, VEGETABLE (FROZEN MEAL)	10000
SHRIMP W/ POTATOES, VEGETABLE (FROZEN MEAL)	10000
SEAFOOD NEWBURG W/ RICE, VEGETABLE (FROZEN MEAL)	10000
SHRIMP W/ RICE, VEGETABLE (FROZEN MEAL)	10000
SHRIMP & CLAMS IN TOMATO SCE, W/ NOODLES(FROZ MEAL)	10000
SHRIMP & VEG IN SAUCE W/ NOODLES (DIET FROZEN MEAL)	10000
MEAT LOAF DINNER, NFS (FROZEN)	10000
MEATLOAF IN TOMATO SAUCE W/ POTATO, VEG (FROZ MEAL)	10000
STUFFED GREEN PEPPER (FROZEN MEAL)	10000
STUFFED GREEN PEPPER (DIET FROZEN MEAL)	10000
STUFFED CABBAGE, W/ MEAT & TOM SCE (DIET FROZ MEAL)	10000

Food Product	cfu/g
LIVERS, CHICKEN, W/ VEGETABLE (DIET FROZEN MEAL)	10000
VEGETARIAN MEAT LOAF OR PATTIES	1000000000
LASAGNA W/ CHEESE & SAUCE (DIET FROZEN MEAL)	10000
VEAL LASAGNA (DIET FROZEN MEAL) (INCL LEAN CUISINE)	10000
LASAGNA, W/ CHEESE & MEAT SAUCE (DIET FROZEN MEAL)	10000
LASAGNA W/CHEESE&MEAT SAU,REDUCED FAT&NA(DIET FROZ)	10000
VEGETABLE LASAGNA (FROZEN MEAL)	10000
ZUCCHINI LASAGNA (DIET FROZEN MEAL)	10000
MACARONI & CHEESE (DIET FROZEN MEAL)	10000
MACARONI W/ VEAL, CHEESE & SAUCE (DIET FROZEN MEAL)	10000
BEEF & NOODLES W/ MEAT SCE & CHEESE (DIET FRZ MEAL)	10000
SPAG W/ BEEF, TOM-BASED SAUCE, LOWFAT, RED SODIUM, FRZ, DIET	10000
NOODLES W/ VEG, TOM-BASED SAUCE, FRZ, DIET	10000
RICE W/ BROC CHEESE SCE (FRZ SIDE DISH)	10000
RICE,GREEN BEANS,WATER CHESTNUTS IN SCE (FRZ DISH)	10000
SPAGHETTI & MEATBALLS DINNER, NFS (FROZEN MEAL)	10000
SPAGHETTI,MEATBALLS,TOM SCE,APPLES,BREAD(FROZ MEAL)	10000
SPAGHETTI W/ MEAT & MUSHROOM SAUCE (DIET FROZ MEAL)	10000
SPAGHETTI W/ MEAT SAUCE (DIET FROZEN MEAL)	10000
RAVIOLI, CHEESE-FILLED, TOMATO SCE (DIET FROZ MEAL)	10000
RIGATONI W/ MEAT SCE & CHEESE (DIET FRZ MEAL)	10000
RAVIOLI, CHEESE-FILLED W/ VEG & FRUIT (FZN MEAL)	10000
MANICOTTI W/ CHEESE, TOMATO SAUCE (DIET FROZ MEAL)	10000
CANNELLONI, CHEESE-FILLED, TOM SCE (DIET FROZ MEAL)	10000
LINGUINI W/ VEG & SEAFOOD IN SCE (DIET FROZEN MEAL)	10000
MOSTICOLLI W/ MEATBALLS, SAUCE, BREAD (FROZEN MEAL)	10000
PASTA,W/ VEGETABLES & CHEESE SAUCE (DIET FROZ MEAL)	10000
BEEF ENCHILADA DINNER, NFS (FROZEN MEAL)	10000
BEEF ENCHILADA, GRAVY, RICE, REFRIED BEANS (FROZEN)	10000
CHEESE ENCHILADA (FROZEN MEAL)	10000
CHICKEN ENCHILADA (DIET FROZEN MEAL)	10000
CHICKEN ENCHILADA W/SALSA,RICE,VEG,DES (DIET FRZ)	10000
CHICKEN FAJITAS (DIET FROZEN MEAL)	10000
CHICKEN BURRITOS (DIET FROZEN MEAL)	10000
BEEF & PORK CANNELLONI (DIET FROZEN MEAL)	10000
FROZEN BREAKFAST, NFS (FROZEN MEAL)	10000
SAUSAGE & FRENCH TOAST (FROZEN MEAL)	10000
PANCAKE & SAUSAGE (FROZEN MEAL)	10000
SAUSAGE RICE LINKS & WHOLE WHEAT PANCAKE(FROZ MEAL)	10000
CANTALOUPE, FROZEN (BALLS)	10000
LYCHEE, RAW (INCLUDE FROZEN)	10000
HONEYDEW MELON, FROZEN (BALLS)	10000
FRUIT COCKTAIL OR MIX (NO CITRUS FRUITS), RAW	1000000000
FRUIT COCKTAIL OR MIX (INCL CITRUS FRUITS), RAW	1000000000
FRUIT COCKTAIL OR MIX, FROZEN	10000
FRUIT SALAD, P.R. STYLE (ENSALADA DE FRUTA)	1000000000
FRUIT SALAD (NO CITRUS) W/ SALAD DRESSING	1000000000

Food Product	cfu/g
FRUIT SALAD (NO CITRUS) W/ CREAM	1000000000
FRUIT SALAD (NO CITRUS) W/ CREAM SUBSTITUTE	1000000000
FRUIT SALAD (NO CITRUS) W/ MARSHMALLOWS	1000000000
FRUIT SALAD (W/ CITRUS) W/ PUDDING	1000000000
FRUIT SALAD (NO CITRUS FRUITS) W/ PUDDING	1000000000
FRUIT SALAD (INCL CITRUS FRUITS) W/ SALAD DRESSING	1000000000
FRUIT SALAD (INCL CITRUS FRUITS) W/ CREAM	1000000000
FRUIT SALAD W/ CREAM SUBSTITUTE	1000000000
FRUIT SALAD W/ MARSHMALLOWS	1000000000
FRUIT DESSERT, NFS	1000000000
GUACAMOLE W/ TOMATOES	1000000000
GUACAMOLE W/ TOMATOES & CHILI PEPPERS	1000000000
GUACAMOLE, NFS	1000000000
CHUTNEY	1000000000
PEAR SALAD W/ DRESSING	1000000000
PINEAPPLE SALAD W/ DRESSING	1000000000
PINEAPPLE SALAD W/ CREAM CHEESE	1000000000
POTATO SALAD W/ EGG	1000000000
POTATO SALAD, GERMAN	1000000000
POTATO SALAD	1000000000
CAESAR SALAD (W/ ROMAINE)	1000000000
SPINACH, RAW	1000000000
CARROTS IN TOMATO SAUCE	1000000000
TOMATO CATSUP	10000
TOMATO CATSUP, LOW SODIUM	10000
TOMATO CHILI SAUCE (CATSUP TYPE)	10000
SALSA, NFS	1000000000
SALSA, RED, UNCOOKED (INCL PICO DE GALLO)	1000000000
ENCHILADA SAUCE, RED	10000
ENCHILADA SAUCE, GREEN	10000
GREEN TOMATO-CHILE SAUCE, RAW	1000000000
TOMATO SAUCE	10000
TOMATO SAUCE, LOW SODIUM	10000
TOMATO PASTE	10000
TOMATO PUREE	10000
SPAGHETTI SAUCE, MEATLESS	10000
SPAGHETTI SAUCE W/ VEGGIE, HOMEMADE-STYLE	10000
SPAGHETTI SAUCE W/ MEAT, CANNED, NO EXTRA MEAT	10000
SPAGHETTI SAUCE, MEATLESS, LOW SODIUM	10000
SPAGHETTI SAUCE, MEATLESS, FAT FREE	10000
TOMATO RELISH (INCLUDE TOMATO PRESERVES)	10000
BARBECUE SAUCE (INCLUDE ARBY'S SAUCE)	10000
BARBECUE SAUCE, LOW SODIUM	10000
STEAK SAUCE, TOMATO-BASE (INCLUDE A-1)	10000
COCKTAIL SAUCE	10000
BROCCOLI SALAD W/CAULIFLOWER,CHEESE,BACON,&DRESSING	1000000000
CABBAGE SALAD OR COLESLAW, W/ DRESSING	1000000000

Food Product	cfu/g
CABBAGE SALAD OR COLESLAW, W/APPLES/RAISINS, DRESS	1000000000
CABBAGE SALAD OR COLESLAW, W/ PINEAPPLE, DRESSING	1000000000
CABBAGE, CHINESE, SALAD, W/ DRESSING	1000000000
CUCUMBER SALAD W/ CREAMY DRESSING	1000000000
CUCUMBER SALAD MADE W/ CUCUMBER, OIL & VINEGAR	1000000000
CUCUMBER SALAD MADE W/ CUCUMBER AND VINEGAR	1000000000
LETTUCE SALAD W/ ASSORTED VEGETABLES	1000000000
LETTUCE SALAD, W/ ASST VEG, NO TOM OR CAR, NO DRESS	1000000000
LETTUCE SALAD, W/ AVOCADO, TOMATO/CAR, NO DRESS	1000000000
LETTUCE SALAD, W/ CHEESE, TOM/CAR, NO DRESSING	1000000000
LETTUCE SALAD, W/ EGG, TOM/CAR, NO DRESSING	1000000000
LETTUCE SALAD W/ EGG, CHEESE, TOM/CAR, NO DRESSING	1000000000
SEVEN-LAYER SALAD(LETTUCE, MAYO, CHEESE, EGG, PEAS)	1000000000
GREEK SALAD	1000000000
SPINACH SALAD, NO DRESSING	1000000000
COBB SALAD W/ DRESSING	1000000000

* These foods are representative of the types of foods to which the ingredient may be added, but does not limit Griffith Laboratories to only those brands provided; NFS = Not food specified; NS = non-specific

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12. APPENDIX 2

Table 9. Foods selected for the consumption analysis of heat-treated *C. maltaromaticum**

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHEESE, BLUE OR ROQUEFORT	5
CHEESE, BRICK	5
CHEESE, BRICK, W/ SALAMI	5
CHEESE, CAMEMBERT	5
CHEESE, BRIE	5
CHEESE, GRUYERE	5
CHEESE, LIMBURGER	5
CHEESE, MONTEREY	5
CHEESE, MONTEREY, LOWFAT	5
BEEF, NS AS TO CUT, COOKED, NS AS TO FAT	5
BEEF, NS AS TO CUT, COOKED, LEAN & FAT	5
BEEF, NS AS TO CUT, COOKED, LEAN ONLY	5
STEAK, NS AS TO TYPE OF MEAT, COOKED, NS AS TO FAT	5
STEAK, NS AS TO TYPE OF MEAT, COOKED, LEAN & FAT	5
STEAK, NS AS TO TYPE OF MEAT, COOKED, LEAN ONLY	5
BEEF, PICKLED	5
BEEF, NS AS TO CUT, FRIED, NS AS TO FAT EATEN	5
BEEF STEAK, NS AS TO COOKING METHOD, NS AS TO FAT	5
BEEF STEAK, NS AS TO COOKING METHOD, LEAN & FAT	5
BEEF STEAK, NS AS TO COOKING METHOD, LEAN ONLY	5
BEEF STEAK, BROILED OR BAKED, NS AS TO FAT	5
BEEF STEAK, BROILED OR BAKED, LEAN & FAT	5
BEEF STEAK, BROILED OR BAKED, LEAN ONLY	5
BEEF STEAK, FRIED, NS AS TO FAT	5
BEEF STEAK, FRIED, LEAN & FAT	5
BEEF STEAK, FRIED, LEAN ONLY	5
BEEF STEAK,BREADED/FLOURED,BAKED/FRIED,NS AS TO FAT	5
BEEF STEAK, BREADED/FLOURED,BAKED/FRIED, LEAN & FAT	5
BEEF STEAK, BREADED/FLOURED, BAKED/FRIED, LEAN ONLY	5
BEEF STEAK, BATTERED, FRIED, NS AS TO FAT	5
BEEF STEAK, BATTERED, FRIED, LEAN & FAT	5
BEEF STEAK, BATTERED, FRIED, LEAN ONLY	5
BEEF STEAK, BRAISED, NS AS TO FAT	5
BEEF STEAK, BRAISED, LEAN & FAT	5
BEEF STEAK, BRAISED, LEAN ONLY	5
BEEF, OXTAILS, COOKED	5
BEEF, NECK BONES, COOKED	5
BEEF, SHORTRIBS, COOKED, NS AS TO FAT	5
BEEF, SHORTRIBS, COOKED, LEAN & FAT	5
BEEF, SHORTRIBS, COOKED, LEAN ONLY	5
BEEF, SHORTRIBS, BBQ, W/ SAUCE, NS AS TO FAT	5
BEEF, SHORTRIBS, BBQ, W/ SAUCE, LEAN & FAT	5
BEEF, SHORTRIBS, BBQ, W/ SAUCE, LEAN ONLY	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BEEF, LOW HEAD, COOKED	5
BEEF, ROAST, ROASTED, NS AS TO FAT	5
BEEF, ROAST, ROASTED, LEAN & FAT	5
BEEF, ROAST, ROASTED, LEAN ONLY	5
BEEF, POT ROAST, BRAISED OR BOILED, NS AS TO FAT	5
BEEF, POT ROAST, BRAISED OR BOILED, LEAN & FAT	5
BEEF, POT ROAST, BRAISED OR BOILED, LEAN ONLY	5
BEEF, STEW MEAT, COOKED, NS AS TO FAT	5
BEEF, STEW MEAT, COOKED, LEAN & FAT	5
BEEF, STEW MEAT, COOKED, LEAN ONLY	5
CORNED BEEF, COOKED, NS AS TO FAT	5
CORNED BEEF, COOKED, LEAN & FAT	5
CORNED BEEF, COOKED, LEAN ONLY	5
CORNED BEEF, CANNED, READY TO EAT	5
BEEF BRISKET, COOKED, NS AS TO FAT	5
BEEF BRISKET, COOKED, LEAN & FAT	5
BEEF BRISKET, COOKED, LEAN ONLY	5
BEEF, SANDWICH STEAK (FLAKED,FORMED, THINLY SLICED)	5
GROUND BEEF OR PATTY, BREADED, COOKED	5
GROUND BEEF, REGULAR, COOKED	5
GROUND BEEF, LEAN, COOKED	5
GROUND BEEF, EXTRA LEAN, COOKED	5
GROUND BEEF W/ TEXTURED VEGETABLE PROTEIN, COOKED	5
BEEF, BACON, COOKED	5
BEEF, BACON, COOKED, LEAN ONLY	5
BEEF BACON, FORMED, LEAN MEAT ADDED (INCL SIZZLEAN)	5
BEEF, PASTRAMI (BEEF, SMOKED, SPICED)	5
PORK, NS AS TO CUT, COOKED, NS AS TO FAT EATEN	5
PORK, NS AS TO CUT, COOKED, LEAN & FAT EATEN	5
PORK, NS AS TO CUT, COOKED, LEAN ONLY EATEN	5
PORK, NS AS TO CUT, FRIED, NS AS TO FAT EATEN	5
PORK, NS AS TO CUT, FRIED, LEAN & FAT EATEN	5
PORK, NS AS TO CUT, FRIED, LEAN ONLY EATEN	5
PORK, NS AS TO CUT, BREADED, FRIED, NS AS TO FAT	5
PORK, NS AS TO CUT, BREADED, FRIED, FAT EATEN	5
PORK, NS AS TO CUT, BREADED, FRIED, LEAN ONLY	5
PORK, GROUND OR PATTY, COOKED	5
PORK, GROUND, GROUND OR PATTY, BREADED, COOKED	5
PORK, DEHYDRATED, ORIENTAL	5
PORK CHOP, NS AS TO COOKING METHOD, NS AS TO FAT	5
PORK CHOP, NS AS TO COOKING METHOD, LEAN & FAT	5
PORK CHOP, NS AS TO COOKING METHOD, LEAN ONLY	5
PORK CHOP, BROILED OR BAKED, NS AS TO FAT	5
PORK CHOP, BROILED OR BAKED, LEAN & FAT	5
PORK CHOP, BROILED OR BAKED, LEAN ONLY	5
PORK CHOP, BREADED, BROILED OR BAKED, NS AS TO FAT	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
PORK CHOP, BREADED, BROILED OR BAKED, LEAN & FAT	5
PORK CHOP, BREADED, BROILED OR BAKED, LEAN ONLY	5
PORK CHOP, FRIED, NS AS TO FAT	5
PORK CHOP, FRIED, LEAN & FAT	5
PORK CHOP, FRIED, LEAN ONLY	5
PORK CHOP, BREADED, FRIED, NS AS TO FAT	5
PORK CHOP, BREADED, FRIED, LEAN & FAT	5
PORK CHOP, BREADED, FRIED, LEAN ONLY	5
PORK CHOP, BATTERED, FRIED, NS AS TO FAT	5
PORK CHOP, BATTERED, FRIED, LEAN & FAT	5
PORK CHOP, BATTERED, FRIED, LEAN ONLY	5
PORK CHOP, STEWED, NS AS TO FAT EATEN	5
PORK CHOP, STEWED, LEAN & FAT EATEN	5
PORK CHOP, STEWED, LEAN ONLY EATEN	5
PORK CHOP, SMOKED OR CURED, COOKED, NS AS TO FAT	5
PORK CHOP, SMOKED OR CURED, COOKED, LEAN & FAT	5
PORK CHOP, SMOKED OR CURED, COOKED, LEAN ONLY	5
PORK STEAK, NS AS TO COOKING METHOD, NS AS TO FAT	5
PORK STEAK, NS AS TO COOKING METHOD, LEAN & FAT	5
PORK STEAK, NS AS TO COOKING METHOD, LEAN ONLY	5
PORK STEAK OR CUTLET, BATTERED, FRIED, NS AS TO FAT	5
PORK STEAK OR CUTLET, BATTERED, FRIED, LEAN & FAT	5
PORK STEAK OR CUTLET, BATTERED, FRIED, LEAN ONLY	5
PORK STEAK OR CUTLET, BROILED OR BAKD, NS AS TO FAT	5
PORK STEAK OR CUTLET, BROILED OR BAKED, LEAN & FAT	5
PORK STEAK OR CUTLET, BROILED OR BAKED, LEAN ONLY	5
PORK STEAK OR CUTLET, FRIED, NS AS TO FAT	5
PORK STEAK OR CUTLET, FRIED, LEAN & FAT	5
PORK STEAK OR CUTLET, FRIED, LEAN ONLY	5
PORK CUTLET, BREADED, BROILED/BAKED, NS AS TO FAT	5
PORK CUTLET, BREADED, BROILED/BAKED, LEAN & FAT	5
PORK CUTLET, BREADED, BROILED/BAKED, LEAN ONLY	5
PORK STEAK OR CUTLET, BREADED, FRIED, NS AS TO FAT	5
PORK STEAK OR CUTLET, BREADED, FRIED, LEAN & FAT	5
PORK STEAK OR CUTLET, BREADED, FRIED, LEAN ONLY	5
PORK, TENDERLOIN, COOKED, NS AS TO METHOD	5
PORK, TENDERLOIN, BREADED, FRIED	5
PORK, TENDERLOIN, BRAISED	5
PORK, TENDERLOIN, BAKED	5
PORK, TENDERLOIN, BATTERED, FRIED	5
HAM, FRIED, NS AS TO FAT	5
HAM, FRIED, LEAN & FAT	5
HAM, FRIED, LEAN ONLY	5
HAM, BREADED, FRIED, NS AS TO FAT	5
HAM, BREADED, FRIED, LEAN & FAT	5
HAM, BREADED, FRIED, LEAN ONLY	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
HAM, FRESH, COOKED, NS AS TO FAT	5
HAM, FRESH, COOKED, LEAN & FAT	5
HAM, FRESH, COOKED, LEAN ONLY	5
HAM, SMOKED OR CURED, COOKED, NS AS TO FAT	5
HAM, SMOKED OR CURED, COOKED, LEAN & FAT	5
HAM, SMOKED OR CURED, COOKED, LEAN ONLY	5
HAM, SMOKED OR CURED, LOW NA, NS AS TO FAT	5
HAM, SMOKED OR CURED, LOW NA, LEAN & FAT	5
HAM, SMOKED OR CURED, LOW NA, LEAN ONLY	5
HAM, PROSCIUTTO	5
HAM, SMOKED OR CURED, CANNED, NS AS TO FAT EATEN	5
HAM, SMOKED OR CURED, CANNED, LEAN & FAT EATEN	5
HAM, SMOKED OR CURED, CANNED, LEAN ONLY EATEN	5
HAM, SMOKED OR CURED, GROUND PATTY	5
PORK ROAST, NS AS TO CUT, NS AS TO FAT	5
PORK ROAST, NS AS TO CUT, COOKED, LEAN & FAT	5
PORK ROAST, NS AS TO CUT, COOKED, LEAN ONLY	5
PORK ROAST, LOIN, COOKED, NS AS TO FAT	5
PORK ROAST, LOIN, COOKED, LEAN & FAT	5
PORK ROAST, LOIN, COOKED, LEAN ONLY	5
FRIED PORK CHUNKS, P.R. (CARNE DE CERDO FRITA)	5
PORK ROAST, SHOULDER, COOKED, NS AS TO FAT	5
PORK ROAST, SHOULDER, COOKED, LEAN & FAT	5
PORK ROAST, SHOULDER, COOKED, LEAN ONLY	5
PORK ROAST, SMOKED OR CURED, COOKED, NS AS TO FAT	5
PORK ROAST, SMOKED OR CURED, COOKED, LEAN & FAT	5
PORK ROAST, SMOKED OR CURED, COOKED, LEAN ONLY	5
PORK ROLL, CURED, FRIED	5
BACON, CANADIAN, COOKED	5
BACON, NS AS TO TYPE OF MEAT, COOKED	5
PORK BACON, NS AS TO FRESH/SMOKED/CURED, COOKED	5
PORK BACON, SMOKED OR CURED, COOKED	5
PORK BACON, SMOKED OR CURED, COOKED, LEAN ONLY	5
BACON OR SIDE PORK, FRESH, COOKED	5
PORK BACON, SMOKED OR CURED, LOWER SODIUM	5
BACON, FORMED, LEAN MEAT ADDED, COOKED	5
SALT PORK, COOKED	5
FAT BACK, COOKED (INCLUDE HOG JOWL)	5
PORK, SPARERIBS, COOKED, NS AS TO FAT EATEN	5
PORK, SPARERIBS, COOKED, LEAN & FAT	5
PORK, SPARERIBS, COOKED, LEAN ONLY	5
PORK, SPARERIBS, BBQ, W/ SAUCE, NS FAT EATEN	5
PORK, SPARERIBS, BBQ, W/ SAUCE, LEAN & FAT EATEN	5
PORK, SPARERIBS, BBQ, W/ SAUCE, LEAN ONLY EATEN	5
PORK, CRACKLINGS, COOKED	5
PORK, EARS, TAIL, HEAD, SNOUT, MISC PARTS, COOKED	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
PORK, NECK BONES, COOKED	5
PORK, PIG'S FEET, COOKED	5
PORK, PIG'S FEET, PICKLED	5
PORK, PIG'S HOCKS, COOKED	5
PORK SKIN, RINDS, DEEP-FRIED	5
PORK SKIN, BOILED	5
HAM, BABY, STRAINED	5
LAMB, NS AS TO CUT, COOKED	5
LAMB CHOP, COOKED, NS AS TO CUT & FAT	5
LAMB CHOP, NS AS TO CUT, COOKED, LEAN & FAT	5
LAMB CHOP, NS AS TO CUT, COOKED, LEAN ONLY	5
LAMB, LOIN CHOP, COOKED, NS AS TO FAT	5
LAMB, LOIN CHOP, COOKED, LEAN & FAT	5
LAMB, LOIN CHOP, COOKED, LEAN ONLY	5
LAMB, SHOULDER CHOP, COOKED, NS AS TO FAT	5
LAMB, SHOULDER CHOP, COOKED, LEAN & FAT	5
LAMB, SHOULDER CHOP, COOKED, LEAN ONLY	5
LAMB, SHOULDER, COOKED, NS AS TO FAT	5
LAMB, SHOULDER, COOKED, LEAN & FAT	5
LAMB, SHOULDER, COOKED, LEAN ONLY	5
LAMB, RIBS, COOKED, LEAN ONLY	5
LAMB, RIBS, COOKED, NS AS TO FAT	5
LAMB, RIBS, COOKED, LEAN & FAT	5
LAMB HOCKS, COOKED	5
LAMB, ROAST, COOKED, NS AS TO FAT EATEN	5
LAMB, ROAST, COOKED, LEAN & FAT EATEN	5
LAMB, ROAST, COOKED, LEAN ONLY EATEN	5
LAMB, GROUND OR PATTY, COOKED	5
GOAT, BOILED	5
GOAT, FRIED	5
GOAT, BAKED	5
GOAT HEAD, COOKED	5
GOAT RIBS, COOKED	5
VEAL, COOKED, NS AS TO CUT & FAT	5
VEAL, NS AS TO CUT, COOKED, LEAN & FAT	5
VEAL, NS AS TO CUT, COOKED, LEAN ONLY	5
VEAL CHOP, NS AS TO COOKING METHOD, NS AS TO FAT	5
VEAL CHOP, NS AS TO COOKING METHOD, LEAN & FAT	5
VEAL CHOP, NS AS TO COOKING METHOD, LEAN ONLY	5
VEAL CHOP, FRIED, NS AS TO FAT	5
VEAL CHOP, FRIED, LEAN & FAT	5
VEAL CHOP, FRIED, LEAN ONLY	5
VEAL CHOP, BROILED, NS AS TO FAT	5
VEAL CHOP, BROILED, LEAN & FAT	5
VEAL CHOP, BROILED, LEAN ONLY	5
VEAL CUTLET, NS AS TO COOKING METHOD, NS AS TO FAT	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
VEAL CUTLET, NS AS TO COOKING METHOD, LEAN & FAT	5
VEAL CUTLET, NS AS TO COOKING METHOD, LEAN ONLY	5
VEAL CUTLET OR STEAK, BROILED, NS AS TO FAT	5
VEAL CUTLET OR STEAK, BROILED, LEAN & FAT	5
VEAL CUTLET OR STEAK, BROILED, LEAN ONLY	5
VEAL CUTLET OR STEAK, FRIED, NS AS TO FAT	5
VEAL CUTLET OR STEAK, FRIED, LEAN & FAT	5
VEAL CUTLET OR STEAK, FRIED, LEAN ONLY	5
VEAL, ROASTED, NS AS TO FAT	5
VEAL, ROASTED, LEAN & FAT	5
VEAL, ROASTED, LEAN ONLY	5
VEAL, GROUND OR PATTY, COOKED	5
CHICKEN, NS AS TO PART, NS METHOD, SKIN	5
CHICKEN, NS AS TO PART, NS METHOD, W/ SKIN	5
CHICKEN, NS AS TO PART, NS METHOD, W/O SKIN	5
CHICKEN, NS PART, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, NS PART, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, NS PART, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, STEWED, NS PART, NS SKIN	5
CHICKEN, STEWED, NS PART, W/ SKIN	5
CHICKEN, STEWED, NS PART, W/O SKIN	5
CHICKEN, FRIED, NO COATING, NS PART, NS SKIN	5
CHICKEN, FRIED, NO COATING, NS PART, W/ SKIN	5
CHICKEN, FRIED, NO COATING, NS PART, W/O SKIN	5
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, NS SKIN EATEN	5
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, SKIN EATEN	5
CHICKEN, COATED, BKD/FRD, PPD W/ SKIN, SKIN NOT EATEN	5
CHICK, NS PART, COATED, BKD/FD, PREP SKINLES, NS COAT EAT	5
CHICK, NS PART, COATED, BKD/FD, PREP SKINLESS, COAT EAT	5
CHICKEN, COATED, BKD/FRD, PPD SKINLESS, COATING NOT EATEN	5
CHICKEN, BREAST, NFS	5
CHICKEN, BREAST, NS AS TO COOKING METHOD, W/SKIN	5
CHICKEN, BREAST, NS AS TO COOKING METHOD, W/O SKIN	5
CHICKEN, BREAST, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, BREAST, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, BREAST, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, BREAST, STEWED, NS AS TO SKIN	5
CHICKEN, BREAST, STEWED, W/ SKIN	5
CHICKEN, BREAST, STEWED, W/O SKIN	5
CHICKEN, BREAST, FRIED, NO COATING, NS AS TO SKIN	5
CHICKEN, BREAST, FRIED, NO COATING, W/ SKIN	5
CHICKEN, BREAST, FRIED, NO COATING, W/O SKIN	5
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN,NS SKIN EATEN	5
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN, SKIN EATEN	5
CHICKEN, BREAST,COATED,BKD/FRD,PPD W/ SKIN, SKIN NOT EATEN	5
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,COAT EATEN	5
CHICKEN,BREAST,COATED,BKD/FRD,PPD SKINLESS,COAT NOT EATEN	5
CHICKEN, LEG, NFS	5
CHICKEN, LEG, NS AS TO COOKING METHOD, W/ SKIN	5
CHICKEN, LEG, NS AS TO COOKING METHOD, W/O SKIN	5
CHICKEN, LEG, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, LEG, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, LEG, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, LEG, STEWED, NS AS TO SKIN	5
CHICKEN, LEG, STEWED, W/ SKIN	5
CHICKEN, LEG, STEWED, W/O SKIN	5
CHICKEN, LEG, FRIED, NO COATING, NS AS TO SKIN	5
CHICKEN, LEG, FRIED, NO COATING, W/ SKIN	5
CHICKEN, LEG, FRIED, NO COATING, W/O SKIN	5
CHICKEN,LEG,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	5
CHICKEN, LEG,COATED,BKD/FRD,PPD W/ SKIN, SKIN EATEN	5
CHICKEN, LEG,COATED,BKD/FRD,PPD W/ SKIN, SKIN NOT EATEN	5
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	5
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,COAT EATEN	5
CHICKEN,LEG,COATED,BKD/FRD,PPD SKINLESS,COAT NOT EATEN	5
CHICKEN, DRUMSTICK, NFS	5
CHICKEN, DRUMSTICK, NS AS TO COOKING METHOD,W/ SKIN	5
CHICKEN, DRUMSTICK, NS COOKING METHOD, W/O SKIN	5
CHICKEN, DRUMSTICK, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, DRUMSTICK, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, DRUMSTICK, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, DRUMSTICK, STEWED, NS AS TO SKIN	5
CHICKEN, DRUMSTICK, STEWED, W/ SKIN	5
CHICKEN, DRUMSTICK, STEWED, W/O SKIN	5
CHICKEN, DRUMSTICK, FRIED, NO COATING,NS AS TO SKIN	5
CHICKEN, DRUMSTICK, FRIED, NO COATING, W/ SKIN	5
CHICKEN, DRUMSTICK, FRIED, NO COATING, W/O SKIN	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EAT	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN, SKIN EAT	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EAT	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS,NS COAT EAT	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS, COAT EAT	5
CHICKEN,DRUMSTICK,COATED,BKD/FRD,PPD SKINLESS, COAT NOT EAT	5
CHICKEN, THIGH, NFS	5
CHICKEN, THIGH, NS AS TO COOKING METHOD, W/ SKIN	5
CHICKEN, THIGH, NS AS TO COOKING METHOD, W/O SKIN	5
CHICKEN, THIGH, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, THIGH, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, THIGH, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, THIGH, STEWED, NS AS TO SKIN	5
CHICKEN, THIGH, STEWED, W/ SKIN	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHICKEN, THIGH, STEWED, W/O SKIN	5
CHICKEN, THIGH, FRIED, NO COATING, NS AS TO SKIN	5
CHICKEN, THIGH, FRIED, NO COATING, W/ SKIN	5
CHICKEN, THIGH, FRIED, NO COATING, W/O SKIN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN, SKIN EATEN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EATEN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS,NS COAT EATEN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS, COAT EATEN	5
CHICKEN,THIGH,COATED,BKD/FRD,PPD SKINLESS, COAT NOT EATEN	5
CHICKEN, WING, NFS	5
CHICKEN, WING, NS AS TO COOKING METHOD, W/ SKIN	5
CHICKEN, WING, NS AS TO COOKING METHOD, W/O SKIN	5
CHICKEN, WING, ROASTED/BROILED/BAKED, NS SKIN	5
CHICKEN, WING, ROASTED/BROILED/BAKED, W/ SKIN	5
CHICKEN, WING, ROASTED/BROILED/BAKED, W/O SKIN	5
CHICKEN, WING, STEWED, NS AS TO SKIN	5
CHICKEN, WING, STEWED, W/ SKIN	5
CHICKEN, WING, STEWED, W/O SKIN	5
CHICKEN, WING, FRIED, NO COATING, NS AS TO SKIN	5
CHICKEN, WING, FRIED, NO COATING, W/ SKIN	5
CHICKEN, WING, FRIED, NO COATING, W/O SKIN	5
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN,NS SKIN EATEN	5
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN, SKIN EATEN	5
CHICKEN,WING,COATED,BKD/FRD,PPD W/SKIN, SKIN NOT EATEN	5
CHICKEN, BACK	5
CHICKEN, NECK OR RIBS, NFS	5
CHICKEN SKIN	5
CHICKEN FEET	5
CHICKEN ROLL, ROASTED, LIGHT & DARK MEAT	5
CHICKEN PATTY/FILLET/TENDERS, BREADED, COOKED	5
CHICKEN PATTY W/ CHEESE, BREADED, COOKED	5
CHICKEN NUGGETS	5
CHICKEN NUGGETS, LOWFAT	5
CHICKEN CRACKLING, P.R. (CHICHARRON DE POLLO)	5
TURKEY, NFS	5
TURKEY, LIGHT MEAT, COOKED, NS AS TO SKIN	5
TURKEY, LIGHT MEAT, COOKED, W/O SKIN	5
TURKEY, LIGHT MEAT, COOKED, W/ SKIN	5
TURKEY, LIGHT, BREADED, BAKED/FRIED, NS AS TO SKIN	5
TURKEY, LIGHT MEAT, BREADED, BAKED/FRIED, W/O SKIN	5
TURKEY, LIGHT MEAT, BREADED, BAKED/FRIED, W/ SKIN	5
TURKEY, LIGHT MEAT, ROASTED, NS AS TO SKIN	5
TURKEY, LIGHT MEAT, ROASTED, W/O SKIN	5
TURKEY, LIGHT MEAT, ROASTED, W/ SKIN	5
TURKEY, DARK MEAT, ROASTED, NS AS TO SKIN	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
TURKEY, DARK MEAT, ROASTED, W/O SKIN	5
TURKEY, DARK MEAT, ROASTED, W/ SKIN	5
TURKEY, LIGHT & DARK MEAT, ROASTED, NS AS TO SKIN	5
TURKEY, LIGHT & DARK MEAT, ROASTED, W/O SKIN	5
TURKEY, LIGHT & DARK MEAT, ROASTED, W/ SKIN	5
TURKEY, LT/DK MEAT, BATTERED, FRIED, NS AS TO SKIN	5
TURKEY, LIGHT/DARK MEAT, BATTERED, FRIED, W/O SKIN	5
TURKEY, LIGHT/DARK MEAT, BATTERED, FRIED, W/ SKIN	5
TURKEY, LIGHT/DARK MEAT, STEWED, NS AS TO SKIN	5
TURKEY, LIGHT/DARK MEAT, STEWED, W/O SKIN	5
TURKEY, LIGHT/DARK MEAT, STEWED, W/ SKIN	5
TURKEY, SMOKED, NS AS TO SKIN	5
TURKEY, SMOKED, SKIN EATEN	5
TURKEY, SMOKED, SKIN NOT EATEN	5
TURKEY, DRUMSTICK, COOKED, NS AS TO SKIN	5
TURKEY, DRUMSTICK, COOKED, W/O SKIN	5
TURKEY, DRUMSTICK, COOKED, W/ SKIN	5
TURKEY, DRUMSTICK, ROASTED, NS AS TO SKIN	5
TURKEY, DRUMSTICK, ROASTED, W/O SKIN	5
TURKEY, DRUMSTICK, ROASTED, W/ SKIN	5
TURKEY, DRUMSTICK, SMOKED, SKIN EATEN	5
TURKEY, THIGH, COOKED, NS AS TO SKIN	5
TURKEY, THIGH, COOKED, W/ SKIN	5
TURKEY, THIGH, COOKED, W/O SKIN	5
TURKEY, NECK, COOKED	5
TURKEY, WING, COOKED, NS AS TO SKIN	5
TURKEY, WING, COOKED, W/O SKIN	5
TURKEY, WING, COOKED, W/ SKIN	5
TURKEY, WING, SMOKED, COOKED, SKIN EATEN	5
TURKEY, ROLLED ROAST, LIGHT OR DARK MEAT, COOKED	5
TURKEY, TAIL, COOKED	5
TURKEY, BACK, COOKED	5
TURKEY NUGGETS	5
TURKEY BACON, COOKED	5
DUCK, COOKED, NS AS TO SKIN	5
DUCK, COOKED, W/ SKIN	5
DUCK, COOKED, W/O SKIN	5
DUCK, ROASTED, NS AS TO SKIN	5
DUCK, ROASTED, W/ SKIN	5
DUCK, ROASTED, W/O SKIN	5
DUCK, BATTERED, FRIED	5
DUCK, PRESSED, CHINESE	5
GOOSE, WILD, ROASTED	5
CORNISH GAME HEN, COOKED, NS AS TO SKIN	5
CORNISH GAME HEN, COOKED, W/ SKIN	5
CORNISH GAME HEN, COOKED, W/O SKIN	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CORNISH GAME HEN, ROASTED, NS AS TO SKIN	5
CORNISH GAME HEN, ROASTED, W/ SKIN	5
CORNISH GAME HEN, ROASTED, W/O SKIN	5
BEEF LIVER, BRAISED	5
BEEF LIVER, FRIED	5
CHICKEN LIVER, BRAISED	5
CHICKEN LIVER, FRIED	5
LIVER PASTE OR PATE, CHICKEN (INCLUDE PATE, NFS)	5
HEART, COOKED	5
KIDNEY, COOKED	5
SWEETBREADS, COOKED	5
BRAINS, COOKED	5
TONGUE, COOKED	5
TONGUE, SMOKED,CURED OR PICKLED, COOKED	5
TONGUE POT ROAST, P.R. (LENGUA AL CALDERO)	5
TRIPE, COOKED	5
CHITTERLINGS, COOKED	5
HOG MAWS (STOMACH) COOKED	5
GIZZARD, COOKED	5
FRANKFURTER, WIENER OR HOT DOG, NFS	5
FRANKFURTER OR HOT DOG, BREADED, BAKED	5
FRANKFURTER OR HOT DOG, CHEESE-FILLED	5
FRANKFURTER OR HOT DOG, BACON & CHEESE-FILLED	5
FRANKFURTER OR HOT DOG, CHILI-FILLED	5
FRANKFURTER OR HOT DOG, BEEF	5
FRANKFURTER OR HOT DOG, BEEF & PORK	5
FRANKFURTER OR HOT DOG, BEEF AND PORK, LOWFAT	5
FRANKFURTER OR HOT DOG, MEAT & POULTRY, FAT FREE	5
FRANKFURTER OR HOT DOG, MEAT & POULTRY	5
FRANKFURTER OR HOT DOG, CHICKEN	5
FRANKFURTER OR HOT DOG, TURKEY	5
FRANKFURTER OR HOT DOG, LOW SALT	5
FRANKFURTER OR HOT DOG, BEEF, LOWFAT	5
FRANKFURTER OR HOT DOG, MEAT & POULTRY, LOWFAT	5
COLD CUT, NFS	5
BEEF SAUSAGE, NFS	5
BEEF SAUSAGE, BROWN & SERVE, LINKS, COOKED	5
BEEF SAUSAGE, SMOKED, STICK (INCLUDE BEEF JERKY)	5
BEEF SAUSAGE, SMOKED	5
BEEF SAUSAGE, FRESH, BULK, PATTY OR LINK, COOKED	5
BEEF SAUSAGE W/ CHEESE, SMOKED	5
BLOOD SAUSAGE	5
BOCKWURST	5
BRATWURST, COOKED	5
BRATWURST W/ CHEESE	5
BOLOGNA, BEEF, LOW FAT	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BOLOGNA, PORK AND BEEF	5
BOLOGNA, NFS	5
BOLOGNA, LEBANON	5
BOLOGNA, BEEF	5
BOLOGNA, TURKEY	5
BOLOGNA RING, SMOKED	5
BOLOGNA, PORK	5
BOLOGNA, BEEF, LOWER SODIUM	5
BOLOGNA, CHICKEN, BEEF, & PORK	5
BOLOGNA, W/ CHEESE	5
BOLOGNA, BEEF & PORK, LOWFAT	5
CAPICOLA	5
CERVELAT	5
CHICKEN & BEEF SAUSAGE, SMOKED	5
CHORIZOS	5
HEAD CHEESE	5
KNOCKWURST	5
MORTADELLA	5
PEPPERONI	5
POLISH SAUSAGE	5
ITALIAN SAUSAGE	5
SAUSAGE (NOT COLD CUT), NFS	5
PORK SAUSAGE, FRESH, BULK, PATTY OR LINK, COOKED	5
PORK SAUSAGE, BROWN & SERVE, COOKED	5
PORK SAUSAGE, COUNTRY STYLE, FRESH, COOKED	5
PORK SAUSAGE RICE LINKS,BROWN & SERVE, COOKED	5
PORK & BEEF SAUSAGE	5
PORK & BEEF SAUSAGE, BROWN & SERVE, COOKED	5
METTWURST	5
SALAMI, NFS	5
SALAMI, SOFT, COOKED	5
SALAMI, DRY OR HARD	5
SALAMI, BEEF	5
SCRAPPLE, COOKED	5
SMOKED LINK SAUSAGE, PORK	5
SMOKED LINK SAUSAGE, PORK & BEEF	5
SMOKED SAUSAGE, PORK	5
SOUSE	5
THURINGER (INCLUDE SUMMER SAUSAGE)	5
TURKEY BREAKFAST SAUSAGE, BULK	5
TURKEY SAUSAGE, SMOKED	5
TURKEY SAUSAGE, REDUCED FAT, BROWN & SERVE, COOKED	5
TURKEY&PORK SAUSAGE,FRESH,BULK,PATTY OR LINK,COOKED	5
TURKEY, PORK, & BEEF SAUSAGE, REDUCED FAT, SMOKED	5
TURKEY, PORK, & BEEF SAUSAGE, LOWFAT, SMOKED	5
LUNCHEON MEAT, NFS	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
HAM, SLICED, PREPACKAGED OR DELI, LUNCHEON MEAT	5
HAM, SLICED, LOW SALT, PREPACKAGED/DELI, LUNCH MEAT	5
HAM, SLICED, EXTRA LEAN, PREPACKAGED/DELI	5
CHICKEN/TURKEY LOAF, PREPACK/DELI, LUNCHEON MEAT	5
HAM LOAF, LUNCHEON MEAT	5
HAM & CHEESE LOAF	5
HONEY LOAF	5
HAM,LUNCH MEAT,CHOP,MINCED,PRESSD,MINCED,NOT CANNED	5
HAM, LUNCHEON MEAT, CHOPPED, SPICED,LOWFAT, NOT CAN	5
LIVERWURST	5
LUNCHEON LOAF (OLIVE, PICKLE OR PIMIENTO)	5
SANDWICH LOAF, LUNCHEON MEAT	5
TURKEY HAM, SLICED, XTRA LEAN, PKG'D, DELI	5
TURKEY HAM	5
VEAL LOAF	5
TURKEY PASTRAMI	5
TURKEY SALAMI	5
TURKEY OR CHICKEN BREAST, PKG'D/DELI, LUNCHEON MEAT	5
BEEF, SLICED, PREPACKAGED/DELI, LUNCHEON MEAT	5
CORNED BEEF, PRESSED	5
MEAT SPREAD OR POTTED MEAT, NFS	5
CHICKEN SALAD SPREAD	5
HAM, DEVILED OR POTTED	5
HAM SALAD SPREAD	5
ROAST BEEF SPREAD	5
CORNED BEEF SPREAD	5
FISH, NS AS TO TYPE, RAW	5
FISH, COOKED, NS AS TO TYPE & COOKING METHOD	5
FISH, NS AS TO TYPE, BAKED OR BROILED	5
FISH, NS AS TO TYPE, BREADED OR BATTERED, BAKED	5
FISH, NS AS TO TYPE, FLOURED OR BREADED, FRIED	5
FISH, NS AS TO TYPE, BATTERED, FRIED	5
FISH, NS AS TO TYPE, STEAMED	5
FISH, NS AS TO TYPE, DRIED	5
FISH, NS AS TO TYPE, SMOKED	5
FISH STICK/FILLET, COOKED, NS TYPE & COOKING METHOD	5
FISH STICK/FILLET, NS AS TO TYPE, BAKED OR BROILED	5
FISH STICK/FILLET, NS TYPE, BREADED/BATTERED, BAKED	5
FISH STICK/FILLET, NS TYPE, FLOURED/BREADED, FRIED	5
FISH STICK OR FILLET, NS AS TO TYPE, BATTERED, FRIED	5
ANCHOVY, COOKED, NS AS TO COOKING METHOD	5
BARRACUDA, COOKED, NS AS TO COOKING METHOD	5
BARRACUDA, BAKED OR BROILED	5
BARRACUDA, FLOURED OR BREADED, FRIED	5
BARRACUDA, STEAMED OR POACHED	5
CARP, COOKED, NS AS TO COOKING METHOD	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CARP, BAKED OR BROILED	5
CARP, FLOURED OR BREADED, FRIED	5
CARP, STEAMED OR POACHED	5
CARP, SMOKED	5
CATFISH, COOKED, NS AS TO COOKING METHOD	5
CATFISH, BAKED OR BROILED	5
CATFISH, BREADED OR BATTERED, BAKED	5
CATFISH, FLOURED OR BREADED, FRIED	5
CATFISH, BATTERED, FRIED (INCLUDE BULLHEAD)	5
CATFISH, STEAMED OR POACHED	5
COD, COOKED, NS AS TO COOKING METHOD	5
COD, BAKED OR BROILED	5
COD, BREADED OR BATTERED, BAKED	5
COD, FLOURED OR BREADED, FRIED	5
COD, BATTERED, FRIED	5
COD, STEAMED OR POACHED	5
COD, DRIED, SALTED	5
COD, DRIED, SALTED, SALT REMOVED IN WATER	5
COD, SMOKED	5
CROAKER, COOKED, NS AS TO COOKING METHOD	5
CROAKER, BAKED OR BROILED	5
CROAKER, BREADED OR BATTERED, BAKED	5
CROAKER, FLOURED OR BREADED, FRIED	5
CROAKER, STEAMED OR POACHED	5
EEL, COOKED, NS AS TO COOKING METHOD	5
EEL, STEAMED OR POACHED	5
EEL, SMOKED	5
FLOUNDER, RAW	5
FLOUNDER, COOKED, NS AS TO COOKING METHOD	5
FLOUNDER, BAKED OR BROILED	5
FLOUNDER, BREADED OR BATTERED, BAKED	5
FLOUNDER, FLOURED OR BREADED, FRIED	5
FLOUNDER, BATTERED, FRIED	5
FLOUNDER, STEAMED OR POACHED	5
FLOUNDER, SMOKED	5
HADDOCK, COOKED, NS AS TO COOKING METHOD	5
HADDOCK, BAKED OR BROILED	5
HADDOCK, BREADED OR BATTERED, BAKED	5
HADDOCK, FLOURED OR BREADED, FRIED	5
HADDOCK, BATTERED, FRIED	5
HADDOCK, STEAMED OR POACHED	5
HADDOCK, SMOKED	5
HERRING, RAW	5
HERRING, COOKED, NS AS TO COOKING METHOD	5
HERRING, BAKED OR BROILED	5
HERRING, FLOURED OR BREADED, FRIED	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
HERRING, PICKLED, IN CREAM SAUCE	5
HERRING, PICKLED	5
HERRING, SMOKED, KIPPERED	5
MACKEREL, RAW	5
MACKEREL, COOKED, NS AS TO COOKING METHOD	5
MACKEREL, BAKED OR BROILED	5
MACKEREL, SALTED	5
MACKEREL, FLOURED OR BREADED, FRIED	5
MACKEREL, PICKLED	5
MACKEREL, SMOKED	5
MULLET, RAW	5
MULLET, COOKED, NS AS TO COOKING METHOD	5
MULLET, BAKED OR BROILED	5
MULLET, FLOURED OR BREADED, FRIED	5
MULLET, STEAMED OR POACHED	5
OCEAN PERCH, RAW	5
OCEAN PERCH, COOKED, NS AS TO COOKING METHOD	5
OCEAN PERCH, BAKED OR BROILED	5
OCEAN PERCH, BREADED OR BATTERED, BAKED	5
OCEAN PERCH, FLOURED OR BREADED, FRIED	5
OCEAN PERCH, BATTERED, FRIED	5
OCEAN PERCH, STEAMED OR POACHED	5
PERCH, COOKED, NS AS TO COOKING METHOD	5
PERCH, BAKED OR BROILED	5
PERCH, BREADED OR BATTERED, BAKED	5
PERCH, FLOURED OR BREADED, FRIED	5
PERCH, BATTERED, FRIED	5
PERCH, STEAMED OR POACHED	5
PIKE, COOKED, NS AS TO COOKING METHOD	5
PIKE, BAKED OR BROILED	5
PIKE, FLOURED OR BREADED, FRIED	5
PIKE, BATTERED, FRIED	5
PIKE, STEAMED OR POACHED	5
POMPANO, RAW	5
POMPANO, COOKED, NS AS TO COOKING METHOD	5
POMPANO, BAKED OR BROILED	5
POMPANO, FLOURED OR BREADED, FRIED	5
POMPANO, BATTERED, FRIED	5
POMPANO, STEAMED OR POACHED	5
POMPANO, SMOKED	5
PORGY, RAW	5
PORGY, COOKED, NS AS TO COOKING METHOD	5
PORGY, BAKED OR BROILED	5
PORGY, BREADED OR BATTERED, BAKED	5
PORGY, FLOURED OR BREADED, FRIED	5
PORGY, BATTERED, FRIED	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
PORGY, STEAMED OR POACHED	5
RAY, COOKED, NS AS TO COOKING METHOD	5
RAY, BAKED OR BROILED	5
RAY, FLOURED OR BREADED, FRIED	5
RAY, STEAMED OR POACHED	5
SALMON, RAW	5
SALMON, COOKED, NS AS TO COOKING METHOD	5
SALMON, BAKED OR BROILED	5
SALMON, FLOURED OR BREADED, FRIED	5
SALMON, BATTERED, FRIED	5
SALMON, STEAMED OR POACHED	5
SALMON, DRIED	5
SALMON, SMOKED (INCLUDE LOX)	5
SARDINES, COOKED	5
SARDINES, SKINLESS, BONELESS, PACKED IN WATER	5
SEA BASS, COOKED, NS AS TO COOKING METHOD	5
SEA BASS, BAKED OR BROILED	5
SEA BASS, BREADED, BAKED	5
SEA BASS, FLOURED OR BREADED, FRIED	5
SEA BASS, STEAMED OR POACHED	5
SEA BASS, PICKLED (MERO EN ESCABECHE)	5
SMELT, COOKED, NS AS TO COOKING METHOD	5
SMELT, BAKED OR BROILED	5
SMELT, FLOURED OR BREADED, FRIED	5
SMELT, BATTERED, FRIED	5
SMELT, STEAMED OR POACHED	5
STURGEON, COOKED, NS AS TO COOKING METHOD	5
STURGEON, BAKED OR BROILED	5
STURGEON, STEAMED	5
STURGEON, FLOURED OR BREADED, FRIED	5
STURGEON, SMOKED	5
SWORDFISH, COOKED, NS AS TO COOKING METHOD	5
SWORDFISH, BAKED OR BROILED	5
SWORDFISH, FLOURED OR BREADED, FRIED	5
SWORDFISH, STEAMED OR POACHED	5
TROUT, COOKED, NS AS TO COOKING METHOD	5
TROUT, BAKED OR BROILED	5
TROUT, BREADED OR BATTERED, BAKED	5
TROUT, FLOURED OR BREADED, FRIED	5
TROUT, BATTERED, FRIED	5
TROUT, STEAMED OR POACHED	5
TROUT, SMOKED	5
TUNA, FRESH, RAW	5
TUNA, FRESH, COOKED, NS AS TO COOKING METHOD	5
TUNA, FRESH, BAKED OR BROILED	5
TUNA, FRESH, FLOURED OR BREADED, FRIED	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
TUNA, FRESH, STEAMED OR POACHED	5
TUNA, FRESH, DRIED	5
TUNA, FRESH, SMOKED	5
WHITING, COOKED, NS AS TO COOKING METHOD	5
WHITING, BAKED OR BROILED	5
WHITING, BREADED OR BATTERED, BAKED	5
WHITING, FLOURED OR BREADED, FRIED	5
WHITING, BATTERED, FRIED	5
WHITING, STEAMED OR POACHED	5
FROG LEGS, NS AS TO COOKING METHOD	5
FROG LEGS, STEAMED	5
OCTOPUS, COOKED, NS AS TO COOKING METHOD	5
OCTOPUS, STEAMED	5
OCTOPUS, DRIED	5
OCTOPUS, DRIED, BOILED	5
OCTOPUS, SMOKED	5
ROE, SHAD, COOKED (INCL COD ROE)	5
ROE, HERRING	5
ROE, STURGEON (INCLUDE CAVIAR)	5
SQUID, RAW	5
SQUID, BAKED OR BROILED	5
SQUID, BREADED, FRIED	5
SQUID, STEAMED OR BOILED	5
SQUID, DRIED	5
ABALONE, COOKED, NS AS TO COOKING METHOD	5
ABALONE, FLOURED OR BREADED, FRIED	5
ABALONE, STEAMED OR POACHED	5
CLAMS, RAW	5
CLAMS, COOKED, NS AS TO COOKING METHOD	5
CLAMS, BAKED OR BROILED	5
CLAMS, FLOURED OR BREADED, FRIED	5
CLAMS, BATTERED, FRIED	5
CLAMS, STEAMED OR BOILED	5
CLAMS, SMOKED, IN OIL	5
CONCH, BATTERED, FRIED	5
CONCH, BAKED OR BROILED	5
CRAB, COOKED, NS AS TO COOKING METHOD	5
CRAB, BAKED OR BROILED (INCL SAUTEED)	5
CRAB, HARD SHELL, STEAMED	5
CRAB, SOFT SHELL, FLOURED OR BREADED, FRIED	5
CRAYFISH, FLOURED OR BREADED, FRIED	5
CRAYFISH, BOILED OR STEAMED	5
LOBSTER, COOKED, NS AS TO METHOD	5
LOBSTER, BAKED OR BROILED	5
LOBSTER, W/O SHELL, STEAMED OR BOILED	5
LOBSTER, FLOURED OR BREADED, FRIED	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
LOBSTER, BATTERED, FRIED	5
LOBSTER, STEAMED OR BOILED	5
MUSSELS, RAW	5
MUSSELS, COOKED, NS AS TO COOKING METHOD	5
MUSSELS, STEAMED	5
OYSTERS, RAW	5
OYSTERS, COOKED, NS AS TO COOKING METHOD	5
OYSTERS, BAKED OR BROILED (INCLUDE SAUTEED)	5
OYSTERS, STEAMED	5
OYSTERS, FLOURED OR BREADED, FRIED	5
OYSTERS, BATTERED, FRIED	5
OYSTERS, SMOKED	5
SCALLOPS, COOKED, NS AS TO COOKING METHOD	5
SCALLOPS, BAKED OR BROILED	5
SCALLOPS, STEAMED OR BOILED	5
SCALLOPS, FLOURED OR BREADED, FRIED	5
SCALLOPS, BATTERED, FRIED	5
SHRIMP, COOKED, NS AS TO COOKING METHOD	5
SHRIMP, BAKED OR BROILED (INCL SAUTEED; PRAWN)	5
SHRIMP, STEAMED OR BOILED	5
SHRIMP, BREADED OR BATTERED, FRIED	5
SHRIMP, DRIED	5
SNAILS, COOKED, NS AS TO METHOD	5
SNAILS, STEAMED	5
MEXICAN BEEF STEW, NO POTATOES, TOMATO SAUCE	5
MEXICAN BEEF STEW, NO POTATOES, W/ CHILI PEPPERS, TOMATO SCE	5
CHILI CON CARNE, NS AS TO BEANS	5
CHILI CON CARNE W/ BEANS	5
CHILI CON CARNE W/O BEANS	5
CHILI CON CARNE, NS AS TO BEANS, W/ CHEESE	5
CHILI CON CARNE W/ BEANS & CHEESE	5
BEEF SLOPPY JOE (NO BUN)	5
BEEF W/ GRAVY (MIXTURE) (INCLUDE COUNTRY STYLE)	5
SALISBURY STEAK W/ GRAVY (MIXTURE)	5
BEEF W/ CREAM OR WHITE SAUCE (MIXTURE)	5
BEEF STROGANOFF	5
SWEDISH MEATBALLS W/ CREAM OR WHITE SAUCE (MIXTURE)	5
BEEF W/ (MUSHROOM) SOUP (MIXTURE)	5
BEEF W/ SOY-BASED SAUCE (MIXTURE)	5
STEAK TERIYAKI W/ SAUCE (MIXTURE)	5
BEEF CURRY	5
BEEF W/ BARBECUE SAUCE (MIXTURE)	5
BEEF W/ SWEET & SOUR SAUCE (MIXTURE)	5
STEWED, SEASONED GROUND BEEF, MEXICAN	5
STEWED,SEASONED GROUND BEEF,PUERTO RICAN STYLE	5
STEWED DRIED BEEF, P.R. (TASAJO GUISADO)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
STUFFED POT ROAST, P.R.,NFS(ASSUME GRAVY,STUFFING)	5
BEEF STEW, P.R., MEAT W/ GRAVY (POTATO SEPARATE)	5
HAM/PORK W/ GRAVY (MIXTURE)	5
HAM/PORK W/ BARBECUE SAUCE	5
SWEET & SOUR PORK	5
HAM STROGANOFF (INCL HAM W/ CREAM OR WHITE SAUCE)	5
HAM/PORK W/ (MUSHROOM) SOUP-BASE SAUCE (MIXTURE)	5
HAM/PORK W/ TOMATO-BASED SAUCE (MIXTURE)	5
SAUSAGE W/ TOMATO-BASED SAUCE (MIXTURE)	5
SAUSAGE GRAVY	5
MEXICAN STYLE PORK STEW,NO POT,TOM-BASE SCE(MIXTUR	5
PORK OR HAM W/ SOY-BASED SAUCE (MIXTURE)	5
FRANKFURTER /HOT DOG,W/CHILI,NO BUN (INCL CHILI DOG,NO BUN)	5
FRANKFURTERS/HOT DOGS W/ TOM-BASED SCE (MIXTURE)	5
PORK W/ CHILE & TOM (MIXTURE) (PUERCO CON CHILE)	5
STEWED PORK, P.R.	5
CHILI CON CARNE W/ BEANS, MADE W/ PORK	5
LAMB W/ GRAVY (MIXTURE)	5
SPAGHETTI SAUCE W/ LAMB, HOMEMADE-STYLE	5
LAMB GOULASH	5
LAMB CURRY	5
STEWED GOAT, P.R. (CABRITO EN FRICASE)	5
VEAL W/ GRAVY (MIXTURE)	5
VEAL W/ CREAM SAUCE (INCLUDE VEAL PAPRIKASH)	5
VEAL W/ BUTTER SAUCE	5
VEAL MARSALA	5
VEAL PARMIGIANA	5
VEAL CORDON BLEU	5
VENISON/DEER W/ TOMATO-BASED SAUCE (MIXTURE)	5
VENISON/DEER W/ GRAVY	5
CHILI CON CARNE W/ VENISON/DEER & BEANS	5
CHICKEN CACCIATORE (INCLUDE CHICKEN W/TOMATO SAUCE)	5
SPAGHETTI SAUCE W/ POULTRY, HOMEMADE	5
STEWED CHICKEN W/ TOMATO SAUCE, MEXICAN STYLE	5
CHILI CON CARNE W/ CHICKEN & BEANS	5
CHICKEN W/ GRAVY (MIXTURE)	5
CHICKEN FRICASSEE	5
TURKEY W/ GRAVY (MIXTURE)	5
CHICKEN OR TURKEY W/ CREAM SAUCE (MIXTURE)	5
CHICKEN W/ (MUSHROOM) SOUP-BASED SAUCE (MIXTURE)	5
CHICKEN TERIYAKI	5
CHICKEN OR TURKEY WITH BARBECUE SAUCE (MIXTURE), SKIN EATEN	5
CHICKEN OR TURKEY W/ BBQ SAUCE (MIXTURE), SKIN NOT EATEN	5
CHICKEN WING W/ HOT PEPPER SCE (INCL BUFFALO WING)	5
SWEET & SOUR CHICKEN	5
CHICKEN CURRY	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHICKEN W/ CHEESE SAUCE (MIXTURE)	5
CHICKEN CORDON BLEU	5
CHICKEN PARMIGIANA	5
LEMON CHICKEN, CHINESE STYLE	5
CHICKEN KIEV	5
STUFFED CHICKEN, DRUMSTICK OR BREAST, P.R.	5
FISH W/ CREAM OR WHITE SAUCE, NOT TUNA OR LOBSTER	5
LOBSTER NEWBURG (INCLUDE LOBSTER THERMIDOR)	5
SHRIMP COCKTAIL (SHRIMP W/ COCKTAIL SAUCE)	5
TUNA W/ CREAM OR WHITE SAUCE (MIXTURE)	5
SEAFOOD NEWBURG (INCLUDE CRABMEAT THERMIDOR)	5
CLAM SAUCE, WHITE	5
SHRIMP W/ LOBSTER SAUCE (MIXTURE)	5
LOBSTER SAUCE (BROTH-BASED)	5
OYSTER SCE (WHITE SCE-BASED)	5
FISH SAUCE (BAGOONG)	5
FISH W/ TOMATO-BASED SAUCE (MIXTURE)	5
MUSSELS W/ TOMATO-BASED SAUCE (MIXTURE)	5
SARDINES W/ TOMATO-BASED SAUCE (MIXTURE)	5
SARDINES W/ MUSTARD SAUCE (MIXTURE)	5
SCALLOPS W/ CHEESE SAUCE (MIXTURE)	5
CRABS IN TOMATO-BASED SAUCE, PUERTO RICAN STYLE	5
SHRIMP IN GARLIC SAUCE, P.R. (CAMARONES AL AJILLO)	5
MEAT W/ BARBECUE SAUCE, NS AS TO TYPE OF MEAT	5
MEATBALLS, NS AS TO TYPE OF MEAT, W/ SAUCE	5
MEAT W/ TOMATO-BASED SAUCE	5
SPAGHETTI SAUCE W/ COMBINATION OF MEATS, HOMEMADE	5
SPAGHETTI SAUCE W/ MEAT & VEGGIE, HOMEMADE-STYLE	5
STEWED SEASONED GROUND BEEF & PORK, MEXICAN	5
MEAT W/ GRAVY, NS AS TO TYPE OF MEAT (MIXTURE)	5
BEEF & POTATOES, NO SAUCE (MIXTURE)	5
BEEF STEW W/ POTATOES, TOMATO-BASED SAUCE	5
MEXICAN BEEF STEW W/POT,TOM SCE (CARNE GUISADA CON)	5
BEEF GOULASH W/ POTATOES (INCL BEEF GOULASH, NFS)	5
BEEF & POTATOES W/ CREAM, WHITE, MUSHROOM SOUP SCE (MIXTURE)	5
BEEF STEW W/ POTATOES, GRAVY	5
BEEF & POTATOES W/ CHEESE SAUCE (MIXTURE)	5
STEWED SEASONED GROUND BEEF W/ POTATOES, MEXICAN	5
BEEF & MACARONI WITH CHEESE SAUCE (MIXTURE)	5
BEEF & NOODLES W/ TOMATO-BASED SAUCE (MIXTURE)	5
BEEF & NOODLES W/ GRAVY (MIXTURE)	5
BEEF & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	5
BEEF STROGANOFF W/ NOODLES	5
BEEF & NOODLES W/ (MUSHROOM) SOUP (MIXTURE)	5
BEEF & RICE, NO SAUCE (MIXTURE)	5
BEEF & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
PORCUPINE BALLS W/ TOMATO-BASED SAUCE (MIXTURE)	5
CHILI CON CARNE W/ BEANS & RICE	5
BEEF & RICE W/ GRAVY (MIXTURE)	5
BEEF & RICE W/ CREAM SAUCE (MIXTURE)	5
BEEF & RICE W/ (MUSHROOM) SOUP (MIXTURE)	5
BEEF & RICE W/ SOY-BASED SAUCE (MIXTURE)	5
MEAT LOAF MADE W/ BEEF	5
MEAT LOAF W/ BEEF, W/ TOMATO SAUCE	5
BEEF WELLINGTON	5
STUFFED POT ROAST (LARDED MEAT), P.R. (MIXTURE)	5
BEEF STEW, P.R. (CARNE GUISADA CON PAPAS)	5
STEWED CORNED BEEF, P.R. ("CORNED BEEF" GUISADO)	5
MEAT LOAF MADE W/ HAM (NOT LUNCHEON MEAT)	5
HAM & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	5
HAM & RICE W/ (MUSHROOM) SOUP (MIXTURE)	5
HAM OR PORK W/ STUFFING	5
PORK & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	5
SAUSAGE & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	5
SAUSAGE & RICE W/ (MUSHROOM) SOUP (MIXTURE)	5
SAUSAGE & RICE W/ CHEESE SAUCE (MIXTURE)	5
SAUSAGE & NOODLES W/ CREAM OR WHITE SAUCE (MIXTURE)	5
HAM & NOODLES, NO SAUCE (MIXTURE)	5
HAM & RICE, NO SAUCE (MIXTURE)	5
HAM/PORK & POTATOES W/ GRAVY (MIXTURE)	5
PORK & POTATOES W/ CHEESE SAUCE	5
PORK ROAST, STUFFED, P.R.	5
MEXICAN STYLE PORK STEW W/POT,TOM-BASE SCE(MIXTURE)	5
LAMB LOAF	5
LAMB OR MUTTON & POTATOES W/ GRAVY (MIXTURE)	5
LAMB & POTATOES W/ TOMATO-BASED SAUCE (MIXTURE)	5
LAMB OR MUTTON & NOODLES W/ GRAVY (MIXTURE)	5
VEAL & NOODLES W/ CREAM/WHITE SCE (MIXTURE)	5
VENISON/DEER & NOODLE MIXTURE W/ CREAM/WHITE SAUCE	5
CHICKEN OR TURKEY & POTATOES W/ GRAVY (MIXTURE)	5
CHICKEN OR TURKEY & NOODLES, NO SAUCE (MIXTURE)	5
CHICKEN OR TURKEY & NOODLES W/ GRAVY (MIXTURE)	5
CHICKEN OR TURKEY & NOODLES W/ (MUSHROOM) SOUP	5
CHICKEN OR TURKEY & NOODLES W/ CREAM OR WHITE SAUCE	5
CHICKEN & NOODLES W/ CHEESE SAUCE	5
CHICKEN & NOODLES, TOMATO-BASED SAUCE (MIXTURE)	5
CHICKEN & RICE, NO SAUCE (MIXTURE)	5
CHICKEN & RICE W/ CREAM SAUCE (MIXTURE)	5
CHICKEN & RICE W/ (MUSHROOM) SOUP-BASED SAUCE	5
CHICKEN & RICE W/ TOMATO-BASED SAUCE (MIXTURE)	5
CHICKEN & RICE W/ SOY-BASED SAUCE (MIXTURE)	5
CHICKEN IN CHEESE SCE W/ SPANISH RICE	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHICKEN W/ DUMPLINGS (MIXTURE)	5
CHICKEN W/ STUFFING (MIXTURE)	5
CHICKEN SOUFFLE	5
MEAT LOAF MADE W/ CHICKEN OR TURKEY	5
CLAMS, STUFFED	5
CODFISH BALL OR CAKE	5
SCALLOPS & NOODLES W/ CHEESE SAUCE (MIXTURE)	5
SHRIMP & NOODLES W/ CHEESE SAUCE	5
TUNA LOAF	5
SEAFOOD, RESTRUCTURED (INCL IMITATION CRABMEAT)	5
TUNA NOODLE CASSEROLE W/ CREAM OR WHITE SAUCE	5
TUNA NOODLE CASSEROLE W/ (MUSHROOM) SOUP	5
TUNA & RICE W/ (MUSHROOM) SOUP (MIXTURE)	5
FISH & RICE W/ TOMATO-BASED SAUCE	5
FISH & RICE W/ CREAM SAUCE	5
FISH & RICE W/ (MUSHROOM) SOUP	5
FISH & NOODLES W/ (MUSHROOM) SOUP (MIXTURE)	5
SHELLFISH & NOODLES, TOMATO-BASED SAUCE	5
STEWED SALMON, P.R. (SALMON GUISADO)	5
MEATLOAF, NS AS TO TYPE OF MEAT	5
MEATBALLS, W/ BREADING, W/ GRAVY	5
MEAT LOAF MADE W/ BEEF & PORK	5
MEAT LOAF W/ BEEF, VEAL & PORK	5
MEAT LOAF W/ BEEF & PORK, W/ TOMATO SAUCE	5
VIENNA SAUSAGES STEWED W/ POTATOES, P.R.	5
STEWED SEASONED GROUND BEEF&PORK,W/POT, MEXICAN	5
BEEF, POTATOES, & VEG (W/ CAR/DK GREEN), NO SAUCE	5
BEEF, POTATOES, & VEG (NO CAR/DK GREEN), NO SAUCE	5
CORNED BEEF, POT & VEG(W/ CAR/DK GREEN), NO SAUCE	5
CORNED BEEF, POTATO & VEG (NO CAR/DK GRN), NO SAUCE	5
BEEF STEW W/ POT & VEG(W/ CAR/DK GRN), TOMATO SAUCE	5
BEEF STEW W/ POT & VEG (NO CAR/DK GREEN), TOM SAUCE	5
BEEF STEW W/ POT & VEG (W/ CAR, DK GREEN), GRAVY	5
BEEF STEW W/ POT & VEG (NO CAR, DK GREEN), GRAVY	5
SHEPHERD'S PIE W/ BEEF	5
BEEF, POT, & VEG (INCL CAR/DK GRN), (MUSHROOM) SOUP	5
BEEF, POT, & VEG (NO CAR/DK GREEN), (MUSHROOM) SOUP	5
BEEF, NOODLES & VEG (W/ CARROTS/DK GREEN), NO SAUCE	5
BEEF, NOODLES & VEG (NO CARROTS/DK GREEN), NO SAUCE	5
BEEF CHOW MEIN OR CHOP SUEY W/ NOODLES	5
BEEF, NOODLES & VEG (W/ CAR/DK GREEN), SOY SAUCE	5
BEEF, NOODLES & VEG (NO CAR/DK GREEN), SOY SAUCE	5
BEEF, NOODLES & VEG (W/ CAR/DK GREEN), TOMATO SAUCE	5
BEEF, NOODLES & VEG (NO CAR/DK GREEN), TOMATO SAUCE	5
BEEF, NOODLES, VEG(INCL CARROTS/DK GREEN), SOUP	5
BEEF, NOODLES, VEG (NO CARROTS/DK GREEN), SOUP	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BEEF, NOODLES, & VEG (INCL CAR/DK GRN), GRAVY	5
BEEF, NOODLES, & VEG (NO CAR/DK GRN), GRAVY	5
BEEF, RICE & VEG (W/ CARROTS/DK GREEN), NO SAUCE	5
BEEF, RICE & VEG (NO CARROTS/DK GREEN), NO SAUCE	5
BEEF, RICE & VEG (W/ CAR/DK GREEN), TOMATO SAUCE	5
BEEF, RICE & VEG (NO CAR/DK GREEN), TOMATO SAUCE	5
STUFFED CABBAGE ROLLS W/ BEEF AND RICE	5
BEEF, RICE & VEGETABLES (W/ CARROTS/DK GREEN), SOUP	5
BEEF, RICE & VEGETABLES (NO CARROTS/DK GREEN), SOUP	5
BEEF, RICE & VEG (INCL CAR/DK GRN), GRAVY, MIXTURE	5
BEEF, RICE & VEG (NO CAR/DK GRN), GRAVY, MIXTURE	5
BEEF, RICE & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	5
BEEF, RICE & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	5
BEEF POT PIE (INCLUDE GREEK MEAT PIE)	5
BEEF, DUMPLINGS & VEG (INCL CAR/DK GRN), GRAVY	5
BEEF, DUMPLINGS & VEG (NO CAR/DK GRN), GRAVY	5
HAM POT PIE	5
HAM/PORK, NOODLES & VEG (NO CAR/DK GR), CHEESE SCE	5
PORK, POTATOES & VEG (W/ CAR, DK GREEN), NO SAUCE	5
PORK, NOODLES, VEG (INCL CAR/DK GRN), TOMATO SAUCE	5
SAUSAGE, NOODLES, VEG (NO CAR/DK GRN), TOMATO SAUCE	5
SAUSAGE, NOODLES, VEG (W/ CAR/DK GRN), TOMATO SAUCE	5
PORK, POTATOES & VEG (W/ CAR, DK GREEN), TOMATO SCE	5
PORK, POTATOES & VEG (NO CAR, DK GREEN), TOMATO SCE	5
SAUSAGE, POT, & VEG (INCL CAR/BROC/DK GREEN), GRAVY	5
SAUSAGE, POT, & VEG (NO CAR/BROC/DK GREEN), GRAVY	5
PORK, POT, & VEG (INCL CAR/DK GRN), GRAVY, MIXTURE	5
PORK, POT, & VEG (NO CAR/DK GRN), GRAVY, MIXTURE	5
PORK, POTATOES & VEG (NO CAR, DK GREEN), NO SAUCE	5
PORK CHOW MEIN OR CHOP SUEY W/ NOODLES	5
PORK, RICE & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	5
PORK, RICE & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	5
PORK, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	5
PORK, RICE & VEG (NO CAR/DK GRN), TOMATO SAUCE	5
HAM, POTATOES & VEG (NO CARROTS/DK GREEN), NO SAUCE	5
HAM, POTATOES & VEG (W/ CARROTS/DK GREEN), NO SAUCE	5
SWEET & SOUR PORK W/ RICE	5
SHEPHERD'S PIE W/ LAMB	5
LAMB STEW W/ POT & VEG (INCL CAR/DK GREEN), GRAVY	5
LAMB, RICE & VEGETABLES (NO CARROT/DK GREEN), GRAVY	5
LAMB, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	5
LAMB, RICE, & VEGETABLES (INCL CAR, DK GRN), GRAVY	5
LAMB STEW W/ POT & VEG (NO CAR/DK GREEN), GRAVY	5
STUFFED GRAPE LEAVES W/ LAMB & RICE	5
LAMB STEW W/ POT & VEG (INCL CAR/DK GRN), TOM SAUCE	5
LAMB STEW W/ POT & VEG (NO CAR/DK GRN), TOMATO SCE	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
VEAL FRICASSEE, P.R. (TERNERA EN FRICASE)	5
VEAL STEW W/ POT, VEG (INCL CAR/DK GRN) TOM SAUCE	5
VEAL STEW W/ POT, VEG (NO CAR,DK GRN), TOMATO SAUCE	5
CHICKEN, POT & VEG (INCL CAR/DK GRN), NO SAUCE	5
CHICKEN, POT & VEG (NO CAR/DK GRN), NO SAUCE	5
CHICKEN STEW W/ POT, VEG (INCL CAR/DK GRN), GRAVY	5
CHICKEN STEW W/ POT & VEG (NO CAR/DK GRN), GRAVY	5
CHICKEN STEW W/ POT & VEG(INCL CAR/DK GRN), TOM SCE	5
CHICKEN STEW W/ POT & VEG(NO CAR/DK GRN), TOM SAUCE	5
CHICKEN, NOODLES & VEG (INCL CAR/DK GRN), NO SAUCE	5
CHICKEN, NOODLES & VEG (NO CAR/DK GRN), NO SAUCE	5
CHICKEN, NOODLES & VEG (INCL CAR/DK GRN), GRAVY	5
CHICKEN, NOODLES & VEG (NO CAR/DK GRN), GRAVY	5
CHICKEN OR TURKEY, NOODLES, AND VEGETABLES (INCLUDING CARROT	5
CHIX, NDL, VEG(NO CAR/DK GRN), CR/SOUP-BASED SAUCE	5
CHICKEN, NOODLES, VEG (INCL CAR/DK GRN), TOMATO SCE	5
CHICKEN, NOODLES, VEG (NO CAR/DK GRN), TOMATO SAUCE	5
CHICKEN CHOW MEIN/CHOP SUEY W/ NOODLES	5
CHICKEN, NOODLES & VEG(INCL CAR/DK GRN), CHEESE SCE	5
CHICKEN, NOODLES & VEG(NO CAR/DK GRN), CHEESE SAUCE	5
CHICKEN, RICE & VEG (INCL CAR/DK GRN), NO SAUCE	5
CHICKEN, RICE & VEG (NO CAR/DK GRN), NO SAUCE	5
CHICKEN, RICE & VEG (INCL CAR/DK GRN), GRAVY	5
CHICKEN, RICE & VEG (NO CAR/DK GRN), GRAVY	5
CHICKEN, RICE & VEG (INCL CAR/DK GRN), SOY SAUCE	5
CHICKEN, RICE & VEG (NO CAR/DK GRN), SOY SAUCE	5
CHIX, RICE, & VEG(INCL CAR/DK GRN), CR/SOUP-BASED SAU	5
CHIX, RICE, AND VEG(NO CAR/DK GRN), CR/SOUP-BASED SAU	5
CHICKEN, RICE & VEG (INCL CAR/DK GRN), CHEESE SAUCE	5
CHICKEN, RICE, VEG (NO CAR/DK GRN), CHEESE SAUCE	5
CHICKEN, RICE & VEG (INCL CAR/DK GRN), TOMATO SAUCE	5
CHICKEN, RICE & VEG (NO CAR/DK GRN), TOMATO SAUCE	5
CHICKEN OR TURKEY POT PIE	5
CHICKEN, STUFFING & VEG (INCL CAR/DK GRN), NO SAUCE	5
CHICKEN, STUFFING, VEG (NO CAR/DK GRN), NO SAUCE	5
CHICKEN, STUFFING & VEG (INCL CAR/DK GRN), GRAVY	5
CHICKEN, STUFFING & VEG (NO CAR/DK GRN), GRAVY	5
CHICKEN, DUMPLINGS, VEG (INCL CAR/DK GRN), GRAVY	5
CHICKEN, DUMPLINGS, VEG (NO CAR/DK GRN), GRAVY	5
CHICKEN FRICASSEE, P.R. (FRICASE DE POLLO)	5
PAELLA WITH SEAFOOD	5
SEAFOOD STEW W/ POT & VEG (NO CAR/DK GREEN),TOM SCE	5
TUNA POT PIE	5
TUNA NOODLE CASSEROLE W/ VEG, CREAM OR WHITE SAUCE	5
FISH, NOODLES, VEG (INCL CAR/DK GRN), CHEESE SAUCE	5
FISH, NOODLES, VEG (NO CAR/DK GRN), CHEESE SAUCE	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BOUILLABAISSE	5
OYSTER PIE (INCLUDE OYSTER POT PIE)	5
SEAFOOD STEW W/ POT & VEG (W/ CAR/DK GREEN),TOM SCE	5
TUNA NOODLE CASSEROLE W/ VEG & (MUSHROOM) SOUP	5
CODFISH SALAD, P.R. (GAZPACHO DE BACALAO)	5
STEWED CODFISH, P.R. (BACALAO GUISADO)	5
BISCAYNE CODFISH, P.R. (BACALAO A LA VIZCAINA)	5
CODFISH SALAD, P.R. (ENSALADA DE BACALAO)	5
SHRIMP & PASTA GARDEN SALAD W/ TOM/CAR, NO DRESSING	5
STEW, NFS	5
GOULASH, NFS	5
MEAT PIE, NFS	5
CHOW MEIN, NS AS TO TYPE OF MEAT, W/ NOODLES	5
PAELLA, NFS	5
BRUNSWICK STEW	5
CHOW MEIN/CHOP SUEY,VARIOUS MEATS, W/ NOODLES	5
STEWED VARIETY MEATS (MOSTLY LIVER), P.R.(GANDINGA)	5
STEWED TRIPE W/ POTATOES, P.R. (MONDONGO)	5
JAMBALAYA W/ MEAT & RICE	5
BEEF & VEG (W/ CAR/DK GREEN, NO POTATO), NO SAUCE	5
BEEF & VEG (NO CAR/DK GREEN, NO POTATO), NO SAUCE	5
BEEF SHISH KABOB W/ VEGETABLES, EXCLUDING POTATOES	5
BEEF & VEG(W/ CAR/DK GREEN, NO POTATO), TOMATO SCE	5
SWISS STEAK	5
BEEF ROLL,STUFFED W/VEG/MEAT MIXTURE,TOM-BASE SAUCE	5
BEEF W/ VEG (NO CAR/DK GREEN, NO POTATO),TOMATO SCE	5
BEEF W/ VEG (INCL CAR/DK GRN, NO POT), SOUP	5
BEEF W/ VEG (NO CAR/DK GRN, NO POT), SOUP	5
BEEF & VEG (W/ CAR/DK GREEN, NO POTATO), SOY SAUCE	5
BEEF, TOFU & VEG(W/ CAR/DK GRN, NO POTATO),SOY SCE	5
BEEF, CHOW MEIN OR CHOP SUEY, NO NOODLES	5
KUNG PAO BEEF	5
BEEF & VEG (NO CAR/DK GREEN, NO POTATO), SOY SAUCE	5
BEEF, TOFU & VEG(NO CAR/DK GRN, NO POTATO), SOY SCE	5
BEEF & VEGETABLES, HAWAIIAN STYLE (MIXTURE)	5
PEPPER STEAK	5
BEEF, GROUND, W/ EGG & ONION (MIXTURE)	5
BEEF SALAD	5
BEEF TACO FILLING: BEEF, CHEESE, TOMATO, TACO SAUCE	5
SUKIYAKI (STIR FRIED BEEF & VEGS IN SOY SAUCE)	5
BEEF & VEG (INCL CAR/DK GRN, NO POTATOES), GRAVY	5
BEEF & VEG (NO CAR/DK GREEN, NO POT), GRAVY	5
SEASONED SHREDDED SOUP MEAT	5
BEEF STEW, P.R. (CARNE A LA JUDIA)	5
CORNED BEEF W/ TOMATO SAUCE & ONION, P.R. STYLE	5
BEEF STEAK W/ ONIONS, P.R. (BIFTEC ENCEBOLLADO)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CABBAGE W/ HAM HOCKS (MIXTURE)	5
HAM OR PORK SALAD	5
FRANKFURTERS OR HOT DOGS & SAUERKRAUT (MIXTURE)	5
PORK & VEG (W/ CAR/DK GREEN, NO POTATO), NO SAUCE	5
GREENS W/ HAM OR PORK (MIXTURE)	5
PORK, TOFU & VEG (W/ CAR/DK GRN,NO POTATO), SOY SCE	5
PORK & VEGETABLES, HAWAIIAN STYLE (MIXTURE)	5
PORK & WATERCRESS W/ SOY-BASED SAUCE (MIXTURE)	5
KUNG PAO PORK	5
MOO SHU (MU SHI) PORK, W/O PANCAKE	5
PORK AND ONIONS W/ SOY-BASED SAUCE	5
PORK HASH,HAWAIIAN--PORK,VEG(NO CAR/DK GRN),SOY SCE	5
HAM & VEG (W/ CARROT/DK GREEN, NO POTATO), NO SAUCE	5
HAM & VEG (NO CARROT/DK GREEN, NO POTATO), NO SAUCE	5
PORK & VEG (NO CAR/DK GREEN, NO POTATO), NO SAUCE	5
PORK,TOFU & VEG(NO CAR/DK GREEN,NO POTATO)SOY SAUCE	5
PORK CHOW MEIN OR CHOP SUEY, NO NOODLES	5
PORK & VEG (INCL CAR/DK GRN, NO POT), TOMATO SAUCE	5
PORK & VEG (NO CAR/DK GRN, NO POT), TOMATO SAUCE	5
SAUSAGE & VEG (INCL CAR/DK GRN)(NO POT), TOM SAUCE	5
SAUSAGE & VEG (NO CAR/DK GRN/POT), TOMATO SAUCE	5
SAUSAGE & PEPPERS, NO SAUCE	5
PORK & VEG (INCL CAR/DK GRN), SOY-BASED SAUCE	5
PORK & VEG (NO CAR/DK GRN), SOY-BASED SAUCE	5
STUFFED CHRISTOPHINE, P.R. (CHAYOTE RELLENO)	5
PORK CHOPS STEWED W/VEG, P.R. (CHULETAS A LA JARD.)	5
LAMB STEW W/ VEG (INCL CAR/DK GRN, NO POT), GRAVY	5
LAMB STEW W/ VEG (NO CAR/DK GRN, NO POT), GRAVY	5
VEAL GOULASH W/VEG(NO CAR/DK GREEN, NO POT),TOM SCE	5
VEAL GOULASH W/VEG(W/ CAR/DK GREEN, NO POT),TOM SCE	5
VEAL W/ VEG (INCL CAR/DK GRN), NO POT, CREAM SAUCE	5
VEAL W/ VEG (NO CAR/DK GRN), NO POT, CREAM SAUCE	5
LAMB SHISH KABOB W/ VEGETABLES, EXCLUDING POTATOES	5
CHICK/TURK & VEG (W/ CAR/DK GRN, NO POT), NO SAUCE	5
CHICK/TURK & VEG (NO CAR/DK GRN, NO POT), NO SAUCE	5
CHICKEN PATE W/ VEGETABLES, DIET	5
CHICKEN CREOLE W/O RICE	5
CHICKEN/TURKEY & VEG (W/ CAR/DK GREEN,NO POT),GRAVY	5
CHICKEN/TURKEY & VEG(NO CAR/DK GREEN,NO POT), GRAVY	5
CHICKEN A LA KING W/VEG(INCL CAR/DK GRN),WHITE SCE	5
CHICKEN A LA KING W/ VEG(NO CAR/DK GRN),WHITE SAUCE	5
CHICKEN DIVAN	5
CHICKEN & VEG (INCL CAR/DK GRN, NO POT), SOY SAUCE	5
CHICKEN & VEG (NO CAR/DK GRN, NO POT), SOY SAUCE	5
GENERAL TSO CHICKEN	5
MOO GOO GAI PAN	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
KUNG PAO CHICKEN	5
ALMOND CHICKEN	5
CHICKEN CHOW MEIN/CHOP SUEY, NO NOODLES	5
CHICKEN OR TURKEY SALAD	5
CHICKEN SALAD W/ EGG	5
CHICKEN GARDEN SALAD W/ TOMATO/CARROT, NO DRESSING	5
CHICKEN GARDEN SALAD W/VEG, NO CAR/TOM, NO DRESSING	5
ORIENTAL CHICKEN GARDEN SALAD, NO DRESSING	5
CHICKEN & VEG (INCL CAR/DK GRN)(NO POT), CHEESE SCE	5
CHICKEN & VEG (NO CAR/DK GRN)(NO POT), CHEESE SAUCE	5
CHICKEN FRICASSEE, NO POT, PUERTO RICAN STYLE	5
CHICKEN FRICASSEE W/SAUCE,NO POT,PUERTO RICAN STYLE	5
CHICKEN FRICASSEE, NO SCE OR POT,PUERTO RICAN STYLE	5
CRAB SALAD	5
LOBSTER SALAD	5
SALMON SALAD	5
SHRIMP CHOW MEIN OR CHOP SUEY, NO NOODLES	5
TUNA SALAD	5
SHRIMP SALAD	5
SEAFOOD SALAD	5
TUNA SALAD W/ CHEESE	5
TUNA SALAD W/ EGG	5
SHRIMP GARDEN SALAD W/ TOMATO/CARROT, NO DRESSING	5
SHRIMP GARDEN SALAD (NO TOMATO/CARROT, NO DRESSING)	5
CRAB SALAD MADE W/ IMITATION CRAB	5
FISH, TOFU, & VEGETABLES, TEMPURA, HAWAIIAN	5
SEAFOOD GARDEN SALAD W/VEG(NO TOM/CAR),NO DRESSING	5
SEAFOOD GARDEN SALAD W/ TOM/CAR, NO DRESSING	5
SEAFOOD GARDEN SALAD W/ EGG, VEG, (NO CAR/TOM), NO	5
SEAFOOD GARDEN SALAD W/ EGG, TOM/CAR, NO DRESSING	5
OYSTERS ROCKEFELLER	5
LOMI SALMON	5
SHRIMP & VEG (W/ CAR/DK GREEN, NO POT), SOY SAUCE	5
SHRIMP & VEG (NO CARROT/DK GREEN, NO POT),SOY SAUCE	5
SHRIMP CREOLE, NO RICE	5
KUNG PAO SHRIMP	5
TUNA CASSEROLE W/ VEG & SOUP, NO NOODLES	5
SHELLFISH MIXTURE & VEG (INCL CAR/DK GRN), SOY SCE	5
SHELLFISH MIXTURE & VEG (NO CAR/DK GRN), SOY SAUCE	5
SHELLFISH & VEG(INCL CAR/DK GRN)(NO POT),SOUP SAUCE	5
SHELLFISH & VEG(NO CAR/DK GRN/POT),SOUP-BASED SAUCE	5
FISH & VEG (INCL CAR/DK GRN, NO POT), TOMATO SAUCE	5
FISH & VEG (NO CAR/DK GRN, NO POT), TOMATO SAUCE	5
FISH & VEGETABLES (W/ CAR/DK GRN), SOY-BASED SAUCE	5
FISH & VEGETABLES (NO CAR/DK GRN), SOY-BASED SAUCE	5
FISH A LA CREOLE, P.R. (PESCADO FRITO CON MOJO)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
LOBSTER CREOLE, P.R. (LANGOSTA A LA CROILLA)	5
OCTOPUS SALAD, P.R. (ENSALADA DE PULPO)	5
CODFISH SALAD, P.R. (SERENATA)	5
CHOW MEIN, NS AS TO TYPE OF MEAT, NO NOODLES	5
LAU LAU(PORK & FISH WRAPPED IN TARO/SPINACH LEAVES)	5
JULIENNE SALAD (MEAT, CHEESE, EGG, VEG) NO DRESSING	5
ANTIPASTO W/ HAM, FISH, CHEESE, VEGETABLES	5
LIVERS, CHICKEN, CHOPPED, W/ EGGS & ONION (MIXTURE)	5
LIVER, BEEF OR CALVES, & ONIONS	5
STEWED SEASONED GROUND BEEF, P.R.	5
STEWED CHITTERLINGS, P.R. (CUAJO GUISADO)	5
STEWED GIZZARDS, P.R. (MOLLEJITAS GUISADAS)	5
GUMBO, NO RICE (NEW ORLEANS TYPE W/MEAT, TOM, OKRA)	5
SANDWICH, NFS	5
MEAT SANDWICH, NFS	5
WRAP SAND, FILL MEAT, POULTRY, FISH, VEG, & CHEESE	5
WRAP SAND, FILL W/ MEAT, POULTRY, FISH, AND VEG	5
BEEF SANDWICH, NFS	5
BEEF BARBECUE SANDWICH OR SLOPPY JOE, ON BUN	5
BEEF BARBECUE SUBMARINE SANDWICH, ON BUN	5
MEATBALL & SPAG SAU SUB SAND	5
CORNED BEEF SANDWICH	5
REUBEN(CORN BEEF W/ SAUERKRAUT & CHEESE) W/ SPREAD	5
PASTRAMI SANDWICH	5
ROAST BEEF SANDWICH	5
ROAST BEEF SANDWICH, W/ GRAVY	5
ROAST BEEF SANDWICH, DIPPED IN EGG, FRIED, W/ GRAVY	5
ROAST BEEF SUB SAND, W/ LETT, TOM, SPRD	5
ROAST BEEF SANDWICH W/ CHEESE	5
ROAST BEEF SANDWICH W/ BACON & CHEESE SAUCE	5
ROAST BEEF SUBMARINE SANDWICH, ON ROLL, AU JUS	5
STEAK SUBMARINE SANDWICH WITH LETTUCE AND TOMATO	5
STEAK SANDWICH, PLAIN, ON ROLL	5
STEAK , CHEESE SUB SAND, W/ LETT, TOM	5
STEAK & CHEESE SANDWICH, PLAIN, ON ROLL	5
STEAK & CHEESE SUBMARINE SANDWICH, PLAIN, ON ROLL	5
FAJITA-STYLE BEEF SAND W/ CHEESE,PITA BRD,W/LET+TOM	5
STEAK & CHEESE SUB, FRIED PEP & ONIONS, ON ROLL	5
STEAK SANDWICH, PLAIN, ON BISCUIT	5
STEAK PATTY(BREADED,FRIED)SANDWICH,W/MAYO,TOM,BUN	5
GYRO SANDWICH W/ TOMATO & SPREAD	5
BACON SANDWICH W/ SPREAD	5
BACON & CHEESE SANDWICH, W/ SPREAD	5
BACON, CHICK, & TOM CLUB SANDWICH W/ LETTUCE+SPREAD	5
BACON & EGG SANDWICH	5
BACON, LETTUCE, & TOMATO SANDWICH W/ SPREAD	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BACON,CHICK,&TOMATO CLUB SANDWICH,MULTIGR W/ SPREAD	5
BACON ON BISCUIT	5
HAM ON BISCUIT	5
HAM SANDWICH W/ SPREAD	5
HAM SANDWICH W/ LETTUCE & SPREAD	5
HAM & CHEESE SANDWICH, W/ LETTUCE & SPREAD	5
HAM & EGG SANDWICH	5
HAM SALAD SANDWICH	5
HAM & CHEESE SANDWICH W/ SPREAD, GRILLED	5
HAM & CHEESE SANDWICH ON BUN W/ LETTUCE & SPREAD	5
HOT HAM & CHEESE SANDWICH, ON BUN	5
HAM & CHEESE ON ENGLISH MUFFIN	5
HAM & CHEESE SUB,MULTIGR ROLL, W/ LET, TOM & SPREAD	5
CUBAN SAND, P.R STYLE(SANDWICH CUBANA), W/ SPREAD	5
MIDNIGHT SAND,P.R. STYLE (MEDIA NOCHE), W/ SPREAD	5
PORK SANDWICH, ON WHITE ROLL, W/ ONIONS, PICKLES & BBQ SAUCE	5
PORK BARBECUE SANDWICH OR SLOPPY JOE, ON BUN	5
PORK SANDWICH	5
PORK SANDWICH W/ GRAVY	5
HAM & TOMATO CLUB SAND, W/ SPREAD	5
CHICKEN SANDWICH, W/ SPREAD	5
CHICKEN SALAD OR CHICKEN SPREAD SANDWICH	5
CHICKEN BARBECUE SANDWICH	5
CHICKEN FILLET (BREADED, FRIED) SANDWICH	5
CHICKEN FILLET(BR FRIED) SAND W/ LET, TOM & SPREAD	5
FAJITA-STYLE CHICKEN SANDWICH W/ CHEESE, LETTUC,TOM	5
CHICKEN PATTY SAND W/ CHEES,WHEAT BUN,LET,TOM, SPRE	5
CHICKEN FILLET,(BROIL) SAND W/ LET, TOM, & SPREAD	5
CHICK FILLET,BROIL,SANDWICH,W/CHEESE,WW ROLL	5
CHICK FILLET, BROILED,SANDWICH,ON OAT BRAN BUN(LTS)	5
CHICKEN FILLET,SANDWICH,W/LETT,TOM,&NON-MAYO SPREAD	5
CHICKEN FILLET,BROILED,SANDWICH,W/CHEESE,ON BUN	5
TURKEY SANDWICH W/ SPREAD	5
TURKEY SALAD SANDWICH	5
TURKEY SANDWICH W/ GRAVY	5
TURKEY SUB SAND, W/ CHEESE, LETT, TOM, SPRD	5
FISH SANDWICH, ON BUN, W/ SPREAD	5
FISH SANDWICH, ON BUN, W/ CHEESE AND SPREAD	5
CRAB CAKE SANDWICH, ON BUN	5
SARDINE SANDWICH, W/ LETTUCE & SPREAD	5
TUNA SALAD SANDWICH W/ LETTUCE	5
TUNA SALAD SANDWICH	5
TUNA MELT SANDWICH	5
TUNA SALSUB SAND, W/ LETT & TOMATO	5
LUNCHEON MEAT SANDWICH, NFS, W/ SPREAD	5
BOLOGNA SANDWICH, W/ SPREAD	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
BOLOGNA & CHEESE SANDWICH W/ SPREAD	5
CORN DOG (FRANKFURTER/HOT DOG W/ CORNBREAD COATING)	5
CORNY DOG, W/ CHILI, ON BUN	5
FRANKFURTER OR HOT DOG, PLAIN, ON BUN	5
FRANKFURTER OR HOT DOG, W/ CHEESE, PLAIN, ON BUN	5
FRANKFURTER/HOT DOG, W/ CATSUP &/ MUSTARD, ON BUN	5
PIG IN A BLANKET (FRANKFURTER OR HOT DOG WRAPPED IN DOUGH)	5
FRANKFURTER/HOT DOG ,W/ CHILI, ON BUN (INCL CHILI DOG)	5
FRANKFURTER /DOG CHILI & CHEESE,BUN (CHILI CHEESE DOG)	5
POCHITO(FRANKFURTER/HOT DOG&BEEF CHILI IN TORTILLA)	5
CHICKEN FRANKFURTER OR HOT DOG, PLAIN, ON BUN	5
PUERTO RICAN SANDWICH, P.R. (SANDWICH CRIOLLO)	5
SALAMI SANDWICH W/ SPREAD	5
SAUSAGE ON BISCUIT(INCL JIMMY DEAN SAUSAGE BISCUIT)	5
SAUSAGE GRIDDLE CAKE SANDWICH	5
SAUSAGE & CHEESE ON ENGLISH MUFFIN	5
SAUSAGE ON BISCUIT, DIET	5
SAUSAGE BALLS (MADE W/ BISCUIT MIX & CHEESE)	5
SAUSAGE SANDWICH	5
SAUSAGE & SPAGH SAUCE SANDWICH	5
SUB, COLD CUT SAND, W/ LETT, TOM	5
MEAT SPREAD OR POTTED MEAT SANDWICH	5
HORS D'OEUVRES, W/ SPREAD	5
BEEF STEW, BABY FOOD, TODDLER	5
BEEF & EGG NOODLES, BABY, NS AS TO STR OR JR	5
BEEF & EGG NOODLES, BABY, STRAINED	5
BEEF & EGG NOODLES, BABY, JUNIOR	5
BEEF W/ VEGETABLES, BABY, STRAINED	5
BEEF W/ VEGETABLES, BABY FOOD, TODDLER	5
CHICKEN & RICE DINNER, BABY, STRAINED	5
CHICKEN NOODLE DINNER, BABY, NS AS TO STR OR JR	5
CHICKEN NOODLE DINNER, BABY, STRAINED	5
CHICKEN NOODLE DINNER, BABY, JUNIOR	5
CHICKEN, NOODLES & VEGETABLES, BABY, TODDLER	5
CHICKEN STEW, BABY FOOD, TODDLER	5
TURKEY, RICE & VEGETABLES, BABY, NS AS TO STR OR JR	5
TURKEY, RICE & VEGETABLES, BABY, STRAINED	5
TURKEY, RICE & VEGETABLES, BABY, JUNIOR	5
TURKEY, RICE, & VEGETABLES, BABY, TODDLER	5
BEEF BROTH, BOUILLON OR CONSOMME (INCL BROTH, NFS)	5
BEEF BROTH OR BOUILLON, CANNED, LOW SODIUM	5
BEEF BROTH OR BOUILLON, DRY, NOT RECONSTITUTED	5
BEEF BROTH, LOW SODIUM, DRY, NOT RECONSTITUTED	5
OXTAIL SOUP	5
BEEF BROTH, W/ TOMATO, HOME RECIPE	5
BEEF BROTH, W/O TOMATO, HOME RECIPE	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHILI BEEF SOUP	5
CHILI BEEF SOUP, CHUNKY	5
MEATBALL SOUP, MEXICAN STYLE (SOPA DE ALBONDIGAS)	5
BEEF NOODLE SOUP, P.R. (SOPA DE CARNE Y FIDEOS)	5
BEEF & NOODLE SOUP, ORIENTAL (VIETNAMESE PHO BO)	5
BEEF & RICE SOUP, P.R.	5
PEPPERPOT (TRIPE) SOUP (INCL MENUDO/MONDONGO SOUP)	5
BEEF VEG SOUP W/POTATO, STEW TYPE (INCL CHUNKY STY)	5
BEEF NOODLE SOUP, CHUNKY STYLE	5
BEEF VEG SOUP W/ NOODLES, STEW TYPE, CHUNKY STYLE	5
BEEF VEG SOUP W/ RICE, STEW TYPE, CHUNKY STYLE	5
BEEF VEGETABLE SOUP,MEXICAN STYLE (SOPA / CALDO DE RES)	5
MEAT & CORN HOMINY SOUP, MEXICAN STYLE (POZOLE)	5
ITALIAN WEDDING SOUP	5
BEEF & MUSHROOM SOUP, CANNED, LOW SODIUM (INCL BEEF	5
BEEF STROGANOFF SOUP, CHUNKY STYLE	5
PORK & RICE SOUP, STEW TYPE, CHUNKY STYLE	5
PORK VEG SOUP W/ NOODLES, STEW TYPE, CHUNKY STYLE	5
HAM, RICE, & POTATO SOUP, P.R.	5
HAM, NOODLE & VEGETABLE SOUP, P.R.	5
PORK, VEGETABLE SOUP W/ POTATOES, STEW TYPE	5
PORK W/VEG (NO CAR,BROC,&/OR DK GREEN)SOUP,ORIENTAL	5
BACON SOUP, CREAM OF, PREPARED W/ WATER	5
SCOTCH BROTH (LAMB, VEGETABLES, BARLEY)	5
LAMB, PASTA & VEGETABLE SOUP, P.R.	5
CHICKEN BROTH/BOUILLON/CONSOMME (INCL FROM POWDER)	5
CHICKEN BROTH, W/O TOMATO, HOME RECIPE	5
CHICKEN BROTH, W/ TOMATO, HOME RECIPE	5
CHICKEN BROTH/BOULLION, DRY, NOT RECONSTITUTED	5
MEXICAN STYLE CHICKEN BROTH SOUP STOCK	5
CHICKEN BROTH, CANNED, LESS/REDUCED SODIUM	5
CHICKEN BROTH, CAN, LOW SODIUM	5
CHICKEN RICE SOUP, P.R. (SOPA DE POLLO CON ARROZ)	5
CHICKEN SOUP W/ NOODLES & POTATOES, P.R.	5
CHICKEN GUMBO SOUP	5
CHICKEN NOODLE SOUP, CHUNKY	5
CHICKEN SOUP, CANNED, UNDILUTED	5
CHICKEN SOUP	5
SWEET & SOUR SOUP	5
CHICKEN SOUP,W/VEGS(BROC,CRT,CELERY,POTS)ORIENTAL	5
CHICKEN CORN SOUP WITH NOODLES, HOME RECIPE	5
CHICKEN VEGETABLE SOUP, STEW TYPE (INCL CHUNKY)	5
TURKEY NOODLE SOUP, CHUNKY	5
CHICKEN VEG SOUP W/ RICE, STEW TYPE, CHUNKY STYLE	5
CHICKEN VEG SOUP W/ NOODLES, STEW TYPE, CHUNKY STYL	5
CHICKEN VEG SOUP W/ RICE, STEW TYPE, PREP W/ MILK	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
CHICKEN OR TURKEY VEGETABLE SOUP, HOME RECIPE	5
CHICKEN VEGETABLE SOUP,W/RICE,MEXICAN(SOPA / CALDO DE POLLO)	5
CHICKEN OR TURKEY & CORN HOMINY SOUP, MEXICAN STYLE (POZOLE)	5
CHICKEN VEG SOUP W/ POTATO & CHEESE, CHUNKY	5
BIRD'S NEST SOUP (CHICKEN, HAM, NOODLES)	5
HOT & SOUR SOUP (INCLUDE HOT & SPICY CHINESE SOUP)	5
CHICKEN SOUP W/ VEGETABLES & FRUIT, ORIENTAL STYLE	5
CHICKEN/TURKEY SOUP, CM OF, CAN, RED SOD, NS W/ MILK/WATER	5
CHICKEN/TURKEY SOUP, CM OF, CAN, RED SOD, W/ MILK	5
CHICKEN/TURKEY SOUP, CM OF, CAN, RED SOD, W/ WATER	5
CHICKEN/TURKEY SOUP, CM OF, CAN, RED SOD, UNDILUTED	5
CHICKEN SOUP, CREAM OF, NS AS TO MILK OR WATER	5
CHICKEN/TURKEY SOUP,CREAM OF, W/ MILK	5
CHICKEN SOUP, CREAM OF, PREPARED W/ WATER	5
CHICKEN SOUP, CREAM OF, CANNED, UNDILUTED	5
CHICKEN & MUSHROOM SOUP, CREAM OF, W/ MILK	5
DUCK SOUP	5
FISH STOCK, HOME RECIPE	5
FISH CHOWDER (INCL FISHERMAN'S SOUP, SEAFOOD CHOWD)	5
CRAB SOUP, NS AS TO TOMATO-BASE OR CREAM	5
CRAB SOUP, TOMATO BASE	5
CLAM CHOWDER, NS AS TO MANHATTAN OR NEW ENGLAND	5
CLAM CHOWDER, MANHATTAN (INCLUDE CHUNKY)	5
TURTLE & VEGETABLE SOUP (INCLUDE SNAPPER SOUP)	5
FISH & VEGETABLE SOUP,NO POTATOES (SOPA DE PESCADO)	5
FISH SOUP, W/ POTATOES (SOPA DE PESCADO)	5
CODFISH, RICE & VEGETABLE SOUP, P.R.	5
CODFISH SOUP W/ NOODLES, P.R.	5
CLAM CHOWDER, NEW ENG, NS AS TO MILK OR WATER ADDED	5
CLAM CHOWDER, NEW ENGLAND, W/ MILK	5
CLAM CHOWDER, NEW ENGLAND, W/ WATER	5
CLAM CHOWDER, CANNED, NEW ENGLAND, RED SODIUM, RTS	5
CRAB SOUP, CREAM OF, W/ MILK	5
LOBSTER BISQUE	5
LOBSTER GUMBO	5
OYSTER STEW	5
SALMON SOUP, CREAM STYLE	5
SHRIMP SOUP, CREAM OF, NS AS TO MILK/WATER ADDED	5
SHRIMP SOUP, CREAM OF, W/ MILK	5
SHRIMP SOUP, CREAM OF, W/ WATER	5
SHRIMP GUMBO	5
SEAFOOD SOUP W/ POTATOES & VEGETABLES (INCL DK GREEN LEAF)	5
SEAFOOD SOUP W/ POTATOES & VEGETABLES (EXCL DK GREEN LEAF)	5
SEAFOOD SOUP W/ VEGETABLES (INCL DK GREEN LEAFY)	5
SEAFOOD SOUP W/ VEGETABLES (EXCL DK GREEN LEAFY)	5
MEAT BROTH, P.R. (CALDO)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
SPANISH VEGETABLE SOUP, P.R. (CALDO GALLEGO)	5
GELATIN DRINK, POWDER, UNFLAVORED, UNSWEETENED, RECONST.	5
GELATIN DRINK, FLAVORED, W/ LOW CALORIE SWEETENER	5
BEE POLLEN	5
GRAVY, POULTRY	5
GRAVY, MEAT/POULTRY, W/ WINE	5
GRAVY, MEAT, W/ FRUIT (INCLUDE FRENCH SAUCE)	5
GRAVY, POULTRY, LOW SODIUM	5
GRAVY, BEEF/MEAT (INCL GRAVY,NFS;BROWN GRAVY;SWISS STEAK GRV	5
GRAVY, GIBLET(INCL ANY POULTRY GRAVY W/PCS OF MEAT)	5
GRAVY, BEEF OR MEAT, LOW SODIUM	5
GRAVY, BEEF OR MEAT, HOME RECIPE	5
GRAVY, POULTRY, HOME RECIPE	5
GRAVY, MUSHROOM	5
GRAVY, REDEYE	5
GRAVY, BEEF/MEAT, FAT FREE	5
GRAVY, POULTRY, FAT FREE	5
GRAVY/SAUCE, POULTRY FROM CHICKEN FRICASSEE, P.R.	5
GRAVY, MEAT-BASED, FROM PUERTO RICAN POT ROAST	5
GRAVY, MEAT-BASED, FROM PUERTO RICAN BEEF STEW	5
GRAVY/SAUCE,CHINESE(SOY SCE,STOCK/BOUILL,CRNSTRCH)	5
OYSTER-FLAVORED SAUCE	5
MOLE POBLANA (SAUCE)	5
MOLE VERDE (SAUCE)	5
BEAN SOUP, NFS	5
BEAN W/ BACON OR PORK SOUP	5
BLACK BEAN SOUP	5
LIMA BEAN SOUP	5
SOYBEAN SOUP, MADE W/ MILK	5
BEANSOUPW/MACARONI&MEAT(INCL PASTA E FAGIOLE W/MEAT	5
SOYBEAN SOUP, MISO BROTH	5
PINTO BEAN SOUP	5
BEAN SOUP W/ MACARONI (INCL PASTA E FAGIOLI)	5
PORTUGUESE BEAN SOUP	5
BEAN & HAM SOUP, CHUNKY STYLE (INCL CAMPBELL'S OLD	5
BEAN SOUP W/ VEG, RICE, & PORK (INCL CAMPBELL'S CHU	5
BEAN SOUP, MIXED BEANS (INCL 15-BEAN SOUP)	5
BEAN SOUP, HOME RECIPE	5
BEAN & HAM SOUP, CAN, REDUCED SODIUM, W/ WATER/RTS	5
BEAN & RICE SOUP	5
BEAN & HAM SOUP, HOME RECIPE	5
LIQUID FROM STEWED KIDNEY BEANS, P.R.	5
CHUNKY PEA & HAM SOUP	5
GARBANZO OR CHICKPEA SOUP	5
SPLIT PEA & HAM SOUP	5
PEA SOUP, INSTANT TYPE	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
SPLIT PEA SOUP	5
SPLIT PEA SOUP, CAN, REDUCED SODIUM, W/ WATER/RTS	5
SPLIT PEA & HAM SOUP, CAN, REDUCED SODIUM, W/ WATER/RTS	5
LENTIL SOUP	5
WHITE BEAN SOUP, P.R.	5
SESAME SAUCE	5
SESAME PASTE	5
SOUP, NFS	5
NOODLE SOUP, NFS	5
RICE SOUP, NFS	5
BARLEY SOUP (INCLUDE BEEF/CHICKEN/MUSHROOM BARLEY)	5
BARLEY SOUP,SWEET,W/ OR W/O NUTS, ORIENTAL STYLE	5
BEEF NOODLE SOUP, CANNED, UNDILUTED	5
BEEF NOODLE SOUP	5
BEEF DUMPLING SOUP	5
BEEF RICE SOUP	5
BEEF NOODLE SOUP, HOME RECIPE	5
CHICKEN NOODLE SOUP (INCLUDE CHICKEN & STARS SOUP)	5
CHICKEN NOODLE SOUP, CANNED, UNDILUTED	5
CHICKEN NOODLE SOUP, CANNED, LOW SODIUM	5
CHICKEN NOODLE SOUP, HOME RECIPE	5
CHICKEN NOODLE SOUP, CREAM OF	5
CHICKEN NOODLE SOUP,CAN,RED SODIUM,READY-TO-SERVE	5
NOODLE & POTATO SOUP, P.R.	5
CHICKEN RICE SOUP (INCL TURKEY RICE SOUP)	5
CHICKEN & RICE SOUP, CANNED, UNDILUTED	5
CHICKEN OR TURKEY RICE SOUP, HOME RECIPE	5
CHICKEN RICE SOUP, CAN, RED SODIUM, PREP W/ WATER/RTS	5
CHICKEN RICE SOUP, CAN, REDUCED SODIUM, W/ MILK	5
RICE AND POTATO SOUP, P.R.	5
MATZO BALL SOUP	5
CHICKEN SOUP W/ DUMPLINGS, POTATOES	5
CHICKEN SOUP W/ DUMPLINGS	5
TURKEY NOODLE SOUP	5
TURKEY NOODLE SOUP, HOME RECIPE	5
INSTANT SOUP, NFS	5
INSTANT SOUP, NOODLE (INCLUDE MEAT & VEG FLAVORS)	5
SOUP, MOSTLY NOODLES(INCL SPAGHETTI SOUP,TOP RAMEN)	5
INSTANT SOUP, RICE (INCLUDE MEAT/CHICKEN FLAVOR)	5
INSTANT SOUP, NOODLE W/ EGG, SHRIMP OR CHICKEN	5
WON TON (WONTON) SOUP	5
NOODLE SOUP W/ VEGETABLES,ORIENTAL STYLE	5
NOODLE SOUP,W/ FISH BALL,SHRIMP,&DK GREEN LEAFY VEG	5
RICE SOUP, MADE W/ TEA	5
SOPA SECA (DRY SOUP), MEXICAN STYLE, NFS	5
SOPA SECA DE FIDEO,MEX STYLE,MADE W/ DRY NOODLES	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
SOPA DE FIDEO AGUADA, MEXICAN STYLE NOODLE SOUP	5
SOPA SECA DE ARROZ (DRY RICE SOUP), MEXICAN STYLE	5
SOPA DE TORTILLA, MEXICAN STYLE TORTILLA SOUP	5
NOODLE SOUP, MADE W/ MILK	5
MACARONI, TOMATOES & BEEF, BABY, NS STR/JR	5
MACARONI, TOMATOES & BEEF, BABY, STR	5
MACARONI, TOMATOES & BEEF, BABY, JR	5
FRUIT, NS AS TO TYPE	5
CANTALOUPE (MUSKMELON), RAW (INCLUDE MELON, NFS)	5
CANTALOUPE, FROZEN (BALLS)	5
CASSABA MELON, RAW	5
CHERRY PIE FILLING	5
CHERRIES, SWEET, RAW (INCLUDE CHERRIES, FRESH, NFS)	5
GRAPES, RAW, NS AS TO TYPE	5
KIWI FRUIT, RAW	5
LYCHEE, RAW (INCLUDE FROZEN)	5
HONEYDEW MELON, RAW	5
HONEYDEW MELON, FROZEN (BALLS)	5
MANGO, RAW	5
PAPAYA, RAW	5
PASSION FRUIT, RAW	5
PEACH, RAW	5
PINEAPPLE, RAW	5
PLUM, RAW	5
POMEGRANATE, RAW	5
WATERMELON, RAW	5
BERRIES, RAW, NFS	5
BLACKBERRIES, RAW	5
BLUEBERRIES, RAW	5
CRANBERRIES, RAW	5
DEWBERRIES, RAW	5
MULBERRIES, RAW	5
RASPBERRIES, RAW, NS AS TO COLOR	5
RASPBERRIES, BLACK, RAW	5
RASPBERRIES, RED, RAW	5
STRAWBERRIES, RAW	5
STRAWBERRIES, RAW, W/ SUGAR	5
FRUIT COCKTAIL OR MIX (NO CITRUS FRUITS), RAW	5
FRUIT COCKTAIL OR MIX (INCL CITRUS FRUITS), RAW	5
FRUIT COCKTAIL OR MIX, FROZEN	5
FRUIT COCKTAIL, COOKED OR CANNED, NS ADDED SWEETNER	5
FRUIT COCKTAIL, CKD OR CND, UNSWEET, WATER PACK	5
FRUIT COCKTAIL, COOKED OR CANNED, IN HEAVY SYRUP	5
FRUIT COCKTAIL, COOKED OR CANNED, IN LIGHT SYRUP	5
FRUIT COCKTAIL, COOKED OR CANNED, DRAINED SOLIDS	5
FRUIT COCKTAIL, COOKED OR CANNED, JUICE PACK	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
FRUIT SALAD, P.R. STYLE (ENSALADA DE FRUTA)	5
FRUIT SALAD (NO CITRUS) W/ SALAD DRESSING	5
FRUIT SALAD (NO CITRUS) W/ CREAM	5
FRUIT SALAD (NO CITRUS) W/ CREAM SUBSTITUTE	5
FRUIT SALAD (NO CITRUS) W/ MARSHMALLOWS	5
FRUIT SALAD (W/ CITRUS) W/ PUDDING	5
FRUIT SALAD (NO CITRUS FRUITS) W/ PUDDING	5
FRUIT SALAD (INCL CITRUS FRUITS) W/ SALAD DRESSING	5
FRUIT SALAD (INCL CITRUS FRUITS) W/ CREAM	5
FRUIT SALAD W/ CREAM SUBSTITUTE	5
FRUIT SALAD W/ MARSHMALLOWS	5
FRUIT DESSERT, NFS	5
GUACAMOLE W/ TOMATOES	5
GUACAMOLE W/ TOMATOES & CHILI PEPPERS	5
GUACAMOLE, NFS	5
CHUTNEY	5
PEAR SALAD W/ DRESSING	5
PINEAPPLE SALAD W/ DRESSING	5
PINEAPPLE SALAD W/ CREAM CHEESE	5
SOUP, FRUIT	5
POTATO SALAD W/ EGG	5
POTATO SALAD, GERMAN	5
POTATO SALAD	5
POTATO SOUP, NS AS TO MADE W/MILK OR WATER	5
POTATO SOUP, CREAM OF, W/ MILK	5
POTATO SOUP, PREPARED W/ WATER	5
POTATO SOUP, INSTANT, MADE FROM DRY MIX	5
POTATO & CHEESE SOUP	5
MACARONI & POTATO SOUP	5
POTATO CHOWDER (INCL CORN CHOWDER)	5
PLANTAIN SOUP, P.R. (SOPA DE PLATANO)	5
CAESAR SALAD (W/ ROMAINE)	5
SPINACH, RAW	5
ESCAROLE SOUP	5
WATERCRESS BROTH W/ SHRIMP	5
SPINACH SOUP	5
DARK-GREEN LEAFY VEGETABLE SOUP,W/MEAT,ORIENTAL	5
DARK-GREEN LEAFY VEGETABLE SOUP,MEATLESS,ORIENTAL	5
CARROTS IN TOMATO SAUCE	5
TOMATO CATSUP	5
TOMATO CATSUP, LOW SODIUM	5
TOMATO CHILI SAUCE (CATSUP TYPE)	5
SALSA, NFS	5
SALSA, RED, UNCOOKED (INCL PICO DE GALLO)	5
SALSA, RED, CKD, NOT HOM (INCL TACO, CREOLE, PICANTE SAUCES)	5
SALSA, RED, COOKED, HOMEMADE (INCL DE CHILE ROJO)	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
ENCHILADA SAUCE, RED	5
ENCHILADA SAUCE, GREEN	5
GREEN TOMATO-CHILE SAUCE, RAW	5
GREEN TOMATO-CHILE SAUCE, COOKED	5
TOMATO SAUCE	5
TOMATO SAUCE, LOW SODIUM	5
TOMATO PASTE	5
TOMATO PUREE	5
SPAGHETTI SAUCE, MEATLESS	5
SPAGHETTI SAUCE W/ VEGGIE, HOMEMADE-STYLE	5
SPAGHETTI SAUCE W/ MEAT, CANNED, NO EXTRA MEAT	5
SPAGHETTI SAUCE, MEATLESS, LOW SODIUM	5
SPAGHETTI SAUCE, MEATLESS, FAT FREE	5
TOMATO RELISH (INCLUDE TOMATO PRESERVES)	5
BARBECUE SAUCE	5
BARBECUE SAUCE, LOW SODIUM	5
STEAK SAUCE, TOMATO-BASE (INCLUDE A-1)	5
COCKTAIL SAUCE	5
TOMATO SOUP, NFS	5
TOMATO SOUP, CREAM OF,PREP W/ MILK	5
TOMATO SOUP, PREPARED W/ WATER	5
TOMATO SOUP, CANNED, UNDILUTED	5
TOMATO SOUP, INSTANT TYPE, PREPARED W/ WATER	5
TOMATO SOUP, CANNED, LOW SODIUM, READY-TO-SERVE	5
TOMATO SOUP, CAN, RED. SODIUM, PREP. W/ WATER	5
TOMATO SOUP, CAN, RED. SODIUM, PREP W/ MILK	5
TOMATO BEEF SOUP, PREPARED W/ WATER	5
TOMATO BEEF NOODLE SOUP, PREPARED W/ WATER	5
TOMATO BEEF RICE SOUP, PREPARED W/ WATER	5
TOMATO NOODLE SOUP, PREPARED W/ WATER	5
TOMATO NOODLE SOUP, CREAM OF	5
TOMATO RICE SOUP, CANNED, UNDILUTED	5
TOMATO RICE SOUP, PREPARED W/ WATER	5
TOMATO VEGETABLE SOUP, PREP W/ WATER	5
TOMATO VEGETABLE SOUP W/NOODLES, PREPARED W/ WATER	5
BROCCOLI SALAD W/CAULIFLOWER,CHEESE,BACON,&DRESSING	5
CABBAGE SALAD OR COLESLAW, W/ DRESSING	5
CABBAGE SALAD OR COLESLAW, W/APPLES/RAISINS, DRESS	5
CABBAGE SALAD OR COLESLAW, W/ PINEAPPLE, DRESSING	5
CABBAGE, CHINESE, SALAD, W/ DRESSING	5
CUCUMBER SALAD W/ CREAMY DRESSING	5
CUCUMBER SALAD MADE W/ CUCUMBER, OIL & VINEGAR	5
CUCUMBER SALAD MADE W/ CUCUMBER AND VINEGAR	5
LETTUCE SALAD W/ ASSORTED VEGETABLES	5
LETTUCE SALAD, W/ ASST VEG, NO TOM OR CAR, NO DRESS	5
LETTUCE SALAD, W/ AVOCADO, TOMATO/CAR, NO DRESS	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
LETTUCE SALAD, W/ CHEESE, TOM/CAR, NO DRESSING	5
LETTUCE SALAD, W/ EGG, TOM/CAR, NO DRESSING	5
LETTUCE SALAD W/ EGG, CHEESE, TOM/CAR, NO DRESSING	5
SEVEN-LAYER SALAD(LETTUCE, MAYO, CHEESE, EGG, PEAS)	5
GREEK SALAD	5
SPINACH SALAD, NO DRESSING	5
COBB SALAD W/ DRESSING	5
SOUP, CREAM OF, NFS	5
ASPARAGUS SOUP, CREAM OF, NS AS TO W/ MILK OR WATER	5
ASPARAGUS SOUP, CREAM OF,W/ MILK	5
ASPARAGUS SOUP, CREAM OF, PREPARED W/ WATER	5
BEET SOUP (BORSCHT)	5
CABBAGE SOUP	5
CABBAGE W/ MEAT SOUP	5
CAULIFLOWER SOUP, CREAM OF, W/ MILK	5
CELERY SOUP, CREAM OF, NS AS TO MILK OR WATER ADDED	5
CELERY SOUP, CREAM OF, W/ MILK	5
CELERY SOUP, CREAM OF, PREPARED W/ WATER	5
CELERY SOUP, CREAM OF, CANNED, UNDILUTED	5
CORN SOUP, CREAM OF, W/ MILK	5
CORN SOUP, CREAM OF, PREPARED W/ WATER	5
CUCUMBER SOUP, CREAM OF, W/ MILK	5
GAZPACHO	5
GAZPACHO, CANNED, UNDILUTED	5
LEEK SOUP, CREAM OF, PREP W/ MILK	5
LEEK SOUP, MADE FROM DRY MIX	5
MUSHROOM SOUP, NFS	5
MUSHROOM SOUP, CREAM OF, PREP W/ MILK	5
MUSHROOM SOUP, CREAM OF, PREPARED W/ WATER	5
MUSHROOM SOUP, CANNED, UNDILUTED (INCL CREAM OF)	5
MUSHROOM SOUP, W/ MEAT BROTH, PREPARED W/ WATER	5
MUSHROOM SOUP, CM OF, LOW SOD, PREP W/ WATER	5
MUSHROOM SOUP, CREAM OF, NS AS TO W/ MILK OR WATER	5
MUSHROOM W/ CHICKEN SOUP, CREAM OF, PREP W/ MILK	5
MUSHROOM SOUP, CREAM OF, CAN, RED. SOD., NS W/ MILK/WATER	5
MUSHROOM SOUP, CREAM OF, CAN, RED. SODIUM, PREP W/ MILK	5
MUSHROOM SOUP, MADE FROM DRY MIX	5
MUSHROOM SOUP, CM OF, CAN, RED SOD, PREP W/ WATER	5
MUSHROOM SOUP, CM OF, CAN, RED SOD, UNDILUTED	5
ONION SOUP, CREAM OF, PREP W/ MILK	5
ONION SOUP, CREAM OF, CANNED, UNDILUTED	5
ONION SOUP, FRENCH	5
ONION SOUP, MADE FROM DRY MIX	5
ONION SOUP, DRY MIX, NOT RECONSTITUTED	5
PEA SOUP, NFS	5
PEA SOUP, PREP W/ MILK	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
PEA SOUP, PREPARED W/ WATER	5
PEA SOUP, CAN, LOW SOD, PREP W/ WATER	5
VEGETABLE SOUP, CREAM OF, PREP W/ MILK	5
ZUCCHINI SOUP, CREAM OF, PREP W/ MILK	5
SHAV SOUP	5
SEAWEED SOUP	5
VEGETABLE SOUP, PREP W/ WATER OR READY-TO-SERVE	5
VEGETABLE SOUP, CANNED, UNDILUTED	5
VEGETABLE SOUP, CANNED, LOW SODIUM	5
VEGETABLE SOUP, MADE FROM DRY MIX	5
VEGETABLE SOUP, DRY MIX, NOT RECONSTITUTED	5
VEGETABLE SOUP, FROM DRY MIX, LOW SODIUM	5
VEG SOUP,CREAM OF,MADE FROM DRY,LOW SODIUM,W/WATER	5
VEGETABLE SOUP, HOME RECIPE	5
VEGETABLE NOODLE SOUP, HOME RECIPE	5
MINESTRONE SOUP, CANNED, REDUCED SODIUM, RTS	5
MINESTRONE SOUP, HOME RECIPE	5
VEGETABLE BEAN SOUP, PREPARED W/ WATER	5
VEGETABLE BEEF SOUP, PREPARED W/ WATER	5
VEGETABLE BEEF NOODLE SOUP, PREPARED W/ WATER	5
VEGETABLE NOODLE SOUP, PREPARED W/ WATER	5
VEGETABLE CHICKEN SOUP, W/ WATER OR READY-TO-SERVE	5
VEGETABLE CHCKEN OR TURKEY SOUP, CANNED, UNDILUTED	5
VEGETABLE RICE SOUP, PREPARED W/ WATER	5
VEG BEEF SOUP W/RICE, PREP W/ WATER, READY-TO-SERVE	5
VEGETABLE CHICKEN SOUP, CAN, LOW SOD, PREP W/ WATER	5
VEG CHICKEN RICE SOUP, PREPARED W/ WATER / READY TO	5
VEG CHICKEN NOODLE SOUP,PREP W/WATER,READY-TO-SERVE	5
VEG SOUP W/ CHICKEN BROTH, MEXICAN STYLE (SOPA RANCHERA)	5
VEGETABLE NOODLE SOUP, CAN, RED SODIUM, PREP W/ WATER/RTS	5
VEGETABLE BEEF SOUP, HOME RECIPE	5
VEGETABLE BEEF SOUP, CANNED, UNDILUTED	5
VEG BEEF SOUP, PREPARED W/ MILK	5
VEG BEEF SOUP W/ NOODLES, HOME RECIPE	5
VEG BEEF SOUP W/ RICE, HOME RECIPE	5
VEGETARIAN VEGETABLE SOUP, PREPARED W/ WATER	5
VEGETARIAN VEGETABLE SOUP, UNDILUTED	5
VEGETABLE SOUP, SPANISH, STEW TYPE	5
VEGETABLE SOUP, CHUNKY STYLE	5
VEGETABLE SOUP W/ PASTA, CHUNKY STYLE	5
VEG BEEF SOUP, CHUNKY STYLE (INCL VEG W/ MEAT SOUPS	5
VEGETABLE BROTH, BOUILLON (INCL POT LIQUOR)	5
BLUE OR ROQUEFORT CHEESE DRESSING	5
BACON & TOMATO DRESSING	5
CAESAR DRESSING	5
COLESLAW DRESSSING	5

Food type	Heat-treated *C. maltaromaticum* (mg/g of food)
FETA CHEESE SALAD DRESSING	5
FRENCH DRESSSING	5
FRUIT DRESSING W/ FRUIT JUICE & CREAM	5
FRUIT DRESSING, MADE W/ HONEY, OIL, WATER	5
HONEY MUSTARD DRESSING	5
CREAMY DRESSING, W/SOUR CREAM/BUTTERMILK & OIL	5
CREAM CHEESE DRESSING	5
MILK, VINEGAR & SUGAR DRESSING	5
THOUSAND ISLAND DRESSING	5
BLUE OR ROQUEFORT CHEESE DRESSING, LOW CALORIE	5
BLUE OR ROQUEFORT CHEESE DRESSING, REDUCED CALORIE	5
BLUE/ROQUEFORT CHEESE DRESSING,RED CAL,NO FAT/CHOL	5

* These foods are representative of the types of foods to which the ingredient may be added, but does not limit Griffith Laboratories to only those brands provided; NFS = Not food specified; NS = non-specific

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14. APPENDIX 4

DOSSIER IN SUPPORT OF THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF SPECIFIC STRAINS OF *Carnobacterium maltaromaticum* AS A FOOD INGREDIENT

780 U.S. HWY 1, Suite 300
Vero Beach, Florida 32962

DOSSIER IN SUPPORT OF THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF SPECIFIC STRAINS OF *Carnobacterium maltaromaticum* AS A FOOD INGREDIENT

September 16, 2004

Panel Members:

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OPINION OF AN EXPERT PANEL ON THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF SPECIFIC STRAINS OF *Carnobacterium maltaromaticum* AS A FOOD INGREDIENT

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OPINION OF AN EXPERT PANEL ON THE GENERALLY RECOGNIZED AS SAFE (GRAS) STATUS OF SPECIFIC STRAINS OF *Carnobacterium maltaromaticum* AS A FOOD INGREDIENT

Summary

The undersigned, an independent panel of recognized experts (hereafter referred to as the Expert Panel)[1], qualified by their scientific training and relevant national and international experience to evaluate the safety of food and food ingredients, was convened to determine the Generally Recognized As Safe (GRAS) status, in accordance with 21 CFR § 170.30, 21 CFR § 170.35 and proposed 21 CFR § 170.36, of *Carnobacterium maltaromaticum* strains CB1, CB2, CB3, LV17, UAL26, ATCC 35586 AND ATCC43225 for use as a preservative in ready-to-eat (RTE) and fresh comminuted[2], processed meat products at a maximum inoculation[3] concentration of 1 x 10^4 colony forming units (cfu)/g. A comprehensive search of the scientific literature for safety and toxicity information on the bacterium commonly known as *Carnobacterium piscicola* (recently renamed from *Lactobacillus piscicola* and reclassified with *Lactobacillus maltaromicus* to the new name of *Carnobacterium maltaromaticum*) was conducted through April 2004 and made available to the Expert Panel. The Expert Panel independently evaluated materials submitted by Griffith Laboratories and other materials deemed appropriate or necessary. Following an independent, critical evaluation, the Expert Panel conferred and unanimously agreed to the decision described herein.

1. History and Phylogenetic Analysis of *Carnobacterium maltaromaticum*

Carnobacterium maltaromaticum is one species of a diverse group of bacteria that are generally classified as atypical Lactic Acid Bacteria (LAB). LAB have been utilized for centuries in the food and dairy industries in the production of fermented foods. Important in this capacity is their ability to produce aromatic and flavor-enhancing compounds (Stiles and Holzapfel, 1997; Carr *et al.*, 2002). LAB have been characterized by their ability to produce a variety of isomers of lactic acid from the fermentation of carbohydrates. Atypical LAB are distinct due their inability to grow on acetate agar at pH 5.6, while being able to produce virtually pure L(+)-lactic acid from glucose and, their ability to ferment both glycerol and mannitol, properties that are unusual in lactobacilli (Holzapfel and Gerber, 1983; Shaw and Harding, 1984).

The name, *Lactobacillus piscicola* spp. nov., was first proposed for a group of 17 bacterial strains that were isolated from stressed rainbow trout (*Salmo gairdneri*), cutthroat trout (*Salmo clarki*) and Chinook salmon (*Oncorhynchus tshawytscha*) (Hiu *et al.*, 1984). The characteristics of the isolates from these fish best matched the description of the genus

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[1] Modeled after that described in section 201(s) of the Federal Food, Drug and Cosmetic Act, As Amended. See also attachments (*curriculum vitae*) documenting the expertise of the Panel members.
[2] Comminute = Reduce to small pieces or particles by pounding or abrading.
[3] Inoculation = Use of a small amount of biological material to initiate a microbial culture.

Lactobacillus. They were, however, genetically distinct from other members of the genus, and differed in their fermentation patterns and natural habitat (associated with fish). Therefore, the name *Lactobacillus piscicola* [(pis.ci' co.la. L.n. *piscis* fish; L. suff *–cola* dweller; M.L. n. *piscicola* fish (dweller)] was proposed.

L. piscicola, as well as *L. divergens,* and *L. carnis* and others, were found to possess a number of properties that were different from normal lactobacilli. These properties included the ability to grow at pH 9.5, resistance to thallous acetate, antibiotic resistance, specific vitamin requirements and, the aforementioned inability of *L. piscicola, L. divergens* and *L. carnis* to grow on acetate agar (Collins *et al.*, 1987; Rogosa *et al.*, 1951; Stiles and Holzapfel, 1997). *Lactobacillus* species were also shown to possess predominantly straight-chain, saturated and mono-unsaturated fatty acids, with the predominant $C_{18:1}$ isomer synthesized as *cis*-vaccenic acid in their cell membranes (Turujmaqn *et al.*, 1974; Uchida and Mogi, 1973; Veerkamp, 1971).

However, Collins *et al.* (1987) reported that *L. piscicola, L. divergens* and *L. carnis* synthesize the major $C_{18:1}$ isomer as oleic acid ($\Delta_{9,10}$), indicative of a different unsaturated fatty acid synthase pathway. Genetic homology classifications and chemical as well as physical characteristics also placed *L. piscicola, L. carnis* and *L. divergens* in the same DNA homology group. In addition, biochemical and chemical data indicated that *L. piscicola* and *L. carnis* should be (and were) reduced to the same species, *L. piscicola*. *L. piscicola*, along with *L. divergens,* were then re-classified into a new genus, *Carnobacterium* (L. gen. N. *carnis*, of flesh; Gr. dim. n. *bakterion*, a small rod; M.L. neut. N. *Carnobacterium*, flesh rodlet) by Collins *et al.* (1987). This was further substantiated when a 16S rRNA sequence analysis demonstrated that the *Carnobacterium* genus forms a distinct phylogenetic clade[4] within the lactic acid bacteria and included *C. funditum*, *C. alterfunditum*, *C. gallinarum* and *C. mobile* (Table 1), with *Lactobacillus maltaromaticus* further defined as an objective synonym of *Carnobacterium piscicola* (Miller *et al.*, 1974; Collins *et al.*, 1991; Lai and Manchester, 2000; Lai *et al.*, 2004). In addition, although the *Carnobacterium* spp. were originally classified with the lactobacilli, phylogenetically the genus is more closely related to the genera *Enterococcus* and *Vagococcus* (Hiu *et al.*, 1984).

Recently, phenotypic and genetic characterizations of *Lactobacillus maltaromicus* strains DSM 20342^T, DSM 20344 and JCM1154 determined that these strains also belonged in the genus *Carnobacterium*. Further comparison with *C. piscicola* resulted in the decision that these two species should be considered synonymous. As a result, *C. piscicola* was reclassified as *Carnobacterium maltaromaticum* comb. nov. (Collins *et al.*, 1991; Mora *et al.*, 2003). Therefore, the common name of *Carnobacterium maltaromaticum* will be used for this GRAS determination.

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[4] Clade = A group of biological taxa or species that share features inherited from a common ancestor.

Table 1. *Carnobacterium* species, their relationship to previously described bacteria and their habitat (Collins *et al.*, 1987; Collins *et al.*, 1991; Mora *et al.*, 2003).

Current nomenclature	Previous nomenclature	Habitat
C. divergens	*L. divergens*	Meat, poultry, surface of ripened mold cheeses
C. gallinarum		Poultry
C. mobile		Poultry
*C. maltaromaticum**	*L. piscicola* *L. carnis* *L. maltaromicus*	Meat, poultry or salmonid fish
C. funditum		Antarctic lake
C. alterfunditum		Antarctic lake

*Proposed as *C. maltaromicus* (Collins *et al.*, 1991) and *C. maltaromaticum* (Mora *et al.*, 2003); *C.* = *Carnobacterium*; *L.* = *Lactobacillus.*

2. Identity and Characteristics of *Carnobacterium maltaromaticum*

Naturally-occurring *C. maltaromaticum* historically belongs to a group of LAB that metabolize glucose heterofermentatively to produce equimolar amounts of lactic acid, carbon dioxide, ethanol and acetic acid from sugars and was previously included in the genus *Lactobacillus* (Stanier *et al.*, 1957; Hiu *et al.*, 1984). Although some research has indicated that *Carnobacterium* spp. are homofermentative for L-lactate [with acetate, formate and CO_2 being produced as end-products of some secondary decarboxylation/dissimilation reactions of pyruvate (Hiu *et al.*, 1984; De Bruyn *et al.*, 1988)], the most recent description and characterization of *C. maltaromaticum* states that L(+)-lactic acid, ethanol and acetate are produced heterofermentatively (Mora *et al.*, 2003). Therefore, for this GRAS determination *C. maltaromaticum* has been characterized as having heterofermentative properties. *C. maltaromaticum* was found frequently in fish that had suffered some form of stress, such as that which occurs at spawning or with handling (Hiu *et al.*, 1984; Baya *et al.*, 1991). *C. maltaromaticum* has also been found by Ringo *et al.* (2000) to be associated with the digestive tract of the Atlantic salmon (*Salmo salar* L.). Carnobacteria have been isolated from refrigerated, vacuum-packaged fish and unprocessed beef and lamb, where it was among the predominant bacteria on the meats (Ahn and Stiles, 1990a; Baya *et al.*, 1991; Barakat *et al.*, 2000; Carr *et al.*, 2002; Paludan-Muller *et al.*, 1998; Sakala *et al.*, 2002; Yamazaki *et al.*, 2003). The methods used in these studies did not enrich or select for any specific bacterial class or species.

A biochemical and physiological comparison between *C. divergens* and *C. maltaromaticum* is given in (Table 2). *C. maltaromaticum* strain B270^T was described as having the following characteristics (Hiu *et al.*, 1984; Collins *et al.*, 1987):

- Gram-positive, non-motile, non-sporeforming rods that occur singly and in short chains;
- Grows well on many standard laboratory media, including TSA and Brain Heart Infusion agar and in deMan, Rogosa and Sharpe (MRS) broth and thioglycolate broth[5];
- Colonies are pinpoint, convex, white, circular and nonpigmented when grown at 25°C for 24h on TSA;
- Temperature range for growth is 6°C to 40°C; optimum temperature is approximately 30°C;
- Optimum pH range is from 6.0 to 7.0;
- Facultatively anaerobic. D, L-lactate is produced homofermentatively, but the species may exhibit heterofermentative properties under certain conditions; lactic acid production is enhanced under anaerobic growth conditions;
- Folic acid, riboflavin, panthothenate and niacin are required for growth; vitamin B_{12}, biotin, thiamine and pyridoxal are not required;
- Catalase and oxidase are not produced;
- Nitrate is not reduced to nitrite;
- Gas production is variable (depending on substrate) and frequently negative; gas production from glucose in arginine-MRS broth;
- Acid is produced from glycerol, ribose, galactose, gluconate, glucose, fructose, mannose, mannitol, *N*-acetyl glucosamine, amygdalin, arbutine, salicin, cellobiose, sucrose and trehalose; acid is not produced from arabinose, xylose, sorbose, rhamnose, dulcitol, inositol, methyl-D-mannoside, inulin or melezitose;
- Arginine and esculin are hydrolyzed;
- H_2S is not detected in TSI[6] slants;
- Resistant to 0.4 and 0.6% Teepol;
- Cell wall peptidoglycan contains diaminopimelic acid;
- DNA G+C content is 33.7-36.4 mol%;
- Major cellular fatty acids are of the straight-chain saturated and mono-unsaturated types with myristic, palmitic, palmitoleic and $\Delta_{9,10}$-oleic acids predominating;
- The type strain is B270^T (ATCC 35586), isolated in 1970 from a stressed adult cutthroat trout reared at Bandon Trout Hatchery in Coos County, Oregon.

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[5] MRS = Lactobacilli de Man-Rogosa-Sharpe broth; TSA = Trypticase Soy Agar.

[6] TSI = Triple Sugar Iron Agar.

Table 2. Biochemical and physiological comparison of the *Carnobacterium* species[1].

Characteristic	*C. divergens*	*C. maltaromaticum*[2]
Acid produced from[3]:		
Amidon	-	-
Amygdalin	+	+
Galactose	-	+
β-Gentiobiose	+	+
Gluconate	+(-)[4]	+
Inulin	-	+
Mannitol	-	+
Melibiose	-	+
Melezitose	+(-)	+(-)
α-Methyl-D-glucoside	-	+
α -Methyl-D-mannoside	-	+
D-Tagatose	-	+(-)
D-Turanose	-	-
D-Xylose	-	-
Voges-Proskauer[5]	+	+
Motility	-	-
Δ9,10-Methyleneoctadecanoic acid[6]	+	-

[1]Adapted from (Collins *et al.*, 1987). [2]Previously designated as *Lactobacillus piscicola* and *Carnobacterium piscicola*; [3]Reading performed at seven days. [4]+(-) = Occasional strain negative; [5]Glucose metabolism test performed on API 10E system; both strains produced arginine dihydrolase and β-galactosidase; both strains were negative for lysine decarboxylase, tryptophan desaminase, urease, ornithine decarboxylase, indole and H_2S; [6]Greater than 15% of total cellular fatty acids.

Alkaline pH (up to pH 9.5) promotes the growth of *Carnobacterium* colonies, while inhibiting other *Lactobacillus* species. Differentiation of *C. maltaromaticum* from other bacteria may be accomplished by modification of growth substrates. Differentiation of *C. maltaromaticum* from the enterococci includes microscopic distinction of rods *vs.* cocci and growing on Cresol Red Thallous Acetate Sucrose (CTAS) medium containing 2% inulin instead of sucrose. Enterococci are not able to ferment inulin, while *C. maltaromaticum* ferments inulin, forming yellowish to pinkish colonies with a metallic bronze sheen, a yellow color change of the medium and a clearance of precipitate. *C. maltaromaticum* forms an umbolate or *beta*-type colony when inosine is substituted for sucrose in CTAS Agar. The enterococci also produce a yellowing of the medium and a clearing of the precipitate, but do not have a metallic sheen (Carr *et al.*, 2002). Different strains of *C. maltaromaticum* have been shown to produce bacteriocins[7] that inhibit the growth of *Lactobacillus*, *Listeria* and other *Carnobacterium* species (McMullen and Stiles, 1996; Duffes *et al.*, 1999c; Schillinger *et al.*, 1993).

[7] Bacteriocins = Ribosomally synthesized, low molecular weight, antibacterial, proteinaceous materials that are able to inhibit the growth or kill closely related bacteria.

Three strains of *C. maltaromaticum* (V1, SF668, NCDO2762) have been tested for antibiotic resistance to 37 antibiotics and found to be resistant to cephalosporin (first, second and third generation), clindamycin, nalidixic acid, fosfomycin and aminosides (Duffes *et al.*, 1999b). In general, most antibiotics are directly (or indirectly) derived from chemicals produced from common bacteria that have a "natural" defense towards other bacteria. Consequently, bacteria develop resistance to these antibiotics. The profile of resistance or sensitivity to various chemotherapeutic drugs can be useful in the characterization of specific bacterial species (Antibiogram Committee of the French Society for Microbiology, 1998; Baya *et al.*, 1991; Duffes *et al.*, 1999b; Euzeby, 2004, Vescovo *et al.*, 1982). As an example, *Lactobacillus* species have been accepted as nonpathogenic, commensal[8] bacteria that have a reputation as health promoters in the human gastrointestinal and female urogenital tracts (Charteris *et al.*, 1998). Forty-six *Lactobacillus* strains evenly divided between isolates derived from human and dairy sources (including commercial sources), were tested for antibiotic resistance to 44 antibiotics (Charteris *et al.*, 1998). The *Lactobacillus* strains were found to exhibit resistance to 14 antibiotics, including inhibitors of cell wall synthesis (vancomycin, cefoxitin and aztreonam), nucleic acid synthesis (sulphamethoxazole, trimethoprim, co-trimoxazole and metronidazole), protein synthesis (fusidic acid, amikacin, gentamycin, kanamycin and streptomycin) and cytoplasmic membrane function (polymyxin B and colistin sulphate). Danielsen and Wind (2003) determined the level of susceptibility of *Lactobacillus* spp. to various antimicrobial agents utilizing the Etest (ABBiodisk, Stockholm, Sweden) kit. Most of the 62 *Lactobacillus* strains screened had minimum inhibitory concentrations (MICs) above the maximum value of the Etest strip, for 13 of the 25 antimicrobial agents utilized, which the authors indicated as a high natural resistance. The antibmicrobial agents were bacitracin, cefoxitin, ciprofloxacin, fusidic acid, kanamycin, metronidazole, nitrofuratoin, norfloxacin, streptomycin, sulphadiazine, teicoplanin, trimethoprim/sulphamethoxazole and vancomycin.

The strains specified in this GRAS document (*e.g.*, *Carnobacterium maltaromaticum* strains CB1, CB2, CB3, LV17, UAL26, ATCC 35586 AND ATCC43225) have been tested for their resistance to 27 antibiotics (Table 3; Griffiths Labs, 2004). Overall, the *C. maltaromaticum* strains tested were sensitive to amoxicillin + clavulanic acid, chloramphenicol, ciprofloxacin, erythromycin, gentamicin, imipenem, netilmicin, rifampin, tetracycline and tobramycin. In viewing the antibiotic resistance profiles (Table 3), the *Carnobacterium* strains are sensitive to those major antibiotics that are commonly associated with transferable genetic elements in gram-positive commensal bacteria; specifically, erythromycin, chloramphenicol and tetracycline. Borriello *et al.* (2003) suggested that when used as probiotics, selected strains should be susceptible to greater than two major antibiotics. A comparison with the antibiotics used by Baya *et al.* (1991), Duffes *et al.*, (1999b) or Euzeby (2004) indicate that the sensitivity of the *C. maltaromaticum* strains (CB1, CB2, CB3, LV17, UAL26, ATCC 35586 and ATCC43225) to various antibiotics correlate well with antibiotic resistance found in *C. maltaromaticum* strains isolated from natural fish sources, as noted in Table 3. The antibiotic resistance profile for the *C. maltaromaticum* strains specified in this GRAS dossier correlate well with the antibiotic resistance profiles of *Lactobacillus* species already being added to food or found in food naturally. This indicates that the addition of these strains of *C. maltaromaticum* to foods would

[8] Of, relating to, or characterized by a symbiotic relationship in which one species is benefited while the other is unaffected.

not be adding any new or significant antibiotic resistance determinants that are not normally found in commensals or probiotic lactobacilli.

Table 3. Antibiotic resistance profile of specific strains of *C. maltaromaticum* (Griffith Labs, 2004).

Antibiotic	CB1	CB2	CB3	LV17	UAL26	ATCC 35586	ATCC 43225	Baya *et al.*, 1991	Euzby, 2004	Duffes *et al.*, 1999b
Amikacin	R	R	R	I	R	R	R			R
Amoxicillin + clavulanic acid	S	S	S	S	R	R	S			S
Aztreonam	R	R	R	R	R	R	R			R
Cefepime	R	R	R	R	R	R	R			R
Cefotaxim	R	R	R	R	R	R	R			R
Cefoxitin	P	P	P	P	P	P	P			R
Ceftazidime	R	R	R	R	R	R	R			R
Cefuroxime	R	R	R	R	R	R	R			R
Chloramphenicol	I	I	S	S	I	S	S	R	S	S
Ciprofloxacin	I	S	S	S	I	S	S			S
Clindamycin	R	R	R	R	R	R	R			R
Colistin	R	R	R	R	R	R	R			R
Erythromycin	I	I	S	I	I	I	I	S	R	S
Gentamicin	I	R	S	I	R	S	I	R		R
Imipenem	S	S	S	S	S	S	S			S
Kanamycin	R	R	I	R	R	I	R	R		R
Minocycline	P	P	P	P	P	P	P			
Moxolactam	P	P	P	P	P	P	P			R
Nalidixic acid	R	R	R	R	R	R	R	R		R
Netilmicin	I	S	S	S	I	S	S			
Piperacillin	R	R	R	R	R	R	R			S
Rifampin	I	I	S	S	I	S	S			S
Streptomycin	R	R	R	R	R	R	R		R	R
Tetracycline	S	I	S	I	I	S	S	S	S	S
Ticarcillin	R	R	R	R	R	R	R			S
Tobramycin	S	S	S	S	S	S	S			R
Vancomycin	R	S	R	S	R	R	R			S

I = Intermediate; P = Pending; R = Resistant; S = Sensitive

3. Natural Occurrence of Bacteria in Food

3.1. Occurrence and use of Lactic Acid Bacteria in Food

Using direct-plating methods to identify bacteriocin-producing LAB isolates from meat and meat products, milk and dairy products, vegetables, fruit and seafoods, a total of 663,533 colonies from 72 food samples (32 milk and dairy, 40 meat) were examined for bacteriocin-production (Coventry *et al.*, 1997). Many of these food samples were judged to have exceeded an acceptable shelf life. A total of 15% of the meat and meat products yielded bacteriocin-producing *Carnobacterium* spp. Of the 72 food samples investigated, 44% yielded bacteriocin-producing bacteria. From the total 663,533 colonies tested, 80,992 colonies (12.2%) were found to be *Carnobacterium* spp., with 0.15% of those producing bacteriocins. The antibacterial activities of filter-sterilized culture supernatant fluids from select strains of the bacteriocin-producers were not affected by catalase, lipase or lysozyme, but were either completely or partially inactivated by at least one of the proteolytic enzymes, indicating that antibacterial activity was associated with proteinaceous substances. This study also shows that humans are already being exposed to *Carnobacterium* spp. and other food-borne bacteria that produce bacteriocins.

Amezquita and Brashears (2002) report the isolation of 49 strains of LAB from commercially available ready-to-eat (RTE) meat products. These were screened for their ability to inhibit the growth of *Listeria monocytogenes* at 5°C on agar spot tests. *Pediococcus acidilactici*, *Lactobacillus casei* and *L. paracasei* were identified as the three species with the greatest inhibitory activity. There was significant inhibition ($P<0.05$) of the growth of *L. monocytogenes* in all of the RTE meat products evaluated (five commercial samples of cooked ham and five commercial samples of frankfurters), when three selected strains of *Pediococcus acidilactici*, *Lactobacillus casei* and *L. paracasei* were added to the RTE meat products. This study showed that select strains of LAB can be isolated from RTE meat products and these strains effectively inhibit the growth of *L. monocytogenes* in frankfurters and cooked ham at 5°C over 28 days of storage. During the time of storage, the numbers of LAB increased by only approximately 1 log cycle and no visible signs of spoilage were evident (*e.g.,* detrimental effect on some organoleptic properties related to external appearance such as color changes, undesirable aromas and stickiness or texture changes) on the surface of the products.

A study was recently conducted by Sakala *et al.* (2002) to investigate the psychrotrophic[9] spoilage microflora on refrigerator-stored, vacuum-packaged beef. This study utilized a less selective glucose-blood-liver agar and Trypticase Soy Agar plating method (allowing for the widest range of bacterial growth) at an incubation temperature of 7°C. Various psychrotrophic species on vacuum packaged beef stored at refrigeration temperatures were identified and quantified over a six-week period to determine alterations in the bacterial species or quantities of the bacteria. Five fresh beef cut samples (acquired and vacuum-packaged approximately 48 hours after slaughter) were utilized to determine the types and quantities of the various bacteria

[9] Psychrotrophic = Bacteria which are able to grow at refrigeration temperatures, but grow optimally at temperatures above 20°C.

found in vacuum-packaged beef. A total of 1493 bacterial strains were identified as: *Brochothrix thermosphacta* (64), *Carnobacterium maltaromaticum* (27), *C. divergens* (79), *Lactobacillus algidus* (637), *Lactobacillus* spp. (4), *Lactococcus piscium* (270), *Leuconostoc gelidum* (375), *Acinetobacter* (3), *Aeromonas* (1), *Bacillus* (10), *Corynebacterium* (3), *Enterobacteriaceae* (1), *Pseudomonas* (13) and *Psychrobacter* (6). *L. gelidum*, *L. piscium* and *L. algidus* increased during the first three weeks of storage from approximately $5x10^3$ cfu/g to approximately $1x10^8$ cfu/g, and remained stable for the rest of the six-week study. *C. maltaromaticum* was inconsistently detected, but when present increased to approximately $5x10^7$ cfu/g during the first three weeks of storage and remained at that level for the last three weeks of the study. Vacuum or modified atmosphere (CO_2) packaging (CO_2-MAP) influences the bacterial species isolated from meat (Labadie, 1999). At low temperatures and with a limited amount of oxygen, LAB comprise the predominant bacterial population of CO_2-MAP packaged meat, at approximately $1x10^7$ cfu/cm^2 (Gill and Newton, 1978). There have been no studies directly comparing the specific quantities of different species of *Lactobacillus*, *Leuconostoc* and *Carnobacterium* on freshly packaged meat under CO_2-MAP conditions. Nilsson *et al.* (1999) isolated $2x10^4$ and $5x10^7$ cfu/g LAB from cold-smoked salmon at the time of purchase and after thirty-two days of incubation, respectively.

3.2. Natural Occurrence of *Carnobacterium maltaromaticum* on Meat, Fish and Cheese Products

Carnobacterium species have been isolated from vacuum-packaged meat, fish and French soft cheese (Ahn and Stiles, 1990a; Buchanan and Klawitter, 1992b; Stoffels *et al.*, 1992; Pilet *et al.*, 1995; Milliere and Lefebvre, 1994a; Milliere *et al.*, 1994b), as summarized in Table 4. A study by Lewus *et al.* (1991) identified two bacteriocin-producing strains of *C. maltaromaticum* from different parts of meat from retail meat products. Other *C. maltaromaticum* strains have been isolated from fish, meat and cheese (Milliere *et al.*, 1994b; Nissen *et al.*, 1994; Pilet *et al.*, 1995; Schillinger *et al.*, 1993; Shaw and Harding, 1984). Leisner *et al.* (1994) found that eighteen of the 80 strains of bacteria originally isolated from vacuum-packed halibut, salmon or mackerel were lactic acid bacteria. Of these, 28% were identified as *C. maltaromaticum.*

Sakala *et al.* (2002) conducted a study to investigate the psychrotrophic spoilage microflora on chill-stored vacuum-packaged beef and determined that out of a total of 1493 strains isolated from five fresh beef cut samples (each from a different meat shop), twenty-seven were identified as *C. maltaromaticum.* This bacterium was detected at 0, 1, 3, 5 and 6 weeks of storage at mean numbers of $2x10^3$, $2x10^4$, $2.5x10^6$, $1x10^7$ and $2.5x10^7$ cfu/g, respectively, for two samples positive for *C. maltaromaticum* and, persisted at the level of approximately $5x10^7$ cfu/g during the last three weeks of the six-week storage period.

The growth of *C. maltaromaticum* in fermented meat products has been noted by Montel (1999), who noted "At the end of the fermentation period, lactic acid bacteria are generally the dominant bacterial flora. The species *Lactobacillus curvatus*, *L. sakei*, *L. plantarum*, *L. viridescens*, *Carnobacterium divergens*, *C. maltaromaticum* and *Leuconostoc* are present naturally, but *Pediococcus* is only found when inoculated as a starter culture. Their count

generally exceeds 10^6 cfu/g and remains at this level during the whole ripening period. *Carnobacterium* is present during the fermentation period, but disappears afterwards."

Table 4. Isolation of *C. maltaromaticum* from food products.

Food Category	Food Product	*C. maltaromaticum* strain*	Reference
Fish	Cultured striped bass, channel catfish and bullhead catfish		(Baya *et al.*, 1991)
	Cold-smoked freshwater fish		(Gonzalez-Rodriguez *et al.*, 2002)
	Salmonid fish		(Hiu *et al.*, 1984)
	Cold-smoked salmon		(Leroi *et al.*, 1998)
	Vacuum-packaged halibut, salmon or mackerel		(Leisner *et al.*, 1994)
	Cold-smoked salmon	A9a, A9b, A9c, A9J, A10a, A10b, A10f, A10J, S1, S2, S3, S4	(Paludan-Muller *et al.*, 1998)
	Fish	V1	(Pilet *et al.*, 1995)
Beef	Vacuum-packaged beef		(Ahn and Stiles, 1990a)
	Raw ground beef		(Buchanan and Klawitter, 1992A)
	Meat	GN, DX	(Lewus *et al.*, 1991)
	Vacuum-packaged beef		(Sakala *et al.*, 2002)
	Meat	LV 61	(Shaw and Harding, 1984)
Lamb	Modified atmosphere-packaged lamb		(Nissen *et al.*, 1994)
Chicken	Modified atmosphere-packaged chicken legs		(Barakat *et al.*, 2000)
	Poultry		(Collins *et al.*, 1987)
Dairy	Soft cheeses	CP5	(Milliere *et al.*, 1994B)

* = Strain given, if known.

Cold-smoked salmon (CSS) is an extremely perishable food product and is highly susceptible to contamination with *Listeria monocytogenes*. CSS spoilage is primarily due to microbial activity during refrigerated storage (Duffes, 1999a). For CSS, it has been estimated that immediately after packing, bacterial counts range from $1x10^3$ to $1x10^4$ cfu/g with a predominance of Gram-negative bacteria (64%) such as *Shewanella putrefaciens* and *Aeromonas* spp. LAB were found to be present (32%), with the majority being *Carnobacterium* spp. (Donald and Gibson, 1992; Huss *et al.*, 1995). At 8°C, the level of bacterial flora increased to $1x10^7 - 1x10^8$ cfu/g over three weeks, with a shift in relative bacterial populations such that LAB predominate (60%), mainly as *Carnobacterium* spp. (47%) and *Lactobacillus* spp. (13%).

Paludan-Muller *et al.* (1998) reported a series of studies that evaluated the role of *C. maltaromaticum* in spoilage of vacuum- and modified-atmosphere-packed cold-smoked salmon stored at 5°C. A mixture of LAB and Gram-negative bacteria are usually found on spoiled CSS. Initial numbers of bacteria were low with total psychrotrophic counts less than $5x10^3$ cfu/g and, specifically, LAB counts of $10 - 1x10^2$ cfu/g. In addition, it was determined (by sensory

evaluation) that the shelf life of vacuum-packed cold-smoked salmon peaked at four weeks at 5°C. The microflora at four weeks was composed of LAB ($1x10^6$ – $1x10^7$ cfu/g) with Gram-negative flora at varying levels ($1x10^5$ – $1x10^7$ cfu/g).

Modified-atmosphere packaging reduced the growth of Gram-negative bacteria and selected specifically for LAB, although growth of LAB was below $3x10^5$ cfu/g during five weeks of storage (Paludan-Muller *et al.*, 1998). The LAB microflora was dominated by *C. maltaromaticum*, accounting for 87% of the 255 LAB isolates characterized. The spoilage potential of *C. maltaromaticum* was further studied by inoculation of approximately $1x10^6$ cfu *C. maltaromaticum per* gram in CSS stored at 5°C (Paludan-Muller *et al.*, 1998). In vacuum-packed salmon inoculated with *C. maltaromaticum* strains, LAB counts reached $1x10^7$ cfu/g after only one week of storage and the level was above $1x10^8$ cfu/g for the rest of the storage period. However, after four weeks of storage, the salmon was not rejected by a sensory taste panel, while the vacuum-packed control was rejected after four to five weeks. In inoculated modified-atmosphere-packed salmon, the LAB counts reached final levels of $1x10^6$ – $1x10^7$ cfu/g after two weeks, but the salmon was not sensory-rejected until four to five weeks of storage. It was concluded that the growth of *C. maltaromaticum* even at high numbers ($1x10^7$ – $1x10^8$ cfu/g) for several weeks did not accelerate the spoilage process of packed cold-smoked salmon.

A bacterial study on the composition of the psychrotrophic and mesophilic flora of French surface-mold-ripened soft cheeses made from raw cow's milk found that *C. maltaromaticum* was the dominant bacteria at the end of ripening on five samples of Brie cheese (Milliere and Lefebvre, 1994a). *C. maltaromaticum* bacteria was also isolated from Coulommiers, Camember, Pon-l'Eveue and Munster cheeses. The number of *Carnobacterium* colonies isolated from these cheeses ranged from 5×10^5 to 8×10^8 cfu/g in the various cheese samples. Milliere *et al.* (1994b) went on to characterize *C. maltaromaticum* strains isolated from five samples of Brie cheese. The pH values of the cheeses were between 6.8 and 7.6 and no off-odors or organoleptic defects were noted. The *Carnobacterium* species were dominant in the cheese samples, at between 1×10^8 and 1×10^9 cfu/g. The results of DNA-DNA hybridizations indicated that 33 of the 36 isolates were of the *C. maltaromaticum* species, while the remaining three (all picked from the same sample) were *C. divergens*.

To summarize, *Carnobacterium* spp. are common components of the microflora on vacuum-packaged meat, poultry, fish and cheese products and in some cases, they can represent a predominant constituent population, reaching levels of $1x10^8$ cfu/g or higher, on products such as smoked fish, chicken, beef and cheese, without being considered spoilage organisms.

4. Production of Carnobacterium maltaromaticum Culture

4.1. Culture Collection

C. maltaromaticum strains are maintained in lyophilized form under vacuum at 4°C, or as frozen cultures in 20% (v/v) glycerol at –80°C. API® strip analysis (a kit for identification of bacteria to the species level) is conducted to ensure viability and strain purity will be confirmed by the absence of bacteriological contamination and/or by random amplified polymorphic DNA (RAPD) and microbiological analysis. Seven lyophilized vials are prepared for each strain

(master seed). From a single vial of the master seed, 15 lyophilized vials are prepared under vacuum and stored at 4°C (secondary seed). From each vial of the secondary seed, enough frozen vials are prepared for one year's production requirements and stored at –80°C. One out of every 10 vials undergoes microbiological testing to confirm strain purity and the absence of bacteriological contamination. A process control flow chart for the production of *C. maltaromaticum* is given in Appendix A.

4.2. Seed and Mother Culture

The seed culture is prepared by transferring a loop full of frozen master seed or a vial of lyophilized culture to 10 ml All Purpose Tween (APT). The seed is then grown overnight. The mother culture is prepared from the seed culture by transferring the seed culture (grown overnight) into 6L of APT medium and incubated again overnight.

4.3. Fermentation and Concentration

The mother culture is aseptically transferred to the production fermentor, which contains Griffith CB medium and was maintained at 25°C. The fermentation is monitored spectrophotometrically (650 nm) and by plating onto APT agar until a cell density of approximately 10^9 cfu is reached. An aliquot (aliquot A) of the fermented CB medium (containing *C. maltaromaticum*) is pasteurized. Maltodextrin[10] is added to the pasteurized culture and the resulting slurry was mixed for five minutes to ensure homogeneity. Maltodextrin is added to the remaining aliquot (aliquot B) of the fermented CB medium (which contained viable *C. maltaromaticum*). Aliquot B is then mixed for five minutes to ensure homogeneity. Aliquot A is utilized to dilute the viable *C. maltaromaticum* culture (Aliquot B) to the required bacterial concentration for delivery to meat products.

4.4. Lyophilization

Aliquots A and B are separately aliquoted onto stainless steel trays. Once frozen, the trays are placed under vacuum. The resulting lyophilized material is scraped from the trays, ground and milled, and placed into polyethylene bags and double-bagged prior to refrigeration (4-8°C).

4.5. Microbiological Analysis

The lyophilized pasteurized cell fraction (aliquot A) and the lyophilized live cell fraction (aliquot B) is analyzed microbiologically for total lactic acid bacteria, non lactic acid bacteria, yeast, molds, total coliforms, *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* spp. (Table 5). If the results meet specifications, the lot is approved for release; otherwise, the lot is placed in a holding section for review by the Non-Conforming Material committee. If the material is deemed outside specification limits, Quality Assurance personnel will place a tag on the container documenting all appropriate product information, date and the reason for the non-conformance. If the viable *Carnobacterium* count is outside specifications, the product will be re-blended to meet the required specifications. A deviation for high moisture content will result in further drying in order to meet specifications. If the product does not meet the microbiological specifications for Salmonella, *E. coli*, *S. aureus*, total coliforms, yeasts or molds, the product will be denatured by the addition of a 200 ppm solution of sodium hypochlorite.

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[10] Maltodextrin = A manufacturing aid (*i.e.*, excipient) for freeze drying.

Autoclaving may be used as an alternative to hypochlorite denaturing. The product will then be disposed of, as applicable to the jurisdiction of the manufacturing facility.

To determine shelf life stability, triplicate vials of the cell culture, previously stored at 30°C, 45°C or 60°C, will be withdrawn from each storage temperature and a viable cell count determined on All Purpose Tween (APT) agar by serial dilution. The Log cell count will be plotted for each temperature and the linear regression of each line will be determined. The linear regression equation for each temperature will be used to determine the time to take to reach the minimum viable bacterial count for each vial, from which one can determine the shelf life of the bacterial culture at any given temperature.

Table 5. Specifications of *Carnobacterium maltaromaticum* lyophilized bacterial powder.

Active Ingredients	*Carnobacterium maltaromaticum*	
Excipients	Maltodextrin	
Shelf Life	> one year	
Storage Conditions	Room Temperature (22°C)	
Physical Aspects	**Specifications**	**Method**
Appearance	Pass	Visual inspection APT plate and comparison to standard plate photograph and description
Concentration	Between $3.2x10^6$/g and $3.2x10^7$ viable cells/g	A.P.H.A./USP
Residual moisture	<5%	O'Haus
Microbiological Specifications		
Lactic Acid Bacteria	Between $3.2x10^6$/g and $3.2x10^7$ cfu/g or between $1.3x10^9$ and $1.4x10^{10}$ cfu/package	A.P.H.A./USP
Non Lactic acid bacteria	<100/g	A.P.H.A./USP
Yeasts	<100/g	A.P.H.A./USP
Molds	<100/g	A.P.H.A./USP
Anaerobic Spore Forming Bacteria	<10/g	A.P.H.A./USP
Clostridium botulinum	Absent *per* 50 g	A.P.H.A./USP
Total coli forms	<10/g	A.P.H.A./USP
Staphylococcus aureus	<100/g	A.P.H.A./USP
E. coli	Absent *per* 25 g	A.P.H.A./USP
***Salmonella* spp.**	Absent *per* g	A.P.H.A./USP

A.P.H.A. = American Public Health Association; USP = U.S. Pharmacopoeia

4.6. Reconstitution of Starter Culture

Standardization of viable cell numbers will be achieved by blending a portion of the lyophilized pasteurized cell fraction (aliquot A) with a portion of the lyophilized live cell fraction (aliquot B) of viable *C. maltaromaticum* cells, to obtain between $3.2x10^6$ and $3.2x10^7$ cfu/g. The standardized viable cell blend will be packaged into plastic foil film packages, flushed with nitrogen and package weight will be customized to the finished product application such that between 10^3 and 10^4 viable *C. maltaromaticum* cells *per* gram of finished product will be achieved. The packages will then be stored at ambient temperature.

The packaged standardized viable cell blend will be analyzed microbiologically for identity, total lactic acid bacteria, non lactic acid bacteria, yeast, molds, total coliforms, *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* spp. (Table 5). If the results of the microbiological testing meet specifications, the lot is approved for release; otherwise, the lot will be placed in a holding section for review by the Non-Conforming Material committee. If the viable *Carnobacterium* count is outside of specifications, the product will be re-blended to meet the required specifications. A deviation for high moisture content will result in further drying in order to meet specifications. If the product does not meet the microbiological specifications for *Salmonella*, *E. coli*, *S. aureus*, total coliforms, yeasts or molds, the product will be denatured by the addition of 200 ppm sodium hypochlorite or autoclaved and then disposed of, as applicable to the jurisdiction of the manufacturing facility.

A dose of reconstituted *C. maltaromaticum*, containing one or more of strains CB1, CB2, CB3, LV17, UAL26, ATCC 35586 or ATCC 43225 (approximately $1x10^3$ to $1x10^4$ cfu/g of finished product) may also be added directly to ground meat prior to ingredient mixing and further grinding and stuffing into casings. The sausages would then be rapid frozen at –50°C until frozen in the center. These sausages would then be wrapped airtight in plastic wrap and kept frozen until thawed for retail sale.

5. Growth Characteristics of *Carnobacterium maltaromaticum* in Meat Products

5.1. Growth Characteristics of *Carnobacterium maltaromaticum* on Vacuum-Packaged Wieners

A laboratory-scale study was designed to investigate the growth characteristics of *C. maltaromaticum* on vacuum-packaged wieners inoculated with *C. maltaromaticum* under conditions comparable to those proposed for commercial production (Griffith Laboratories, 2002). In addition, the effects on sensory properties, such as aroma and flavor profile, were investigated and are detailed in Appendix B. The methods and results of this study were as follows:

Two strains of *C. maltaromaticum* were chosen for study: LV17 (a synonym for UAL 8) was originally isolated from vacuum-packaged, refrigerated, fresh pork and described by Shaw and Harding (1984) and, strain UAL 26, which was isolated from vacuum-packaged beef (Stiles and Holzapfel, 1997). The inoculum was prepared by adding washed bacterial cells to sterile 0.85% saline to provide an inoculum level of $2.5x10^6$ cfu/ml. Individual wieners were dipped into the inoculum suspension for one minute, drain dried and vacuum-packaged in groups of five

wieners *per* bag (high barrier, low O_2 transmission, VP bags). As a control, wieners were dipped in 0.85% sterile saline without bacterial inoculum. Treated and control samples were then placed into refrigerated (4°C) storage for up to 12 weeks. Sampling of the wieners for microbiological analyses and sensory evaluation was performed on day zero and after 2, 4, 6, 7, 8, 10 and 12 weeks of storage.

Samples were prepared for microbial analysis by cutting 1.8 cm length piece of wiener (equivalent to a surface area of 10 cm^2), placing it in a sterile tissue homogenizer bag and homogenizing. Bacterial counts were conducted by standard dilution and plating techniques and included: 1) Total aerobic plate count on Plate Count Agar incubated aerobically at 25°C, 48 hours; 2) Lactic acid bacteria on APT agar incubated anaerobically at 25°C, 48 hours; 3) *Enterobacteriaceae* on Violet Red Bile Agar with one *percent* added glucose incubated at 35°C, 18 hours. Concentrations of bacteria were reported as cfu *per* cm^2 of product (cfu/cm^2).

This study reported that sample wieners that had been inoculated with *C. maltaromaticum* strains LV17 or UAL 26 reached maximum anaerobic lactic acid bacteria (LAB) counts of 2.75×10^6 and 1.2×10^5 cfu/cm^2 after seven or eight weeks of cold storage, respectively. *C. maltaromaticum* grew at a slow rate on vacuum-packaged wieners and growth was accompanied by a relatively small decrease in surface pH during storage. LV17 varied from pH 6.2 at Week 0 to pH 6.1 at Week 10, while UAL 26 varied from an initial pH 6.2 to approximately 5.9 during Weeks 6-8 and Week 12).

It was concluded that in comparison with other lactic acid bacteria, such as *L. gelidum*, *C. maltaromaticum* is a slow-growing species when inoculated onto refrigerated (4°C), vacuum packaged wieners. The levels of *C. maltaromaticum* reached a maximum of 5×10^7 cfu/cm^2 after 12 weeks of cold storage. Based on sensory evaluations using a trained nine-member panel over the 12-week storage period, there were no significant adverse effects on aroma, off-flavors, sour intensity, or overall acceptability resulting from inoculation with *C. maltaromaticum*.

5.2. Growth Characteristics of *Carnobacterium maltaromaticum* When Inoculated into Sausages

C. maltaromaticum CB1 was added to pork in three trials as an inoculant during the production of sausages (Griffith Laboratories, 2003a, Internal Report). Odor intensity and freshness attributes for the sausages (evaluated as both raw and cooked) were treated on a 21-point line scale. Inoculum levels ranged from 1×10^3 to 1×10^5 cfu/g of meat. Bacteriological analyses were conducted on Days 0, 5, 10, 15 and 20 to assess the growth of *C. maltaromaticum* and bacteriocin production.

Chilled pork shoulder and pork fat were weighed, coarse ground and divided into four batches to which 2.76% water and 1.8% of seasoning were added. Test product was inoculated with *C. maltaromaticum* up to 10^5 cfu/g. The ground meat and ingredients were mixed, ground fine and stuffed into collagen casing (UniPac, Edmonton). The stuffed casing was cut into links 3.5-3.75 inches, to give sausages that were approximately 20.4 g/sausage. The individual sausage links were rapid frozen at –50°C for approximately 35 minutes. The frozen sausages were packaged on Styrofoam trays (approximately 10 oz *per* pack) and airtight wrapped and

sealed in plastic wrap. The samples were thawed and stored at 4°C prior to bacterial sampling. Usual manufacturing procedures for meats include the procedure of "flash freezing" meat for shipment, with subsequent thawing for sale or further processing.

Bacteriological sampling was done on samples that had been thawed and stored at 4°C for 0, 5, 10, 15 and 20 days. Duplicate 10 g samples were placed into sterile stomacher bags (VWR International) and blended with 90 ml of sterile 0.1% peptone water. Appropriate serial dilutions in 0.1% peptone water were streaked onto prepoured APT agar and MRS agar plates and incubated at 30°C for 48 h. Duplicate counts (cfu/g of meat) were recorded for each sample after the incubation period.

Over a 20 day period, total anaerobic bacterial counts on MRS agar increased from 10^3 – 10^5 cfu/g, up to 10^9 cfu/g of product. The growth of background microflora in the test product did not differ from that associated with un-inoculated samples, as evidenced by the growth on APT agar. This indicates that the inoculation of the sausage meat with C. maltaromaticum did not increase the overall incidence of bacterial growth in the sausage. The microbiology assays indicated that the total number of bacteria growing on APT and MRS agar was similar on the uninoculated control and the test products. Therefore, added *C. maltaromaticum* cultures did not increase the number of bacteria found on the test products, nor cause the meat to spoil faster than the control.

Bacteriocin production in the sausage samples was tested at Days 0, 5, 10, 15 and 20 by direct and indirect assays and was detected, indicative of bacteriocin production by the added *C. maltaromaticum*. Suppression of the indicator organism, *L. monocytogenes*, was noted by Day 10 *via* the indirect assay [portions of the sausage were heat-treated (to kill the producer organism) and directly embedded into APT agar inoculated with *L. monocytogenes* CDC 7762 (serotype 4b)], with this suppression maintained through Day 20 of the assay. The direct assay for bacteriocin production (heat-treated supernatant of a homogenized sausage was directly added to APT agar plates overlaid with the *L. monocytogenes* indicator organism) in the sausages inoculated with *C. maltaromaticum* indicated that bacteriocin production occurred by Day 15 of sausage storage at 4°C and continued through Day 20 of storage (Griffith Laboratories, 2003b, Internal Report).

6. Intended Use of the Addition of *Carnobacterium maltaromaticum* in Ready-To-Eat and Fresh Comminuted, Processed Meat Products

RTE meat and fresh comminuted, processed meat products require preservation techniques that inhibit the growth of potentially pathogenic bacteria. A deadly *Listeria monocytogenes* outbreak recently spread across the northeast US, resulting in the U.S. Food and Drug Administration and the USDA's Food Safety Inspection Service (FSIS) issuing a health advisory in September, 2003 (Morbidity and Mortality Weekly Report, 2003). Symptoms of listeriosis in healthy individuals are usually short-term and include a severe headache, high fever, abdominal pain, stiffness, nausea and diarrhea. However, in those with weakened immune systems, newborns and the elderly, listeriosis may cause mortality, while pregnant women may have an increased risk to miscarriages and stillbirths (Water Quality Health Council, 2003; Doganay,

2003). Research has indicated that the growth of *L. monocytogenes* is inhibited when co-cultured in the presence of *C. maltaromaticum*, as summarized in Appendix C. *C. maltaromaticum* is to be added to RTE meat and fresh comminuted, processed meat products to inhibit the growth of human pathogenic bacteria, such as *L. monocytogenes*, on these food products.

It is proposed that *C. maltaromaticum* will be added to vacuum- or modified atmosphere-packaged ready-to-eat (RTE) meat products and fresh comminuted, processed meat products as a means of mitigating the effects of contamination caused by human pathogenic bacteria, such as *L. monocytogenes*. During packaging of RTE meat products, such as wieners, it is proposed that a dose (approximately 1.5 ml, or $5x10^6$ cfu) of reconstituted *C. maltaromaticum* will be applied to each 454 g (1 pound) package.

An aliquot of reconstituted *C. maltaromaticum* (to deliver approximately $1x10^3$ to $1x10^4$ cfu/g) would also be added to fresh comminuted, processed meat products prior to ingredient mixing and further grinding and stuffing into casings to produce fresh comminuted, processed meat products. The fresh comminuted, processed meat products would be rapid frozen at –50°C until frozen in the center, then wrapped airtight in plastic wrap and stored frozen.

The inoculation ranges for RTE meat products and fresh comminuted, processed meat products would be approximately $1x10^3$ to $1x10^4$ viable *C. maltaromaticum* cells (cfu) *per* gram of product.

7. Exposure/Consumption Assessment

7.1. *Carnobacterium maltaromaticum* in Commercial Use

Lallemand S.A. of Toulouse, France, produces and markets a range of LAB for use in the French food industry, including sausage fermentation. *C. maltaromaticum* is among the bacterial species listed by this company for this food application. A memo from Institut Rosell (Lallemand) of Montreal, Canada, attesting to this fact, along with a page of a Lallemand S.A. product catalogue, attesting to the fact of use, have been included in Appendix D. The European Commission has made reference to the fact that Carnobacterium species have been and are used to produce fermented foods both in Europe and around the world (European Commission, 2002).

7.2. Background Exposure to *Carnobacterium maltaromaticum*

Studies have shown that lactic acid bacteria in general and, specifically *C. maltaromaticum*, are found in retail food products (modified-atmosphere packaging and refrigeration preferentially selects for anaerobic *Carnobacterium* spp.) within the expiration dates (Milliere and Lefebvre, 1994A; Kelly *et al.*, 1996; Schobitz *et al.*, 1999; Amezquita and Brashears, 2002; Sakala *et al.*, 2002). Therefore, for an accurate assessment of the numbers of *C. maltaromaticum* that could maximally be consumed, one must take into account any theoretical amount of *C. maltaromaticum* that may already be present on the proposed foods.

An extensive search of the literature resulted in two references specifically analyzing the quantity of *C. maltaromaticum* found on commercially available foods. Sakala *et al.* (2002) determined that two beef samples contained *C. maltaromaticum*. It was detected at 0, 1, 3, 5 and 6 weeks of storage (vacuum-packaged and stored at 2°C) at mean numbers of $2x10^3$, $2x10^4$, $2.5x10^6$, $1x10^7$ and $2.5x10^7$ cfu/g of meat, respectively. Montel (2000) found that at the end of the fermentation period of sausages, lactic acid bacteria were generally the dominant bacterial flora, with *C. maltaromaticum* naturally present during the fermentation period at levels of approximately $5x10^7$ cfu/g of sausage, but disappeared afterwards. Sterile cold smoked salmon inoculated with *C. maltaromaticum* at 10^4-10^5 cfu/g of salmon was found to have final counts ranging between $5x10^7$ to 10^9 cfu/g, after two to three weeks of storage at 6°C (Stohr *et al.*, 2001). Nadon *et al* (2001) showed that LAB (which included carnobacteria) increased from an initial 100 cfu/cm^2 to an average level of $1x10^6$ cfu/cm^2 for the first six weeks of storage in vacuum-packaged or carbon dioxide-controlled atmosphere-packaged (CO_2-CAP) treated pork and maintained that level of LAB for the remainder of the thirteen-week study. In the CO_2-CAP pork samples, there was no significant increase in LAB until the 11th week of storage, with a maximum level of LAB at $3.2x10^5$ cfu/cm^2. Unpublished work by Nadon *et al.* (2001) demonstrated that carnobacteria dominate the LAB microflora during storage at –1.5°C in the absence of oxygen.

Therefore, to consider the number of *C. maltaromaticum* that could "theoretically" be found on commercial food products, one could take the highest number of *C. maltaromaticum* found in foods ($5x10^7$ cfu/g of meat) and utilize this number as the amount of potentially naturally-occurring *C. maltaromaticum* found on foods (theoretical). Therefore, a consumption analysis was performed to determine the theoretical amount of *C. maltaromaticum* naturally consumed from the foods stated in Appendix E. Consumption of each food was determined from an initial two-day intake survey acquired by the USDA's Continuing Survey of Food Intakes by Individuals and a weighted average of the amount (in grams) of each food eaten was extrapolated for the US population at the time of the survey. This gram amount of each food was then multiplied by the amount of *C. maltaromaticum* added *per* gram weight and divided by the total US population to obtain a percentage of the total amount of *C. maltaromaticum* ingested, when added to the foods specified.

Theoretical maximal background consumption of *C. maltaromaticum* from the RTE and fresh comminuted, processed food products outlined above has been determined (*via* consumption analysis of the proposed foods that *C. maltaromaticum* would be added) to be $4.3x10^9$ cfu/day (Table 6). This number is based on the highest number of LAB found on commercial food products, as described above ($5x10^7$ cfu/g of meat). Therefore, the theoretical consumption of the foods to which *C. maltaromaticum* would be added would result in a background consumption of $4.3x10^9$ cfu/day.

It must be noted, however, that several studies have determined that the growth of *C. maltaromaticum* plateaus at a maximum of $1x10^9$ cfu/g of meat (a reported range of $1x10^7$ to $1x10^9$ cfu/g when grown under optimal conditions on media or sterile cuts of meat), as the growth of *C. maltaromaticum* is self-limiting, as well as limiting to the growth of other types of bacteria (Paludan-Muller *et al.*, 1998; Stohr *et al.*, 2001; Duffes *et al.*, 2000; Yamazaki *et al.*, 2003). Therefore, it can be assumed that the addition of *C. maltaromaticum* to RTE meat products is not likely to significantly add to the ingestion of these bacteria.

7.3. *Per* Capita Consumption of *Carnobacterium maltaromaticum* From Additional Exposure Due to Intended Uses

Foods included in the analysis were chosen by searching the CSFII database using descriptor words to generate a list of foods to consider for the analysis. The list of foods was reviewed by Griffith Laboratories and Burdock Group and, only those foods that represented a targeted food were selected. Foods from the CSFII database selected for the analysis and treatment with *C. maltaromaticum* are noted in Appendix E.

Per capita estimate of intake, also called the Maximum Survey-derived Daily Intake (MSDI), is based on "disappearance data" from periodic surveys of ingredient manufacturers reporting the volume of ingredients produced during the survey year. The method is easy to use because it divides the total annual production by the population in the survey year and the number of days *per* year[11]. The assumption is that there is a finite amount of substance available and the general population ingests it as an added food ingredient regardless of source at the retail level. It is also assumed in this analysis that only 10% of the population consumes the products.

The intake profile (amount and frequency) by individuals in USDA's Continuing Survey of Food Intakes by Individuals 1994-96, 98 (CSFII 1994-96, 2000) was used to calculate the estimated daily intake (EDI) of *C. maltaromaticum* for individuals consuming the food groups selected for the addition of *C. maltaromaticum per* this GRAS evaluation. Calculation of the EDI is unique in this situation; *C. maltaromaticum* is a dynamic ingredient, multiplying during the storage period. Therefore, the highest quantity of *C. maltaromaticum* that has been found to grow on commercial meats (*i.e.*, $5x10^7$ cfu/g) was used to determine the maximal possible amount of exposure to *C. maltaromaticum*, when added to RTE foods and fresh comminuted, processed meat products. The calculated EDI would be $4.3x10^9$ cfu/day, or $7.2x10^7$ cfu/kg/day for a 60 kg person (Table 6).

Therefore, summation of the potential (theoretical) natural consumption of *C. maltaromaticum* in RTE and fresh comminuted, processed meat products ($4.3x10^9$ cfu/day), with the proposed maximal addition of *C. maltaromaticum* to RTE meats ($4.3x10^9$ cfu/day for the proposed RTE and fresh comminuted, processed meat products) gives a total theoretical maximal consumption of *C. maltaromaticum* equaling $8.6x10^9$ cfu/day (Table 6). The total number of LAB found on meat and cold-smoked salmon was not found to increase after the addition of *C. maltaromaticum* (Griffiths Lab, 2003a; Leroi *et al.*, 1996; Nilsson *et al.*, 1999; Paludan-Muller *et al.*, 1998). LAB has been typically found on cold-smoked salmon at the end of the shelf-life period at levels of $10^7 - 10^9$ cfu/g (Paludan-Muller *et al.*, 1998). Therefore, the addition *C. maltaromaticum* would not significantly increase the consumption of bacteria, as *C. maltaromaticum* growth plateaus at a maximal level of $1x10^9$ cfu/g of meat.

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[11] *Per Capita* Estimate = (Number of pounds of RTE meats (as specified in Appendix E) produced / Annual U.S. population) / 365 days *per* year.

Table 6. Proposed consumption of *C. maltaromaticum* as added to RTE and fresh comminuted, processed meats.

	Theoretical maximal amount of *C. maltaromaticum* ingested	90th Percentile
Naturally occurring bacteria on RTE and fresh comminuted, processed meat products.	4.3×10^9 cfu/day	8.1×10^9 cfu/day
Addition of *C. maltaromaticum* to RTE and fresh comminuted, processed meat products.	4.3×10^9 cfu/day	8.1×10^9 cfu/day
Total number of ingested bacteria from specified RTE and fresh comminuted, processed meat products.	8.6×10^9 cfu/day	1.6×10^{10} cfu/day

cfu = colony forming units; RTE = Ready To Eat.

Addition of *C. maltaromaticum* to the fresh comminuted, processed sausage meat products (as indicated in Appendix E) would not add to the consumption of viable *C. maltaromaticum*, because adequate cooking of the products, as indicated for these products, would render the bacteria nonviable. This was confirmed in a study by Samelis *et al.* (1998) who indicated that prior to cooking, Carnobacteria (*C. divergens* and *C. maltaromaticum*) dominated the distribution of sixty strains of lactic acid bacteria isolated along the processing line and prior to the cooking of ham. *C. divergens* and *C. maltaromaticum* dominated by gradually increasing their percentage distribution from the beginning to the end of processing. The lactic acid flora contained on the ham just before cooking comprised 87% *Carnobacterium* spp. However, carnobacteria were not found on sliced or whole ham after cooking, indicating the lethality of heat treatment.

This consumption analysis has been accomplished with the assumption that the selected foods reasonably represent the proposed sources of *C. maltaromaticum* intake as an added ingredient. This analysis is considered conservative because the concentration of *C. maltaromaticum* added to each food product is based on the proposed maximum amount of *C. maltaromaticum* added *per* product.

8. Biological Toxicity and Pathogenicity

8.1. Biogenic Amine Formation

Biogenic amines are formed in foods as a result of amino acid decarboxylation catalyzed by bacterial enzymes. Histamine and tyramine, two well-characterized biogenic amines, catalyzed by several microorganisms isolated from food products, are believed to cause adverse effects in humans (Jansen *et al.*, 2003). Histamine has been noted in several fish products (pickled fish samples, crab sauce, fish paste and mackeral fish) at levels above 100 mg/kg for fish and fish products (Den Brinker *et al.*, 1995). Histamine production by bacteria in fish

products can potentially cause food poisoning symptoms similar to scombroid poisoning[12] (Leisner *et al.*, 1994; Stratton and Taylor, 1991). Leisner *et al.* (1994) noted that the *C. maltaromaticum* strains tested were not able to produce histamine, but produced tyramine.

Pharmacological and toxicological evidence indicates that tyramine injected intravenously acts mainly by an indirect mechanism of action, releasing noradrenaline from the sympathetic nervous system. Due to this systemic response, tyramine ingestion may increase blood pressure by peripheral vasoconstriction and by increasing the cardiac output. Tyramine also dilates the pupils, dilates the palpebral tissue, causes lacrimation, salivation and increased respiration. At high doses, the blood sugar level is increased (Joosten, 1988). Tyramine metabolism by oxidative deamination to *p*-hydroxyphenylacetic acid is the main degradative pathway. Tyramine is also catalyzed by monoamine oxidase (MAO), present in almost every organ. There are two types of MAO, A and B, with either type having the ability to degrade tyramine. Elimination of tyramine from the body through monoamine oxidases is normally efficient. However, people on nonselective monoamine oxidase inhibitors may be at risk for increased blood pressure after ingesting increased amounts of tyramine. Only one incidence of potential food-induced sickness due to tyramine has been reported from fish products (Nuessle *et al.*, 1965) from a patient taking tranylcypromine, a nonselective monoamine oxidase inhibitor. New monoamine oxidase inhibitor medications inhibit only one of the types of MAO, thereby decreasing the possibility of adverse effects associated with tyramine ingestion.

During storage at –1.5°C, some LAB (including carnobacteria) grow steadily on fresh pork packaged either by vacuum-packaged or carbon dioxide-controlled atmosphere-packaged (CO_2-CAP) treatments (Nadon *et al.*, 2001). Unpublished work by Nadon *et al.* (2001) demonstrated that carnobacteria dominate the LAB microflora during storage at –1.5°C in the absence of oxygen. Nadon *et al* (2001) showed that LAB increased from an initial 100 cfu/cm^2 to an average level of 1×10^6 cfu/cm^2 for the first six weeks of storage in vacuum-packaged pork and maintained that level of LAB for the remainder of the thirteen-week study. In the CO_2-CAP pork samples, there was no significant increase in LAB until the 11th week of storage, with a maximum level of LAB at 3.2×10^5 cfu/cm^2. Histamine concentrations in both packaging treatments did not exceed 16 μg/g. Tyramine concentrations in the vacuum-packaged pork did not change until Week 4, when it increased to nearly 40 μg/g, but on average, the concentrations of tyramine fluctuated between 26 and 38 μg/g. Tyramine concentrations in the CO_2-CAP pork were significantly lower than in the vacuum-packaged samples, with levels averaging 2 μg of tyramine /g for the first 7 weeks of storage, then an increase to an average of 18 μg of tyramine /g for the remainder of the thirteen week study (Nadon *et al.*, 2001). Tyramine production has been shown to increase in salmon that has first been frozen to –20°C or –30°C, then thawed and refrigerated for greater than 21 days. Tyramine concentrations in salmon previously frozen, then thawed and maintained at 2°C attained 56.3±12.5 μg/g after 21 days and 41.8±3.6 μg/g after 34 days (Emborg *et al.*, 2002). Duffes *et al.* (1999b) reported that at 8°C, *C. maltaromaticum* SF668 produced 262 μg of tyramine /g after four weeks of storage, when grown on vacuum-packed, cold-smoked salmon. At 4°C, 82 μg of tyramine/g was produced by *C. maltaromaticum* V1 after one week and 165 μg/g was produced by *C. maltaromaticum* SF668 after four weeks.

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[12] Scombroid poisoning = poisoning from ingestion of heat-stable toxins produced by bacterial action on inadequately preserved dark-meat fish of the order Scombroidea (tuna, bonito, mackerel, albacore, skipjack); characterized by epigastric pain, nausea and vomiting, headache, thirst, difficulty in swallowing, and urticaria.

Natural tyramine concentration in commercial vacuum-packed, cold-smoked salmon after three weeks of refrigerated storage contained between 80 and 230 μg/g; some French cheeses contain tyramine in a range between 130 to 290 μg/g, while in fermented meat, tyramine concentrations could exceed 150 μg/g (Duffes *et al.*, 1999b).

Tyramine formation during the malting and brewing process in the production of beer has been noted, with tyramine concentrations ranging from 4.0 to 45.6 mg/L. These levels were determined to be well below levels that may elicit direct adverse reactions (Izquierdo-Pulido *et al.*, 1994).

The toxic threshold dose of tyramine is not precisely known (Nadon *et al.*, 2001). *Carnobacterium* spp. produced tyramine in amounts higher than 426 μg/ml/day, when grown in Maijala's liquid medium supplemented with 2% histamine and 2% tyrosine (Masson *et al.*, 1996). The bacteria were incubated for five days at 30°C prior to biogenic amine measurement *via* HPLC. The production of tyramine by *C. maltaromaticum* bacteria has been shown to be approximately 1.02 mmol/liter/day (*i.e.*, 140 μg/g/day) in laboratory broth supplemented with two *percent* tyrosine (Leisner *et al.*, 1994).

Ingestion of tyramine HCl (200 mg, approximately 2.86 mg/kg bodyweight) in 12 healthy men after an overnight fast was well tolerated (Grind *et al.*, 1986). However, ingestion of 400 mg tyramine resulted in three of the twelve subjects having an increase in systolic blood pressure greater than 30 mm Hg, within 20 minutes after tyramine ingestion and lasting approximately 20 minutes. Simultaneously, there was a decrease in heart rate. Therefore, the threshold dose for the blood pressure increase after oral tyramine was found to be between 200 and 400 mg in normal healthy subjects. The mean concentrations of tyramine found in the blood after ingestion of 200 or 400 mg tyramine was 31±19 and 79±74 ng/ml, respectively.

Tyramine has been shown to have a reduced bioavailability when ingested in conjunction with food (VanDenBerg *et al.*, 2003). Tyramine (200 mg, given orally as a 253 mg dose of tyramine HCl) was given to eight healthy males, either in a fasted state or during a meal. Results showed that the maximum serum concentration ranged from 13.6 to 85.7 ng/ml when 200 mg tyramine was administered to fasting subjects and from 2.96 to 27.9 ng/ml when the same dose was administered to subjects during a meal. The difference averaged 72% (P=0.0056). Administration of 200 mg tyramine during a meal resulted in a median delay in time of maximum concentration of 0.5 hours (P=0.0156). No reported adverse events were serious, and all resolved completely without problem. The most frequently reported adverse event was hypertension, as defined as a semi-recumbent systolic blood pressure greater than 160 mm Hg and was observed in three subjects. In one subject, hypertension was observed after tyramine was administered during a fast and was possibly treatment related. In two subjects, hypertension was observed after tyramine was administered during a meal but was not considered treatment related. This indicates that ingestion of tyramine during a meal results in decreased concentrations of tyramine reaching the bloodstream.

In addition, conflicting research has been published questioning the hypothesis that food intolerance reactions are related to biogenic amine ingestion. A review of thirteen oral challenge studies with biogenic amines (five with positive results and eight with negative results) found that only ten were randomized, double-blind, placebo-controlled studies (Jansen *et al.*, 2003). Of

these, six were found to be inconclusive, with the remaining four reporting no relation between biogenic amine ingestion and food intolerance. Jansen *et al.* (2003) therefore concluded that the currently published data do not substantiate the hypothesis that oral ingestion of biogenic amines and food intolerance reactions are related.

8.2. Pathogenicity Studies

C. maltaromaticum has been implicated in producing pathogenicity in stressed fish, such as occurs during spawning or handling. Measurements of the number of *C. maltaromaticum* in control *vs.* stressed (*e.g.,* starved) fish showed that fasting does not change total numbers of viable autochthonous[13] aerobic bacteria or composition of carnobacteria. Daily, repeated stress and starvation of the fish over eleven days had no influence on the total culturable bacterial numbers or population level of *C. maltaromaticum* associated with the digestive tract. A comparative analysis was conducted of the phenotypic and serological properties of *Carnobacterium* strains associated with mortalities of cultured striped bass and channel catfish and the properties of isolates obtained from wild brown bullhead catfish (Baya *et al.*, 1991). Experimental virulence tests conducted to assess the pathogenicity of selected *Carnobacterium* strains indicated that only the isolates HB-425 and HB-426 (isolated from striped bass) and the *C. maltaromaticum* reference strain (ATCC 35586) proved to be pathogenic for rainbow trout, with 50% lethal doses of 1.4×10^6, 2.3×10^6 and 2.0×10^6 cfu/g, respectively (Baya *et al.*, 1991). The trout died within 5-9 days after challenge.

Conversely, no mortalities were recorded in striped bass during a two-week period (50% lethal dose, $>8 \times 10^7$ cfu/g). However, the *C. maltaromaticum* strains were recovered from the kidneys of all survivor fish (trout and bass), even those injected with the lowest doses. Histological examination of dead and carrier fish revealed abundant melanomacrophage centers in the kidneys, necrotic areas in the livers and acute inflammation of the brains. Interestingly, none of the *Carnobacterium* strains showed lipolytic, phospholipolytic, amylolytic or hemolytic activity. No strain produced gelatinase, but most exhibited caseinolytic activity. This study indicates that *Carnobacterium* strains are associated with fish mortalities and that a carrier state can be established in surviving fish populations. However, it should be noted that these studies are not be realistic in determining the virulence of *C. maltaromaticum* through an oral route, since the method of inoculation was by injection into the intraperitoneal cavity. Natural exposure to *C. maltaromaticum* is *via* a skin wound or oral ingestion in a water environment. Interestingly, although the exposure was injection directly into the fish, thereby removing any natural barrier systems, the authors state that stress conditions are important in predisposing fish to infection by *Carnobacterium* spp. The authors also noted that *Carnobacterium* infection frequently occurs in association with secondary pathogenic bacteria, such as *Aeromonas hydrophila* and *Pseudomonas fluorescens*, with the fish mortalities often following spawning or repeated stressful handling practices (Baya *et al.*, 1991). Taken as a whole, *C. maltaromaticum* is not believed to be a pathogenic species *via* the oral route.

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[13] autochthonous = native to the place inhabited; aboriginal.

8.3. Safety of bacteriocins produced by *Carnobacterium maltaromaticum*

One of the methods that *C. maltaromaticum* may inhibit potentially pathogenic bacteria is through the production of bacteriocins. Bacteriocins are ribosomally synthesized, low molecular weight antibacterial proteinaceous materials that are able to kill closely related bacteria (Klaenhammer, 1993). Bacteriocins have been isolated from beef, spoiled ham, as well as from French mold-ripened soft cheese (Jack *et al.*, 1996; Herbin *et al.*, 1997). Because bacteriocins are isolated from foods such as meat and dairy products, which normally contain LAB, both LAB and bacteriocins have been consumed for centuries. Bacteriocins produced from *C. maltaromaticum* have been shown to be susceptible to proteolytic enzymes. The bacteriocin from *C. maltaromaticum* LV17 is stable during heat treatment at 62°C, boiling for 30 min and, after autoclaving at 121°C for 15 minutes. Trypsin, protease types I, IV, VIII, XIV, α-chymotrypsin, β-chymotrypsin and papain inactivated the bacteriocin, while non-proteolytic enzymes did not (Ahn and Stiles, 1990b). Piscicolin 126, a bacteriocin produced by *C. maltaromaticum* JG126 was inactivated by α- and β-chymotrypsin, proteases (types I, XIV, XXIII and trypsin), but catalase, lipase or lysozyme had no effect (Jack *et al.*, 1996). Similarly, the bacteriocin produced by *C. maltaromaticum* LV61 is resistant to heat (100°C for 20 minutes), while being inactivated by α-chymotrypsin, trypsin, pepsin, papain and proteinase K. Treatment with catalase, α-amylase, lipase, phosphlipase C, DNase I and lysozyme did not affect the antibacterial activity (Schillinger *et al.*, 1993). This evidence has indicated that ingestion of bacteriocins would not have an effect on the beneficial gut microorganisms. Trypsin has been shown to inactivate the bacteriocin, nisin[14] (Hara *et al.*, 1962).

Strains of *C. maltaromaticum* produce several different carnobacteriocins (Quadri *et al.*, 1994), which have been identified as heat-resistant peptides, stable over a wide pH range and capable of acting as bactericides (Jack *et al.*, 1996). A bacteriocin from *C. maltaromaticum* L103 was recently tested in a study to determine the ability of this bacteriocin to control the growth of *Listeria monocytogenes* in vacuum-packaged meat (Schobitz *et al.*, 1999). Steaks from beef semitendinosus muscle were inoculated with the partially purified bacteriocin at a concentration of 100 AU[15]/ml. *L. monocytogenes* was added to the meat as an indicator strain at a final concentration of $1x10^3$ cfu/cm^2. After assuring good contact with the meat, the steaks were vacuum-packaged and stored at 4°C for 21 days. Non-inoculated controls and meat containing only the indicator strain were included for each sampling date. Duplicate steaks were sampled at time 0 and every seven days for growth of *L. monocytogenes* and LAB growth. After seven days of storage at 4°C, a significant decrease in the *L. monocytogenes* counts were observed, from an initial count of $2x10^3$ cfu/cm^2 to 4 cfu/cm^2, with complete inhibition of the pathogen (<1 cfu/cm^2) on day 14 of storage. The LAB multiplied on the vacuum-packaged meats, reaching counts of $1x10^7$ cfu/cm^2 after 14 days, with a starting level of $1.6x10^2$ cfu/cm^2. Color and odor of the meat remained acceptable during the 14 days of storage. The results of this study indicate that the bacteriocin from *C. maltaromaticum* was able to inhibit *L. monocytogenes* on vacuum-packaged meat, while maintaining edible characteristics of the meat for up to 14 days (Schobitz *et al.*, 1999). *C. maltaromaticum* V1 produces a bacteriocin that was active against *C. maltaromaticum* 2762 and *L. monocytogenes* (strains R2, Lud 1033, Br124 6,

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[14] nisin = A bacteriocin produced by Lactococcus lactis (a LAB) that is selectively active against members of the same or other species.
[15] AU/ml = Arbitrary units of activity.

Lud 905 and T), but was inactivated by pronase E, proteinase K and trypsin (Pilet *et al.*, 1995). Other research has indicated that the purified bacteriocin from *C. maltaromaticum* LV61 inhibits several strains of *Carnobacterium* and *Enterococcus*, but does not inhibit several strains of *Listeria* (Holck *et al.*, 1994). It was therefore concluded that *C. maltaromaticum* LV61 produces, in addition to piscicolin 61, another factor involved in the anti-listerial activity.

The following table (Table 7) indicates the ability of simulated gastric fluid (SGF[16]) to inhibit the activity of *C. maltaromaticum* bacteriocins (Griffith Laboratories, 2003b). The bacteriocin was small and estimated to be 4.5 kDa. The stability of protein or protein fragments to digestion in simulated gastric fluid may be used to assess the potential allergenicity of a protein. Stability is dependent on the ratio of pepsin to the test protein. Proteins that are rapidly degraded in SGF (within 15 to 30 minutes) are generally assumed to be incapable of inducing a toxic and/or allergenic response.

The SGF digestion stability assay was initiated by first growing the producer organism, *C. maltaromaticum* CB1 overnight at 25°C in APT[17] broth. The resulting culture was then centrifuged at 15,000 x g for 5 minutes, with the supernatant removed and heat-treated at 60°C for 30 min. The supernatant was concentrated to 10x and the protein content and activity (AU) of the supernatant and 10x concentrated supernatant against *L. monocytogenes* CDC 7762 was determined. Supernatant and concentrated supernatant were added to pepsin at a starting ratio of 13:1 (w/w). The samples were incubated for 0, 0.5, 5, 10, 15 and 30 min to test for bacteriocin activity. The plate was incubated overnight and visually inspect for zones of inhibition.

As shown by the absence of bacteriocin activity noted in Table 7, the results of this study indicate that the bacteriocin produced from CB1 is readily digested in simulated gastric fluid and, therefore, has a low potential for the production of allergenicity or toxicity.

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[16] SGF was produced (in accordance with US Pharmacopoeia (2000) methods) by first dissolving 0.2 g of sodium chloride and 0.32 g of purified pepsin (derived from porcine stomach mucosa), with an activity of 800 to 2500 units *per* mg of protein (with an activity of 3,460 units/mg protein), in 0.70 ml of hydrochloric acid and sufficient water to make 100 ml, with a pH of approximately 1.2.

[17] APT = All purpose Tween medium (Difco Laboratories, Detroit, Michigan).

Table 7. Effect of treatments on the presence (+) or absence (-) of *C. maltaromaticum* bacteriocin activity.

	CB1 Time (minutes)					10x CB1 Time (minutes)				
Treatments	0	0.5	2	10	30	0	0.5	2	10	30
Pepsin										
0.32% pH 1.2	+	-	-	-	-	+	+	-	-	-
0.16% pH 1.2	+	-	-	-	-	+	+	-	-	-
0.08% pH 1.2	+	-	-	-	-	+	+	-	-	-
0.04% pH 1.2	+	-	-	-	-	+	+	-	-	-
0.02% pH 1.2	+	-	-	-	-	+	+	-	-	-
pH										
0.32% pH 1.2	+	-	-	-	-	+	-	-	-	-
0.32% pH 2	+	-	-	-	-	+	+	-	-	-
0.32% pH 3	+	Slight +	-	-	-	+	+	+	+	Slight +
0.32% pH 4	+	-	-	-	-	+	+	+	+	Slight +
Bacteriocin Added										
5 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
15 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
35 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
55 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
75 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
95 µl to 95 µl SGF	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
						N/A	N/A	N/A	N/A	N/A
SGF Added						N/A	N/A	N/A	N/A	N/A
95 µl to 5 µl of 307	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
75 µl to 5 µl of 307	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
55 µl to 5 µl of 307	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A
35 µl to 5 µl of 307	+	-	-	-	-	N/A	N/A	N/A	N/A	N/A

SGF = Simulated gastric fluid; N/A = Not applicable

8.4. Observations of *Carnobacterium maltaromaticum* in humans

There have been no reports of human pathogenicity associated with the oral consumption of *C. maltaromaticum*. Extensive searches of various electronic medical and toxicological databases with the terms "*Carnobacterium maltaromaticum*", "*Carnobacterium piscicola*", "*Lactobacillus piscicola*" or "*Lactobacillus carnis*" and, "pathogenicity", "toxicity" or "human" failed to recover any information on human pathogenicity connected with the oral consumption of this specific bacterial species. For the purposes of the Human Pathogens Importation Regulations (SOR/94-558), the genus *Carnobacterium* has been characterized in Canada and France as having non-pathogenic organism status (Health Canada, 2003; Republic of France, 1994). It is believed that ingestion of *C. maltaromaticum*, by the addition to RTE meats and fresh comminuted, processed meat products, will not have significant adverse effects on people with suboptimal health.

In addition, the American Type Culture Collection Repository (ATCC) has designated *C. maltaromaticum* strains ATCC 35586 and ATCC 43225 as requiring a biosafety level (BSL) of

1. As stated by the ATCC, those items in BSL-1 are not known to cause disease in healthy adult humans. This classification system is based on assessment of the potential risk using U.S. Public Health Service guidelines, with assistance provided by ATCC scientific advisory committees (American Type Culture Collection (ATCC): Collections & Repository, 2004a, b).

Reviews of the available literature on the safety of lactic acid bacteria, in general, concluded that except for a few cases of endocarditis occurring in patients without past cardiac problems (or possible cardiac disease that was overlooked), there has always been a severe underlying disease prior to LAB pathogenicity. Often, the infection was not through normal ingestion of the bacteria, but through an obvious aberrant portal of entry, *i.e.*, a breach of the barrier between a septic site known to contain LAB and a sterile site in the body (Aguirre and Collins, 1993; Gasser, 1994; Borriello *et al.*, 2003).

There has been one published report of the isolation of *C. maltaromaticum* from humans (Chmelar *et al.*, 2002). This report details a man being treated for the loss of his arm after accidental amputation in a water sawmill. The arm stump had been polluted with water and debris before the patient entered the hospital. The amputation was completed at the carpometacarpal joint. Suturing of the arm was completed after leveling and a post-surgical antibiotic was given (cefuroxim). Six days after the surgery the stump was revised (cleaned and any necrotic tissue removed). At this time an abscess was evacuated and a pus sample collected for bacterial cultivation. *Serratia marcescens*, a known harmful human pathogen that has been known to cause urinary tract infections, wound infections and pneumonia, was isolated from the pus. This bacterium was shown to be resistant to cefuroxim and colistin. In addition, a white, relatively large nonhemolytic colony of Gram-positive rods was isolated from the wound, on sheep blood agar plates. The general description was as follows: Gram-positive rods, facultatively anaerobic; fermentation products from glucose were lactic acid and some acetic acid; motility-negative; negative spore formation; negative catalase formation; negative gas formation from glucose. The configuration of lactic acid was L-(+)-, meso-2,6-diamino-pimelic acid in positive cell hydrolyzates, with an undetermined peptidoglycan-type. The initial conventional biochemical tests performed on the bacteria yielded a profile of 99.5% identity to *C. maltaromaticum*. As indicated, the source of this infection may have been pollution of the wound itself, as well as exposure to the open water. Subsequently, the *S. marcescens* and *C. maltaromaticum* bacteria may have entered the wound and caused the infection. This infection by *C. maltaromaticum* was under extreme conditions and, was likely not to exemplify potential pathogenicity of *C. maltaromaticum* through ingestion.

9. Discussion

C. maltaromaticum is a Gram-positive, non-motile, non-sporeforming, rod-shaped bacterium, recently redefined from the genus *Lactobacillus* to *Carnobacterium*. *C. maltaromaticum* has been indicated as one of a large, diverse group of lactic acid-producing bacteria, which metabolize glucose to produce lactic acid and other acids that inhibit the growth of several pathogenic bacteria. *C. maltaromaticum* was initially found in salmonid fish, but has since been found on various food products, from meats and fish to fruits and vegetables, produced and stored by current agricultural practices, at levels exceeding $1x10^7$ cfu/g. Lactic acid bacteria have been used for centuries in the fermentation and preservation of food products

(*e.g.*, yogurts, sausages, vegetables, breads, wine, cheeses and milk). *C. maltaromaticum* has already been used as part of a starter bacterial culture in sausage fermentation in France.

Carnobacterium spp. are psychrotrophic, grow at elevated pH values of 8 to 9 and ferment inulin. In culture conditions in the presence of inulin, *C. maltaromaticum* forms yellowish to pinkish colonies with a metallic bronze sheen, a yellow color change of the medium and a clearance of precipitate. Various *C. maltaromaticum* strains have been shown to produce bacteriocins, proteinaceous compounds with the ability to inhibit the growth of other *Carnobacterium*, *Lactobacillus* and *Listeria* species.

It is proposed that *C. maltaromaticum* will be inoculated into various ready-to-eat and fresh comminuted, processed meat products at a range of $1x10^3$ to $1x10^4$ cfu/g for enhanced preservation and decreased pathogenic bacterial growth. Based on these inoculation ranges, as well as the theoretical assumption that the bacteria will grow over an extended period of time in storage, the mean *per capita* consumption estimate of *C. maltaromaticum* as an addition to the selected RTE foods would be $4.3x10^9$ cfu/day or $7.2x10^7$ cfu/kg/day for a 60 kg person.

The suppression of the pathogen, *L. monocytogenes,* by *C. maltaromaticum* occurs when assessed in salmon, chicken, pork, beef and other commercial meat products. Co-culturing of *C. maltaromaticum* with *L. monocytogenes* results in log reductions in *L. monocytogenes* growth. Compared to *L. monocytogenes* growth at low temperatures, the suppressive effect of *C. maltaromaticum* on *L. monocytogenes* growth is enhanced at low temperatures. *L. monocytogenes* suppression may be mediated through production of lactic acid, competition for nutrients, as well as the production of bacteriocins. Bacteriocin production is correlated with increased suppression of *L. monocytogenes* growth. The activity of bacteriocins produced by *C. maltaromaticum* is rapidly degraded when subjected to simulated gastric acid or proteolytic enzymes, an indication of a non-toxic and non-allergenic protein.

C. maltaromaticum has been implicated in the pathogenicity of stressed salmonid fish. *C. maltaromaticum* has been found to be associated with the digestive tract of Atlantic salmon, while carrier states of *C. maltaromaticum* infections in fish have been shown to occur. The induction of stress on a fish is important in predisposing fish to pathogenic infection by the *Carnobacterium* spp., while further evidence indicates that the *Carnobacterium* infection frequently occurs in association with secondary bacteria.

C. maltaromaticum has been shown to produce the biogenic amine, tyramine, formed as a result of amino acid decarboxylation. Tyramine releases noradrenaline from the sympathetic nervous system, which may increase blood pressure and increase cardiac output. Tyramine elimination is normally very efficient *via* monoamine oxidase enzymes (MAO), but can be inhibited by the use of a class of pharmaceuticals, monoamine oxidase inhibitors. Ingestion of tyramine, in conjunction with food, has been shown to reduce the bioavailability of tyramine. Tyramine has been hypothesized to play a part in the formation of food intolerance; however, recent research has found that levels of tyramine production in food (*e.g.*, μg/g concentrations) are significantly below the doses known to cause adverse effects (mg/g concentrations ingested). Other research has indicated that a correlation between tyramine consumption and adverse food intolerance reactions could not be verified.

C. maltaromaticum increases the storage time of RTE and vacuum-packaged meat products, while decreasing the growth of pathogenic bacteria. *C. maltaromaticum* growth has been found to be self-limiting, with levels of *C. maltaromaticum* on RTE meat products and vacuum-packaged, cold-smoked salmon stabilizing at approximately $1x10^9$ cfu/g. Addition of *C. maltaromaticum* to the proposed RTE and fresh comminuted, processed meat products at a level between $1x10^3$ and $1x10^4$ cfu/g, would not significantly increase the overall human consumption of LAB from these food products (theoretical natural consumption determined at $4.3x10^9$ cfu/day). *C. maltaromaticum* has been shown to be self-limiting in its growth; the growth of *C. maltaromaticum* will plateau between approximately $1x10^8$ and$1x10^9$ cfu/g of meat. This has been speculated to be due to the release of specific bacteriocins that limit a higher bacterial density.

C. maltaromaticum has been determined to be nonpathogenic by both Canada and France. The ATCC has also defined the biosafety requirement of *C. maltaromaticum* to the category of organisms not causing disease to humans. *C. maltaromaticum* strains have been isolated from fish, meat and cheese at levels exceeding $1x10^7$ cfu/g. Although one case of human pathogenicity by *C. maltaromaticum* has been reported, it occurred through the infection of an accidental amputation of a limb, not through oral ingestion. There have been no human illnesses or mortalities associated with ingestion of *C. maltaromaticum* bacteria.

In summary, *C. maltaromaticum* has been found to be safe when added to RTE and fresh comminuted, processed meats at inoculation ranges between $1x10^3$ to $1x10^4$ cfu/g of product, resulting in the added consumption of bacteria from RTE and fresh comminuted, processed meat products to be approximately $4.3x10^9$ cfu/day of food. The inoculation of RTE and fresh comminuted, processed meat products with this level of *C. maltaromaticum* does not significantly increase the levels of *Carnobacterium* already being consumed in the American diet.

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10. Conclusion

Based on a critical evaluation of the information available, the Expert Panel has determined that *Carnobacterium maltaromaticum*, meeting Food Chemical Codex specifications, is Generally Recognized As Safe (GRAS), by scientific procedures, when used as a food ingredient in meat products. Concentrations for use range from 10^3 to 10^4 cfu/g of food for fresh comminuted, processed meat products and 10^3 to 10^4 cfu/g of food for ready-to-eat meat products, produced in accordance with current good manufacturing practice.

Signatures

(b) (6) [redacted]

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Todd Klaenhammer, Ph.D. — 9/21/04 Date

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Mary Ellen Sanders, Ph.D. — 9/28/04 Date

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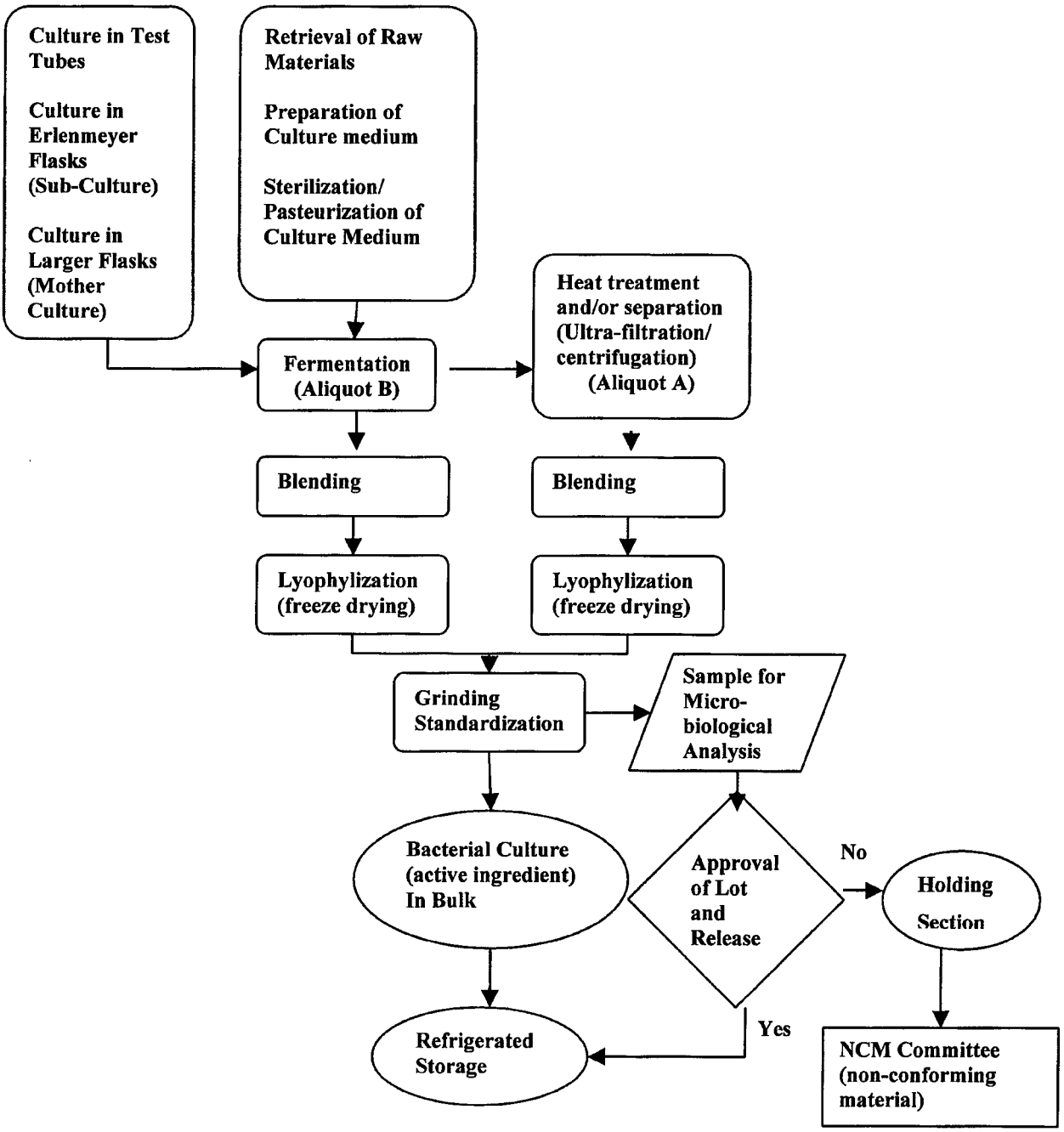
12. Appendix A



Process control flow chart for the production of *Carnobacterium maltaromaticum.*

13. Appendix B

Sensory Characteristics of *Carnobacterium maltaromaticum* on Vacuum-Packaged Wieners

A laboratory-scale study was designed to investigate the sensory characteristics, such as aroma and flavor profile, of *C. maltaromaticum* on vacuum-packaged wieners inoculated with *C. maltaromaticum* under conditions comparable to those proposed for commercial production (Griffith Laboratories, 2002). The methods and results of this study were as follows:

Two strains of bacteriocin-producing *C. maltaromaticum* were chosen for study: UAL 8 (synonym LV17) was originally isolated from vacuum-packaged, refrigerated, fresh pork and described by Shaw and Harding (1984) and, strain UAL 26, which was isolated from vacuum-packaged beef (Stiles and Holzapfel, 1997). The inoculum was prepared by adding 10 ml of washed bacterial cells to 4 L of sterile 0.85% saline to provide an inoculum level of 2.5×10^6 cfu/ml. Individual wieners were dipped into the inoculum suspension for one minute, drain dried and vacuum-packaged in groups of five wieners *per* bag (high barrier, low O_2 transmission, VP bags). As a control, wieners were dipped in 0.85% sterile saline without bacterial inoculum. Treated and control samples were then placed into refrigerated (4°C) storage for up to 12 weeks. Sampling of the wieners for microbiological analyses and sensory evaluation was performed on day zero and after 2, 4, 6, 7, 8, 10 and 12 weeks of storage.

The wieners to be evaluated for sensory characteristics were cooked in "just boiled" water and allowed to stand for five minutes (internal wiener temperature approximately 83°C). Wieners were cut into pieces, placed in coded foil-covered jars and heated for 15 min in a 94°C oven just prior to evaluation. Sensory evaluation was conducted by a group of nine panelists trained over a three-month period. Samples were evaluated for overall aroma intensity, meat flavor intensity, seasoned flavor, smoke intensity, sourness/acidity, off-flavor and overall acceptability using a 15 cm unstructured line scale with 0 = very bland and 15 = very strong. Between samples, palates were cleansed with crackers and a 1:1 dilution of 7-Up®.

This study reported that sample wieners that had been inoculated with *C. maltaromaticum* strains UAL 8 or UAL 26 reached maximum anaerobic lactic acid bacteria (LAB) counts of 2.75×10^6 and 1.2×10^5 cfu/cm^2 after seven or eight weeks of cold storage, respectively. *C. maltaromati`cum* grew at a slow rate on vacuum-packaged wieners and growth was accompanied by a relatively small decrease in surface pH during storage. UAL 8 varied from pH 6.20 at Week 0 to 6.10 at Week 10, while UAL 26 varied from an initial pH 6.20 to approximately 5.9 during Weeks 6-8 and Week 12. Based on sensory evaluations using a trained nine-member panel over the 12-week storage period, there were no significant adverse effects on aroma, off-flavors, sour intensity, or overall acceptability resulting from inoculation with *C. maltaromaticum*.

It was concluded that in comparison with other lactic acid bacteria, such as *L. gelidum*, *C. maltaromaticum* is a slow-growing species when inoculated onto refrigerated (4°C), vacuum packaged wieners. The levels of *C. maltaromaticum* reached a maximum of 5×10^7 cfu/cm^2 after 12 weeks of cold storage, while having no adverse effects on the overall acceptability as an edible food product.

14. Appendix C

Inhibition of Pathogenic Bacteria by *Carnobacterium maltaromaticum* in Meat Products

The U.S. Food and Drug Administration's Center for Food Safety and Applied Nutrition has stated in the document "Processing parameters needed to control pathogens in cold-smoked fish" that *C. maltaromaticum* and *C. divergens* inhibit the growth of *L. monocytogenes* in food products. Specifically, the growth of *L. monocytogenes* in cold-smoked salmon can be completely inhibited by addition of *C. maltaromaticum* (U. S. Food and Drug Administration, 2003).

Examination of the potential of a bacteriocin-producing strain of *C. maltaromaticum* (strain SF668) isolated from commercial, vacuum-packaged cold-smoked salmon (CSS) to inhibit *L. monocytogenes* growth on CSS by Duffes *et al.* (2000), found that *C. maltaromaticum* SF668 was able to grow from $1x10^5$ to $3x10^7$ cfu/ml in 21 days on vacuum-packaged, cold-smoked salmon stored at 4°C (Table 8). *L. monocytogenes* co-cultured with *C. maltaromaticum* grew from $1x10^3$ cfu/ml to $3.5x10^3$ cfu/ml after three weeks at 4°C. This co-culturing of *C. maltaromaticum* with *L. monocytogenes* resulted in a significant bacteriostatic effect on *L. monocytogenes* growth on cold-smoked salmon (*L. monocytogenes* growth in the absence of *C. maltaromaticum* reached approximately $5x10^4$ cfu/ml).

When screened against 21 strains of *Listeria* spp., distinct zones of inhibition formed by *C. maltaromaticum* LK5 were evident with seventeen of the strains (Buchanan and Klawitter, 1992a). *C. maltaromaticum* LK5 was found to lack hydrogen peroxide formation, while producing a bacteriocin. The ability of *C. maltaromaticum* LK5 to inhibit *Listeria* spp. was temperature-dependent (determined at both 5°C and 19°C), with a substantially greater suppression of *L. monocytogenes* co-cultured with *C. maltaromaticum* LK5 occurring at 5°C than at 19°C. *C. maltaromaticum* LK5 was shown to be capable of substantially faster growth than *L. monocytogenes* at refrigeration temperatures, whereas the growth rates were approximately the same at 19°C. At 19°C, suppression of *L. monocytogenes* (the inoculation concentration was kept constant at $1x10^3$ cfu/ml) was dependent on inoculum ratio, with only LK5:*L. monocytogenes* ratios of ≥1:1 producing a substantial degree of inhibition. At 5°C, an increased level of anti-listerial activity was observed with the higher inoculum ratios during the early stages of the incubation, but by approximately 300 h of incubation, LK5 inoculum size had no effect on inhibitory activity; the degree of suppression was equivalent for ratios ranging from 0.01:1 to 1000:1 ($10:1x10^3$ and $1x10^6:1x10^3$ cfu/ml, respectively). The *Carnobacterium* isolate was extremely competitive at refrigeration conditions, indicating that even small inocula could be used to control *L. monocytogenes* in refrigerated foods. This study confirms the report by Schillinger and Holzapfel (1990), who reported that out of thirteen strains of *C. maltaromaticum*, ten significantly inhibited the growth of *L. monocytogenes* DSM 20600, as determined by the agar spot test.

Table 8. Inhibition of *L. monocytogenes* growth by *C. maltaromaticum* at refrigeration temperatures.

Food Product	Initial *C. maltaromaticum* (cfu/g of meat)*#	Initial *L. monocytogenes* (cfu/g of meat)*	Incubation period (days)	Final *L. monocytogenes* (cfu/g of meat)*	Reference
Crabmeat	$1x10^4$	$1x10^3$	21	$1x10^4$†	(Buchanan and Klawitter, 1992b)
Vacuum-packaged cold-smoked salmon	$3.2x10^4$ (strain V1)	$5.1x10^2$	28	<10 (DL)	(Duffes *et al.*, 1999b)
Vacuum-packaged cold-smoked salmon	$4x10^4$ (strain NCDO2762)	$1x10^3$	28	$1.6x10^4$†	(Duffes *et al.*, 1999b)
Simulated cold-smoked fish system	$1.8x10^5$ cfu/ml	$2.2x10^3$ cfu/ml	18	<10 cfu/ml (DL)	(Duffes *et al.*, 1999c)
Vacuum-packaged cold-smoked salmon	$1.6x10^5$ (strain SF668)	$6.3x10^2$	28	$1.2x10^2$	(Duffes *et al.*, 1999c)
Vacuum-packaged cold smoked salmon	$1x10^5$ (strain SF668)	$1x10^3$	21	$3.5x10^3$ †	(Duffes *et al.*, 2000)
Cold-smoked salmon juice	~10^6 cfu/ml	$1x10^3$ cfu/ml	32	<10 cfu/ml (DL)	(Nilsson *et al.*, 1999)
Vacuum-packaged cold-smoked salmon	$2x10^6$	$2x10^2$	20	$2x10^3$†	(Nilsson *et al.*, 1999)
Cold-smoked salmon	$1x10^6$	$1x10^3$	7	<50 (DL)	(Yamazaki *et al.*, 2003)
Cold-smoked salmon	$1x10^4$	$1x10^3$	21	<50 (DL)	(Yamazaki *et al.*, 2003)
Frankfurters	$1x10^6$	$1x10^6$	29	$5x10^5$	(Buchanan and Klawitter, 1992b)
UHT milk	$1x10^4$ cfu/ml	$1x10^3$ cfu/ml	21	$5x10^3$ cfu/ml†	(Buchanan and Klawitter, 1992b)
Canned corn	$1x10^4$	$1x10^3$	19	$1x10^3$	(Buchanan and Klawitter, 1992b)
"All beef" dog food	$1x10^4$	$1x10^3$	12	<10 (DL)	(Buchanan and Klawitter, 1992b)
Vacuum-packaged processed chicken cubes	$1x10^4$ (strain DX)	$1x10^2$	28	$1x10^{5\%}$	Campos *et al.*, 1997
MRS broth	10^5 cfu/ml	$1x10^5$ cfu/ml	28	10^2 cfu/ml	(Amezquita and Brashears, 2002)

DL = Detection limit; * cfu/g of meat, unless otherwise noted; # *C. maltaromaticum* strain indicated when known; MRS = de Mann-Rogosa-Sharpe bacterial growth medium; UHT = Ultra High Temperature †Growth of *L. monocytogenes* was significantly less than control cultures; % = significantly suppressed from a maximal *L. monocytogenes* at $1x10^9$ cfu/g of meat.

L. monocytogenes inhibition by *C. maltaromaticum* DX (a bacteriocin producer) or *C. maltaromaticum* 2818 (lacking bacteriocin production) was examined in vacuum-packed, minimally-processed chicken cubes with gravy at 4°C, 8°C and 15°C (Campos *et al.*, 1997). Alone, *L. monocytogenes* reached levels of 10^7 to 10^8 cfu/g (when initially inoculated at $1x10^2$ cfu/g) after 14 days at 4°C. *C. maltaromaticum* DX and *C. maltaromaticum* 2818 reached levels of approximately $1x10^8$ to $1x10^9$ cfu/g during the first week of storage at 4°C, 8°C or 15°C, when inoculated at $1x10^4$ cfu/g (Table 8). The growth of these strains was not influenced by the presence of *L. monocytogenes*. At 4°C and 8°C, growth of *C. maltaromaticum* DX inhibited *L. monocytogenes* by 3 log cycles during the second to third week of storage, while *C. maltaromaticum* 2818 suppressed *L. monocytogenes* growth to a lesser extent. No significant differences between the inhibition of *L. monocytogenes* by *C. maltaromaticum* DX and *C. maltaromaticum* 2818 were observed at 15°C (both *C. maltaromaticum* strains reduced *L. monocytogenes* growth by one log at 15°C). This study indicates that antagonistic actions by *C. maltaromaticum* strains against *L. monocytogenes* occur and are enhanced by low temperatures and the production of a bacteriocin.

Nilsson *et al.* (1999) reported that *C. maltaromaticum* strains A9a, A9b, A10a and A10b are able to inhibit the growth of *L. monocytogenes* strains 049, 050, 051, 052, 056, 057 and Scott A in an agar diffusion assay. The culturing of *L. monocytogenes* 057 alone on vacuum-packed, cold-smoked salmon stored at 5°C at an initial concentration of 2×10^2 cfu/g led to maximum cell numbers of $3x10^8$ cfu/g after 14 days of storage. Co-culture of *L. monocytogenes* with *C. maltaromaticum* led to relatively low maximum cell counts of $1x10^4$ and $2x10^3$ *L. monocytogenes* cfu/g were observed after 14 and 20 days of storage, respectively. *C. maltaromaticum* A9b and A10a grew rapidly at 5°C on cold-smoked salmon, increasing from an initial concentration of $7x10^6$ to approximately $4x10^8$ cfu/g after three days of storage, maintaining approximately $4x10^8$ cfu/g for the remainder of the study (Table 8).

Lewus *et al.* (1991) isolated two strains of *C. maltaromaticum* (GN and DX) from retail cuts of meat. Utilizing a bacterial overlay technique, the resulting zones of inhibition of growth of the pathogenic bacteria confirmed that these strains of *C. maltaromaticum* were antagonistic to four different strains of *L. monocytogenes* (Scott A, V7, 101m and 103m) and moderately antagonistic to *Aeromonas hydrophila* strains 7965 and K144.

An anti-listerial strain isolated from frozen surimi was identified as *C. maltaromaticum* CS526 and found to inhibit *L. monocytogenes* IID581 in cold-smoked salmon stored at refrigeration temperatures (Yamazaki *et al.*, 2003). In the absence of *C. maltaromaticum*, the *L. monocytogenes* grew from $1x10^6$ to approximately $1x10^9$ cfu/ml within three days in Trypticase Soy-Yeast Extract (TSYE) broth at 12°C. In contrast, *L. monocytogenes* viable counts declined to below the detection limit (10 cfu/ml) within one day and the organism was completely inhibited during incubation (seven days) in the presence of *C. maltaromaticum* CS526. Growth of *L. monocytogenes* in cold-smoked salmon in the absence of *C. maltaromaticum* increased from $1x10^3$ to $1x10^6$ cfu/g after 42 days at 4°C, 17 days at 12°C and 2 days at 20°C. Both *C. maltaromaticum* CS526 (a bacteriocin-producing strain) and *C. maltaromaticum* JCM5348 (which does not produce a bacteriocin) grew rapidly from initial inoculation levels of $1x10^6$ or $1x10^4$ cfu/g, respectively, to approximately $1x10^8$ to $1x10^9$ cfu/ml throughout the storage period. During co-culture with *C. maltaromaticum* CS526, at either 4°C or 12°C, *L. monocytogenes* populations decreased to below the detection limit (50 cfu/g of salmon) after seven days when

the initial inoculum levels of *C. maltaromaticum* CS526 were $1x10^6$ cfu/g of salmon. *L. monocytogenes* populations also decreased to below detection limits after 21 days at 4°C and 12 days at 12°C when the initial inoculum levels of *C. maltaromaticum* CS526 were $1x10^4$ cfu/g (Table 8). This work indicates that inhibition of *L. monocytogenes* is enhanced by increased concentrations of *C. maltaromaticum* and lowered incubation temperatures.

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15. Appendix D

Use of *C. maltaromaticum* as a Starter Culture for Commercial Fermented Sausage Production.

Lallemand S.A. of Toulouse, France, produces and markets a range of LAB for use in the French food industry, including sausage fermentation. *C. maltaromaticum* is among the bacterial species listed by this company for this food application. A memo from Institut Rosell (Lallemand) of Montreal, Canada, attesting to this fact, along with a page of a Lallemand S.A. product catalogue, attesting to the fact of use, have been included.

[Remainder of page blank]

INSTITUT ROSELI

Montreal. Quebec

January 25,2002

Senior Director of Development
Griffith Laboratories
757 Pharmacy Avenue
Toronto. ON M1L3JB

Dear Mr. Dariey,

This is to confirm that the bacteria (Carnobacterium piscicola) has been used in sausage fermentation in France for many years.

If you have any questions do not hesitate to contact me, by e-mail (ajoyeaux@lallemand.com).

Sincerely,

Dr. And re Joyeaux
Market Development Manager
Institut Rosell/ Lallemand

?480, boulevard SairK-Laurent Montreal (Quebec) Canada H2P 2Mb Telephone 1514) 381-5631 • 1-800-452-4364
T^lpcopieur (514) 383-4493 • Courriet coniact^rosell com

LALLEMAND
TC50

Bacterial Strains : *Staphylococcus xylosus and Staphylococcus carnosus*

Lactobacillus sake and Carnobacterium piscicola

CHARACTERISTICS :

QUALITY	Mechanism of action	Lactobacilles Pediocoques	Microcoques Staphyloc
COLOR	reduction of nitrates	-	+++
	lowering of pH	+++	-
	consumption of O_2		++
	degradation of H_2O_2	-	±
AROMAS	Acid production	+++	-
	Protein hydrolyzation		++
	Lipid hydrolyzation		++
	Reduction in rancidite	-	++
TEXTURE FIRMNESS	Reduction in pH	+++	-
CONSERVATION	Suppression of the undesirable bacteria	++	-
	Reduction of nitrates	-	++

APPLICATIONS :

The mixture TC 50 east is intended for the support of dry products.

Pediococcus and *Lactobacillus*:

Provides regular acidification and prolonged time for a good connection of the meats.

Limitation of the development of the undesirable enterobacterias.

Staphylococcus:

Development of the coloring and the taste of dry sausages

Reduction in the residual amount of nitrates and nitrites.

16. Appendix E

Table 9. Foods selected for consumption analysis of *C. maltaromaticum* (ordered by food code).

FOOD CODE	DESCRIPTION	*C. maltaromaticum* ADDED (cfu/g of meat)	*Percent (%)* of total consumption of *C. maltaromaticum*[18]
23322100	Deer Bologna	10000	0.0328
25210110	Frankfurter wiener or hot dog NFS	10000	2.7263
25210150	Frankfurter or hot dog cheese-filled	10000	0.0505
25210210	Frankfurter or hot dog beef	10000	8.9948
25210220	Frankfurter or hot dog beef and pork	10000	3.0623
25210230	Frankfurter or hot dog beef and pork lowfat	10000	0.9155
25210250	Frankfurter or hot dog meat & poultry fat free	10000	0.2226
25210280	Frankfurter or hot dog meat & poultry	10000	1.3047
25210310	Frankfurter or hot dog chicken	10000	0.6235
25210410	Frankfurter or hot dog turkey	10000	1.2922
25210610	Frankfurter or hot dog beef lowfat	10000	0.1624
25210700	Frankfurter or hot dog meat & poultry lowfat	10000	0.0678
25220010	Cold cut NFS	10000	0.0205
25220100	Beef sausage NFS	10000	0.1552
25220110	Beef sausage brown & serve links cooked	5000	0.0826
25220120	Beef sausage smoked stick (include beef jerky)	10000	0.0612
25220130	Beef sausage smoked	10000	1.0471
25220140	Beef sausage fresh bulk patty or link cooked	5000	0.0632
25220350	Bratwurst cooked	5000	0.6471
25220390	Bologna beef low fat	10000	0.0551
25220400	Bologna pork and beef	10000	0.9724
25220410	Bologna NFS	10000	4.5450
25220420	Bologna Lebanon	10000	0.5302
25220430	Bologna beef	10000	1.0281
25220440	Bologna turkey	10000	0.4377
25220450	Bologna ring smoked	10000	0.0856
25220460	Bologna pork	10000	0.1059
25220470	Bologna beef lower sodium	10000	0.0287

[18] Consumption of each food was determined from an initial two-day intake survey acquired by the USDA's Continuing Survey of Food Intakes by Individuals and a weighted average of the amount (in grams) of each food eaten was extrapolated for the US population at the time of the survey. This gram amount of each food was then multiplied by the amount of *C. maltaromaticum* added *per* gram weight and divided by the total US population to obtain a percentage of the total amount of *C. maltaromaticum* ingested, when added to the foods specified.

FOOD CODE	DESCRIPTION	*C. maltaromaticum* ADDED (cfu/g of meat)	*Percent (%)* of total consumption of *C. maltaromaticum*[18]
25220480	Bologna chicken beef & pork	10000	0.1194
25220500	Bologna beef & pork lowfat	10000	0.2625
25220510	Capicola	10000	0.3115
25220710	Chorizos	10000	0.8460
25220910	Head cheese	10000	0.0307
25221210	Mortadella	10000	0.0643
25221250	Pepperoni	10000	0.7992
25221310	Polish sausage	10000	4.0309
25221350	Italian sausage	10000	1.7101
25221400	Sausage (not cold cut) NFS	10000	0.0559
25221410	Pork sausage fresh bulk patty or link cooked	5000	2.1181
25221420	Pork sausage brown & serve cooked	5000	0.4895
25221430	Pork sausage country style fresh cooked	5000	0.0203
25221460	Pork & beef sausage	10000	0.3050
25221470	Pork & beef sausage brown & serve cooked	5000	0.0921
25221480	Mettwurst	10000	0.2336
25221500	Salami NFS	10000	4.8150
25221520	Salami dry or hard	10000	0.3845
25221530	Salami Beef	10000	0.1184
25221610	Scrapple cooked	5000	0.1269
25221650	Smoked link sausage pork	10000	1.4479
25230310	Chicken/turkey loaf pre-pkg'd/deli luncheon meat	10000	9.6836
25230410	Ham loaf luncheon meat	10000	0.0694
25230430	Ham & cheese loaf	10000	0.1125
25230510	Ham lunch meat chop minced pressed minced not canned	10000	0.8951
25230520	Ham luncheon meat chopped spiced lowfat not can	10000	0.1244
25230530	Ham/pork luncheon meat chopped can (including spam)	10000	0.7590
25230560	Liverwurst	10000	0.9349
25230610	Luncheon loaf (olive pickle or pimiento)	10000	0.6365
25230710	Sandwich loaf luncheon meat	10000	0.3629
25230790	Turkey ham sliced extra lean pkg'd deli	10000	0.9747
25230800	Turkey ham	10000	0.7869
25230810	Veal loaf	10000	0.0931
25230820	Turkey pastrami	10000	0.1704
25230840	Turkey salami	10000	0.2609

FOOD CODE	DESCRIPTION	*C. maltaromaticum* ADDED (cfu/g of meat)	*Percent (%)* of total consumption of *C. maltaromaticum*[18]
25230900	Turkey or chicken breast pkg'd/deli luncheon meat	10000	3.7329
25231110	Beef sliced prepackaged/deli luncheon meat	10000	2.6110
25231150	Corned Beef pressed	10000	0.4076
25240000	Meat spread or potted meat NFS	10000	0.0084
25240210	Ham deviled or potted	10000	0.1379
25240310	Roast beef spread	10000	0.0686

NFS = Not food specific

Pages 000172-000227 of Curriculum Vitae removed in accordance with the Privacy Act of 1974.

Pages 000228 - 000429 have been removed in accordance with copyright laws. Please see appended bibliography list of the references that have been removed from this request.

Griffith Laboratories (2003b) Inactivation of Bacteriocins Produced by *Carnobacterium piscicola* CB1 by Pepsin in Simulated Gastric Fluid and Activity of Various Digestive Enzymes Against Inhibitory Substances Produced by *Carnobacterium piscicola* UAL 307 *(Internal Report)*.

Inactivation of Bacteriocins Produced by *Carnobacterium piscicola* CB1 by Pepsin in Simulated Gastric Fluid

CanBiocin Inc.
June 2003

Preparation of SGF (Simulated Gastric Fluid)

Dissolve 20 mg of sodium chloride and 0.32% (w/v) of purified pepsin in 70 ul of hydrochloric acid and sufficient water to make 10 ml. The pH should be ~1.2. Store solution at 4°C.

Reference: Anonymous. Simulated Gastric Fluid and Simulated Intestinal Fluid, TS. In *The U.S. Pharmacopoeia 26, The National Formulary 18* ; The U.S. Pharmacopoeia Convention, Inc.: Rockville, MD, 2000; p. 2235.

Procedure For Enzyme Inactivation Assay

- Grow producer organism *Carnobacterium piscicola* CB1 overnight at 25°C in APT broth.
- Centrifuge the fully-grown culture at 15,000 x *g* for 5 min, remove and heat the supernatant at 60°C for 30 min.
- Place aliquots of SGF (95 ul) in 1.5 ml Eppendorf tubes and hold at 37°C in a water bath for 10 min.
- Add 5ul of CB1 or 10X CB1 concentrated supernatant to each tube.
- Incubate samples for intervals 0, 0.5, 2, 10 and 30 min and test for bacteriocin activity.

- Add 36 ul 0.2 M Na_2CO_3 to each vial to stop the reaction.
- Spot 10 ul sample from each time interval onto an APT plate.
- Overlayer the plate with *Listeria monocytogenes* CDC 7762.

Fu, T., U. Abbott, C. Hatzos. Digestibility of Food Allergens and Nonallergenic Proteins in Simulated Gastric Fluid and Simulated Intestinal Fluid - A Comparative Study. *J. Agric. Food Chem.* 2002, 50, 7154-7160.

Fu,T. Digestion Stability as a Criterion for Protein Allergenicity Assessment. *Ann N.Y. Acad. Sci.* 2002, 964, 99-110.

Astwood, J.D., J. Leach, R. Fuchs. Stability of food allergens to digestion in vitro. *Nat. Biotechnol.* 1996, 14, 1269-1273.

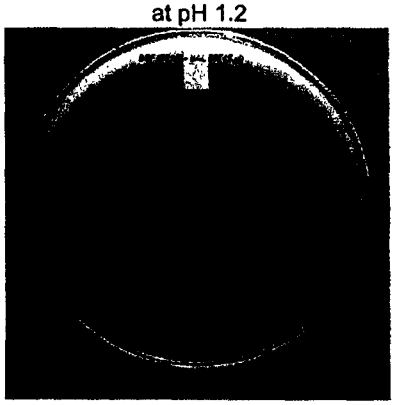
Different Treatments Performed In Experiment

- Alter percentage of pepsin in SGF solution from 0.32 to 0.02%.
- Alter pH of the SGF solution from pH 1.2 up to 4.
- Change amount of CB1 bacteriocin added to the SGF solution (from 5 ul up to 95 ul).
- Change amount (95 to 35 ul). of SGF solution and add to CB1 supernatant (bacteriocin)

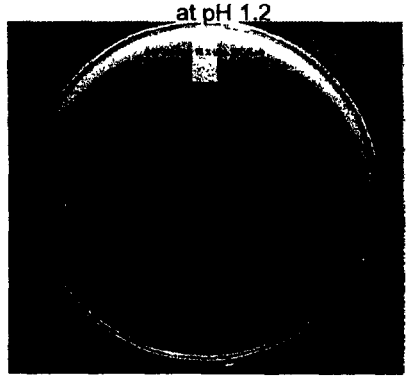
Effects of Treatments on the Presence (+/-) of CB1 Bacteriocin

	UAL 307						10 X UAL 307				
	Time (minutes)						Time (minutes)				
Treatments	0	0.5	2	10	30		0	0.5	2	10	30
Pepsin											
0.32%, pH 1.2	+	-	-	-	-		+	-	-	-	-
0.16%, pH 1.2	+	-	-	-	-		+	+	-	-	-
0.08%, pH 1.2	+	-	-	-	-		+	+	-	-	-
0.04%, pH 1.2	+	-	-	-	-		+	+	-	-	-
0.02%, pH 1.2	+	-	-	-	-		+	+	-	-	-
pH											
0.32%, pH 1.2	+	-	-	-	-		+	-	-		-
0.32%, pH 2	+	-	-	-	-		+	+	-	-	-
0.32%, pH 3	+	slight +	-	-	-		+	+	+	+	slight +
0.32%, pH 4	+	-	-	-	-		+	+	+	+	slight +
Bacteriocin Added											
5 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
15 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
35 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
55 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
75 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
95 ul to 95 ul SGF	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
SGF Added											
95 ul to 5 ul of 307	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
75 ul to 5 ul of 307	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
55 ul to 5 ul of 307	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A
35 ul to 5 ul of 307	+	-	-	-	-		N/A	N/A	N/A	N/A	N/A

CB1 Bacteriocin Inactivation by Pepsin in SGF at pH 1.2



CB1 Bacteriocin (10X) Inactivation by Pepsin in SGF at pH 1.2



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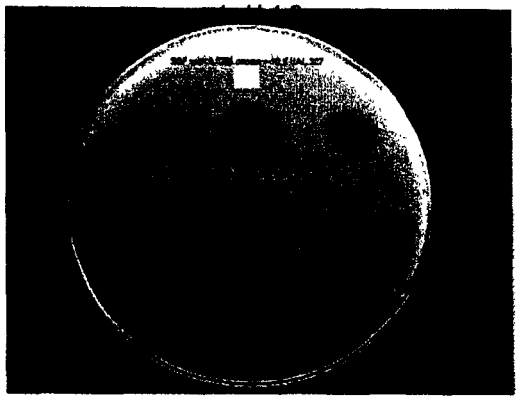
CB1 Bacteriocin Inactivation by 0.02% Pepsin in SGF



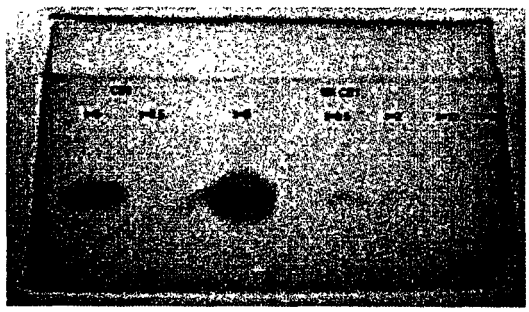
Activity Level (AU) of Bacteriocin

Serial doubling dilutions (1:1) were spotted onto APT plates and overlayered with *Listeria monocytogenes* CDC 7762

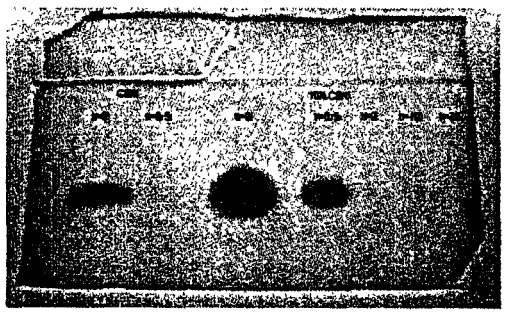
Indicator	CBT	10X CBT
CDC 7762	12 800	102 400

Data are reported as activity units (AU) per mL

SDS-PAGE Gel overlayered with L. m. 7762 to Illustrate Bacteriocin Inactivation by Pepsin in SGF at pH 1.2



SDS-PAGE Gel overlayered with L. m. 7762 to Illustrate Bacteriocin Inactivation by 0.02% Pepsin in SGF at pH 1.2



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Activity of Various Digestive Enzymes Against Inhibitory Substances Produced by *Carnobacterium piscicola* UAL 307 - Part 1

Draft Report by CanBiocin Inc.

17 March 2003

Digestive Enzyme Assay
Spot On Lawn Procedure

- UAL 307 was grown in APT broth at 25°C for 24 h.
- 1ml of UAL 307 supernatant was placed into an Eppendorf tube
- Centrifuge at 12000 rpm for 5 min.
- Supernatant removed and placed into a new Eppendorf tube
- heat at 60°C for 30 min in a hot water bath
- Spot 10*ul* of UAL 307 heat-treated supernatant onto the surface of an APT agar plate and dry completely

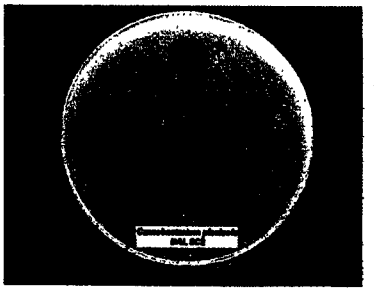
- Spot 5 *ul* of trypsin, chymotrypsin and pronase E (10 mg/ml) to the right of the dried UAL 307supernatant spot
- Spot 5 *ul* of pepsin-treated supernatant and untreated control at the bottom of the plate (see description of this procedure later)
- Dry proteases spots completely and incubate at 30°C for 2 h.
- Overlayer the dried plates with 6 ml of soft APT agar (0.75%) containing 60 *ul* of an indicator organism
- Incubate for 24 h: *Carnobacterium piscicola* at 25°C;*Listeria monocytogenes*, *Enterococcus faecium* and *Staphylococcus aureus* at 37°C; *Pediococcus acidilactici* at 30°C

- the following indicators were used:
  - *Carnobacterium piscicola* UAL 9
  - *Carnobacterium piscicola* UAL 8C2
  - *Pediococcus acidilactici* PA 1.0
  - *Listeria monocytogenes* CDC 7762
  - *Listeria monocytogenes* HPB 642
  - *Listeria monocytogenes* NCTC 5105.3
  - *Listeria monocytogenes* ATCC 15313
  - *Listeria monocytogenes* SCOTT A
  - *Enterococcus faecium* 19434
  - *Staphylococcus aureus* S13

Protocol for Pepsin Treatment and Control

- Place 10 ml of UAL 307 supernatant in a Falcon tube
- Centrifuge at 12000 rpm for 5 min.
- Remove supernatant and place in a new tube
- Adjust pH of supernatant to pH 2.0 with conc. HCl
- Add pepsin to give a final concentration of 10 mg/ml and hold at 37°C for 2 h
- Adjust reaction mixture to pH 4.0 with 10M NaOH
- Spot 5 *ul* onto APT plates and overlayer

Spot On Lawn Plates



Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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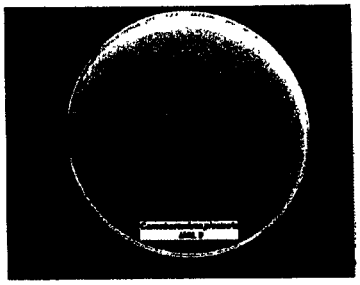

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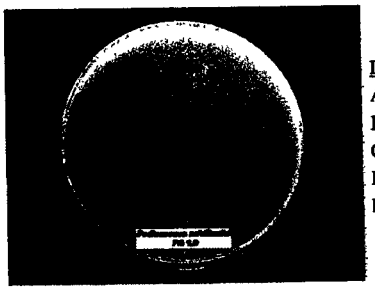

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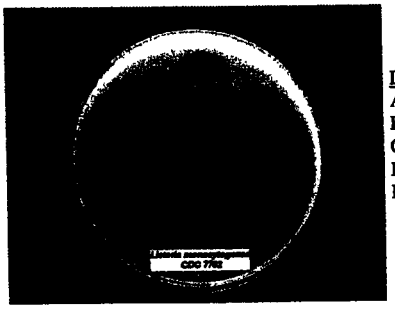

Legend:
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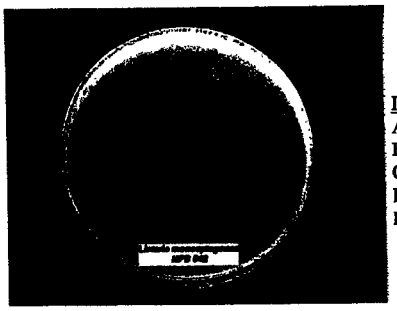
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
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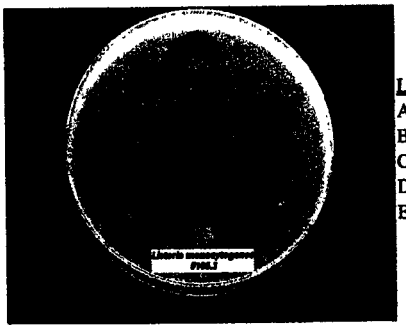
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
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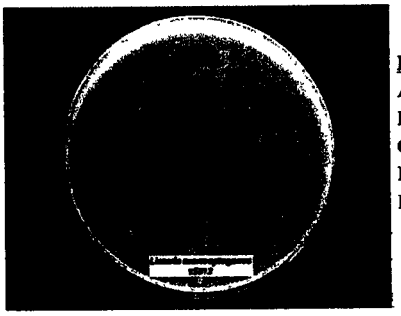
C = chymotrypsin
D = pepsin control
E = pepsin treatment



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B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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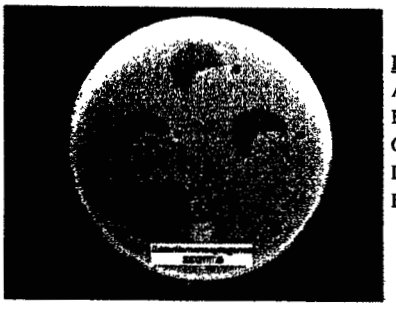

Legend:
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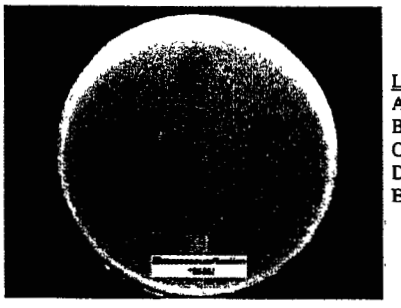
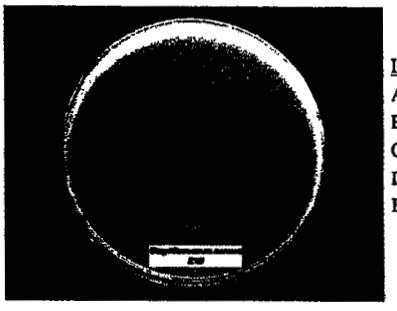
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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Activity of Various Digestive Enzymes Against Inhibitory Substances Produced by *Carnobacterium piscicola* UAL 307 Part 2

Draft Report by CanBiocin Inc.

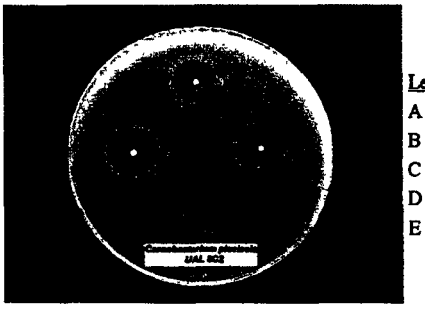
17 March 2003

Digestive Enzyme Assay
Deferred Inhibition Procedure

- Grow 5 ml of UAL 307 at 25 °C for 24 h.
- Spot (*ca.* 2 *ul*) UAL 307onto APT plates using a replicate platre
- Dry the plates and incubate at 25 °C for 24 h.
- Chloroform fixed for 3 min.
- Spot 10 *ul* of pronase E, trypsin and chymotrypsin (10mg/ml) next to the UAL 307 colony
- Spot 10 *ul* of the pepsin treatment and pepsin control at the bottom of the plate
- Dry and hold the plates at 30 °C for 2 h.

- Overlayer the plates with soft APT agar containing an indicator (same as the spot on lawn experiment)
- Dry the plates and incubate for 24 h at the appropriate temperature for the indicator strain

Deferred Inhibition Plates



Legend:
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B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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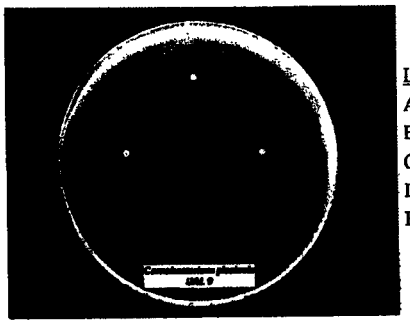
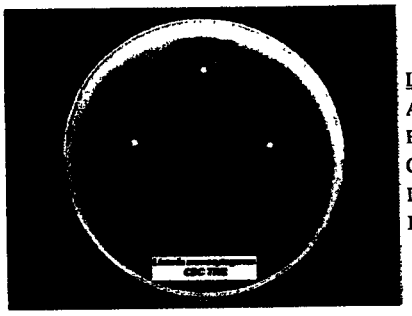


Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
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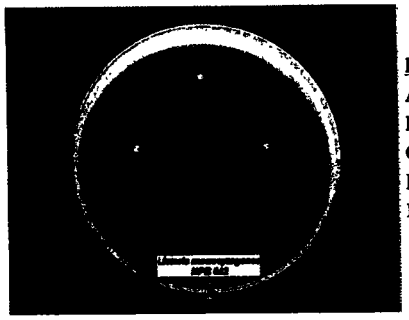
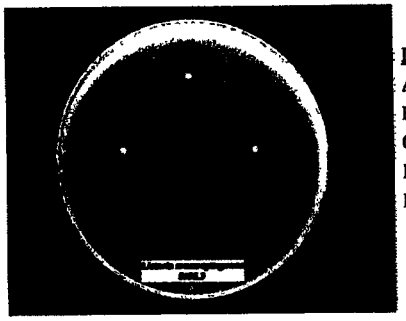
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
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B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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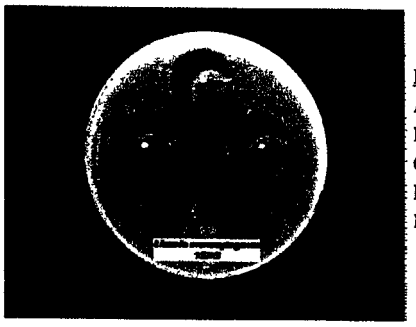
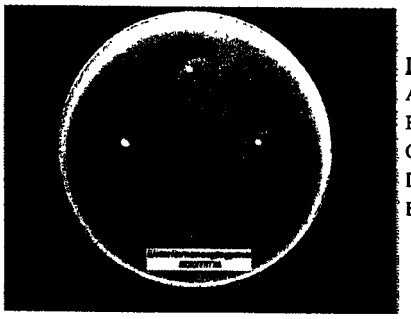
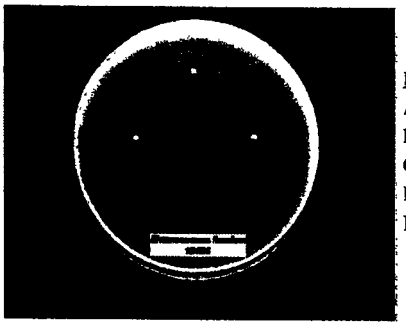


Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment



Legend:
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B = trypsin
C = chymotrypsin
D = pepsin control
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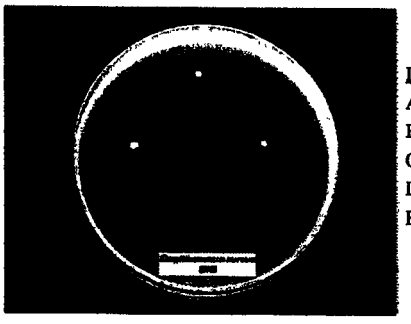

Legend:
A = pronase E
B = trypsin
C = chymotrypsin
D = pepsin control
E = pepsin treatment

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Activity of Various Digestive Enzymes Against Inhibitory Substances Produced by *Carnobacterium piscicola* UAL 307 - Part 3

Draft Report by CanBiocin Inc.

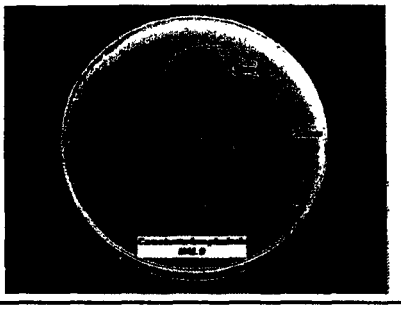
17 March 2003

Digestive Enzyme Assay
Time Dependent Experiment

- This experiment was done due to meas ure the effect of carboxypeptidases A and B and amino-peptidase the inhibitory substances produced by UAL 307
- Heat-treated supernatant + proteases were incubated up to 6 h at 37°C and tested for activity
- Pepsin treatment and pepsin control were prepared as described earlier
- Add 100 *ul* of carboxypeptidase A (5 mg/ml), B and aminopeptidase (10 mg/ml) separately to 1 ml of UAL 307 in Eppendorf tubes
- Incubate at 37°C up to 6 h.

- Remove a 100*ul* aliquot from each tube at 0, 1, 2, 4 and 6 h. and freeze at -20°C
- Spot 10 *ul* of sample from each time point onto APT plates
- Dry and overlayer with soft APT agar containing an indicator organism
- Incubate for 24 h at appropriate temperature for the indicator organism

Time Dependent Plates with UAL 9 Indicator Carboxypeptidase A



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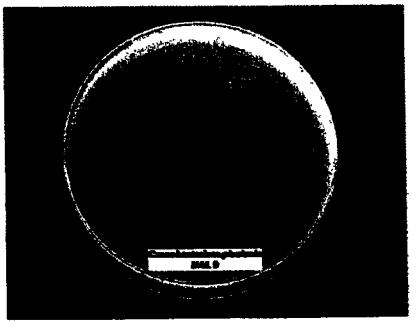
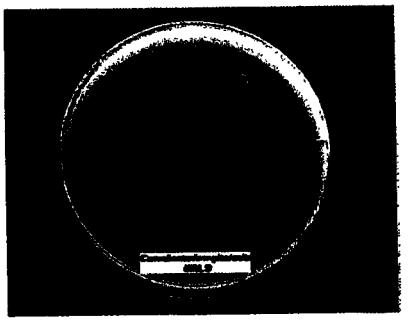
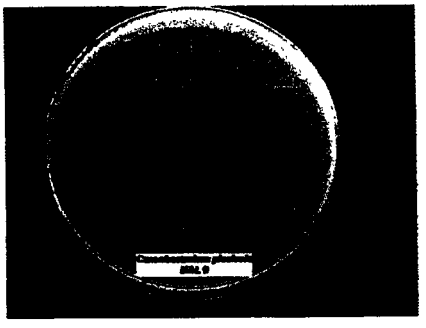
Time Dependent Plates with UAL 9 Indicator
Carboxypeptidase B



Time Dependent Plates with UAL 9 Indicator
Aminopeptidase



Time Dependent Plates with UAL 9 Indicator
Pepsin



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MANUFACTURING PROCESS

Micocin X is produced by a well known and well documented contained system of pure culture fermentation of *Carnobacterium maltaromaticum*. Following fermentation the fermentation medium is pasteurized. The lyophilized or spray-dried pasteurized concentrate is then tested against product specifications, and packaged for commerce. The Micocin X preparation is manufactured in accordance with current good manufacturing practice (cGMP) for foods, and in accordance with all applicable environmental and bio-safety regulations.

RAW MATERIALS USED IN THE MICOCIN X MANUFACTURING PROCESS

All of the raw materials (Table 1) used in the fermentation and formulation stages of the Micocin X manufacturing process are appropriate for their intended use and are either approved food additives or generally recognized as safe (GRAS) for use in food manufacture. All of the materials are food grade, where available, or high-quality chemical or pharmaceutical grades (USP, ACS, or reagent grades) from approved suppliers.
Where applicable, materials are subject to quality inspection before use, including a review of the manufacturer's certificate of analysis to assure conformance with specifications, along with a visual inspection or identification test.

Table 1. Raw materials used in the manufacturing process for Micocin X™

Substance	CAS[a] Registry No.	Other References
Dextrose (glucose, D-)	14431-43-7	IFN[b] 4-24-966
Maltodextrin (malto dextrins)	9050-36-6	IFN 4-08-023 GRAS[c] 184.1444
Sodium phosphate, dibasic (Na_2HPO_4)	7558-79-4	IFN 6-04-286
Vegetable protein, hydrolyzed	100209-45-8	
Yeast nitrogen base	008013-01-2	

a. CAS = Chemical Abstracts Series
b. IFN = International Feed Number
c. GRAS = Generally recognized as safe, reference is section in U.S. Code of Federal Regulations (CFR) 21.

The fermentation medium contains a carbon and energy source (primarily dextrose), nitrogen sources (food grade yeast nitrogen base and hydrolyzed vegetable protein), and disodium hydrogen phosphate (Na_2HPO_4) to control the pH during the fermentation process.

MASTER AND WORKING CELL BANKS

A working cell bank (WCB), which is prepared from a master cell bank (MCB), is used for all fermentation operations. The manufacturing MCB and WCB vials contain *Carnobacterium maltaromaticum* bacterial culture with 50% (v/v) glycerol added as a cryoprotectant. The master cell bank is stored at –80°C and serves as the parent to all working cell banks used for manufacturing.

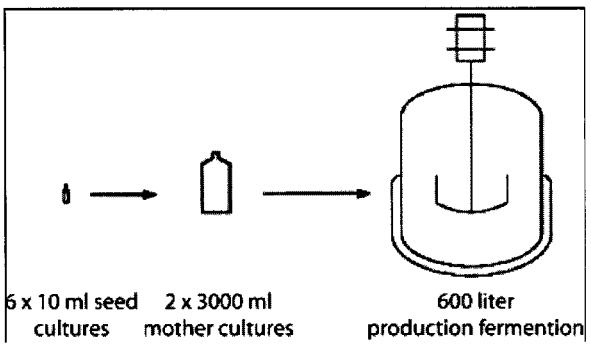
Table 2. Quality control parameters for master and working cell banks.

Master and Working Cell Banks -- Quality Control Parameters	
Control Parameter	**Action**
Culture purity (Absence of contaminating organisms)	Samples from 1 of every 10 master cell bank vials are subjected to RAPD marker analysis to confirm strain purity. Samples from 1 of every 10 master and working cell bank vials are subjected to standard microbiological analysis, including: 1. Total aerobic plate count on Plate Count agar (PCA; Difco) incubated aerobically at 25°C, 48 hr; 2. Lactic acid bacteria on APT agar (Difco) incubated anaerobically (BBL Anaerobic System with 10% CO2) at 25°C, 48hr; and 3. Enterobacteriaceae on Violet Red Bile Agar with 1% added glucose (VRBG, Difco) incubated at 35°C, 4-18 hrs.
Morphological Check	Samples from 1 of every 10 master and working cell bank vials are checked microscopically for typical morphology.
Growth	The seed flasks used to make the cell bank (and subsequent test seed flasks inoculated from the cell bank) achieve a minimum OD (A650) of between 1.1 - 1.2 after 20-24 hours of growth at 22°C.
Productivity	The measured bacteriocin activity of a test seed flask inoculated from the working cell bank after 16-24 hours of growth is at least 800 U/ml using the spot-on-lawn inhibition test.

The MCB was tested initially for cultural purity by API strip analysis and random amplified polymorphic DNA (RAPD) marker analysis acceptable productivity, and typical morphology and growth. The master and working cell banks will be similarly tested every 12 months to confirm the maintenance of good growth and productivity (Table 2).

SEED CULTURE, SEED FLASK AND FERMENTATION

Seed Culture



The build-up of the seed culture begins by inoculating six sterile culture tubes containing 10 ml APT (All Purpose Tween; steam sterilized 121°C, 15 min) with a flame-sterilized and cooled loop full of frozen cells aseptically transferred from a working cell bank vial. The seed culture is incubated at room temperature (~22-26°C). Acceptable growth is achieved when a minimum turbidity of OD650nm between 1.1 – 1.2 is obtained within 20-24 hours. A second 10 ml culture tube of APT broth is then inoculated with 10 µl of fully-grown culture and incubated for 20-24 hours.

Mother Culture

The final seed stage culture is initiated by inoculating 2 pre-sterilized (121°C, 45 min) and cooled 3-liter Nalgene plastic bottles each containing 3000 ml of APT medium with 3 ml of *Carnobacterium maltaromaticum* seed culture. The mother cultures are incubated at room temperature (~22-26°C). Acceptable growth is achieved when a minimum turbidity of OD650nm between 1.1 - 1.2 is obtained within 20-24 hours.

Fermentation

The production fermentation is conducted in a stainless steel fermentation vessel (Escan Metal) of approximately 800 liters (600 liters working volume). The vessel is carefully designed, constructed, operated, cleaned and maintained to prevent contamination by foreign microorganisms. The vessel is pasteurized with steam at a minimum temperature of 95°C for a minimum of 30 min. The fermentation medium (dextrose, food grade yeast nitrogen base, hydrolyzed vegetable protein, disodium hydrogen phosphate) is pasteurized along with the fermentation vessel.

The contents of two 3-liter mother cultures are aseptically transferred to the production fermentation vessel, which is maintained at 25°C with gentle agitation (10 rpm). The fermentation is monitored spectrophotometrically (A650 nm) and by plating onto APT agar until a cell density of 10_9 - 10_{10} CFU/ml is reached (10-12 hours).

After fermentation the product will be either lyophilized or spray-dried to remove water.

LYOPHILIZATION

Pasteurized Cell Fraction

The production fermentation is pasteurized (60°C, 30 min) and a viable cell density of <= 10,000 CFU/g is ensured. Maltodextrin (60 kg) is added to a final concentration of 10% (w/v) as a stabilizing agent for lyophilization. The resulting slurry is mixed (5 min) to ensure homogeneity.

Lyophilization

The pasteurized cell fraction is aliquoted into stainless steel trays (approx. 2 l/tray, 32 trays per freeze-dryer) and placed into the freeze-driers. The first step in the freeze-drying stage is to freeze the trays to a temperature of -20°C. Once frozen, a vacuum is pulled into the freeze-drier (0.1 mm Hg) and heat is applied to the trays (40°C) to sublimate the water in the product until it is completely lyophilized (48 h). The lyophilized material is scraped from the trays, ground and placed into polyethylene bags, and double-bagged prior to placing into refrigerated storage (20-22°C).

SPRAY-DRY

Mixing

Maltodextrin (60 kg) is added to the production fermentation at a final concentration of 10% (w/v) as a stabilizing agent for evaporation and spray-drying. The resulting slurry is mixed (5 min) to ensure homogeneity and sampled to ensure a 13 -14.5% solids content.

Evaporation

The slurry is fed into an evaporator with the tube heated to 45-55 °C and pressure set to 0.5-0.55 atm. Water is evaporated from the slurry until 45-50% solids content is achieved.

Spray-drying

The evaporated product is fed into a spray drier or tower preheated to 180°C. The slurry is first pumped through an atomizer or rotary nozzle. The outlet product temperature should be 80°C. The dried material descends to the bottom of the tower and is sampled for residual moisture (<5.0%) and collected into polyethylene bags and double bagged prior to placing in refrigerated storage (20-22°C).

MILLING

Only the lyophilized cell fraction is processed through a milling machine (Apex Mill model 114S2 SN: S15418) at high speed using a screen with 0.097 inch mesh size. Bags of material are emptied progressively into the milling machine intake and milled material is collected into a polylined plastic drum. Drums are placed into refrigerated storage (4-8 °C).

SANITATION

There are three potential points of release of the microorganism from the manufacturing facilities, first as liquid residues from fermentation vessels, secondly as solids from the lyophilization process or finally from the evaporation and spray-drying process. Standard risk mitigation measures to prevent the environmental release of viable bacteria include the use of disinfectants to clean work surfaces and treat residual liquid wastes and autoclaving of residual solid wastes.
All equipment and work surfaces in contact with the live cell fraction are sanitized using 5% (v/v) Desi Fome (Constant America, DIN#01924486; sodium hypochlorite solution) disinfectant with a 15 minute contact time, which has been shown to be effective in killing *C. maltaromaticum* (Appendix A-8; Lyo-San, Inc.). Equipment and work surfaces are then rinsed and cleaned using normal cleaning and sanitation procedures.

Any solid product containing the live cell fraction that is recovered during sanitation procedures is autoclaved prior to disposal.

PRODUCT FORMULATION AND SPECIFICATIONS

The lyophilized or spray-dried cell fractions are analyzed microbiologically for: total lactic acid bacteria; non lactic acid bacteria; yeast; molds; total coliforms; *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* species.
Only lots meeting product specifications are approved for use in product formulation. Lots that do not meet specifications are placed in a holding section for review by the Non-Conforming Material committee. If the material is deemed outside specification limits, Quality Assurance personnel will place a tag on the container documenting all appropriate product information, date and the reason for the non conformance. If the bacteriocin activity is outside product specifications, the product will be re-blended to meet the required specification. A deviation for high moisture content will result in further drying in order to meet specifications. If the product does not meet the microbiological specifications for *Salmonella*, *E. coli*, *S. aureus*, total coliforms, yeasts or molds, the product will be denatured by the addition of a 200 ppm solution of sodium hypochlorite. Autoclaving may be used as an alternative to hypochlorite denaturing. The product will then be disposed of, as applicable to the jurisdiction of the manufacturing facility.

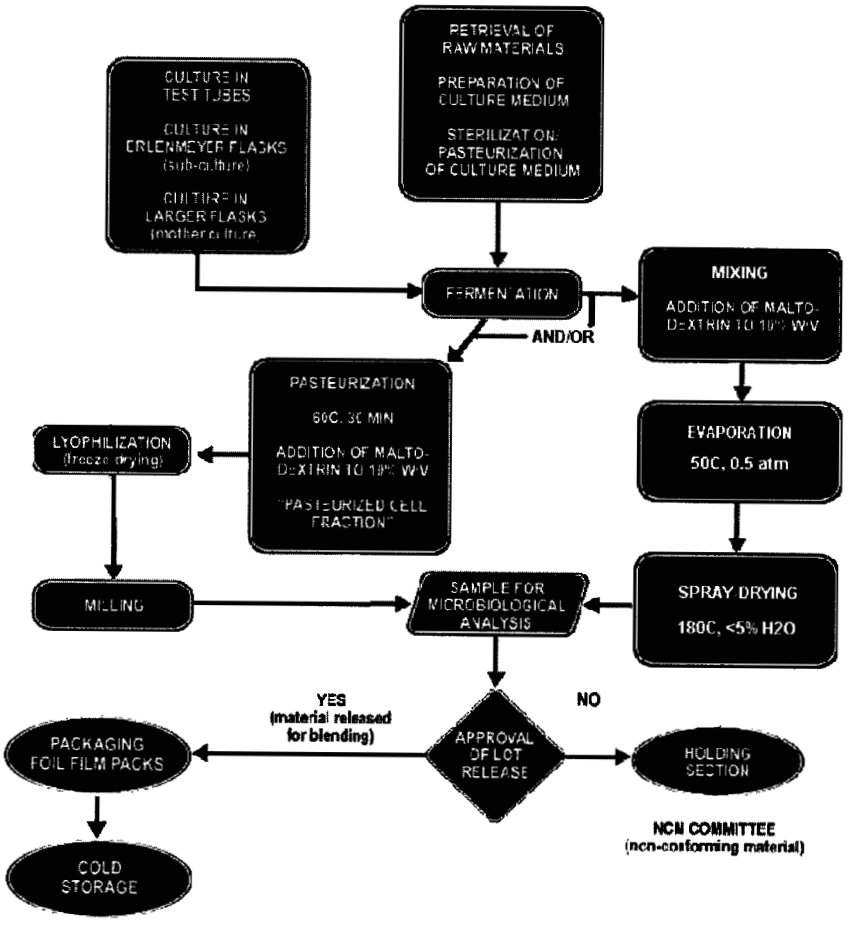
PACKAGING

The dried blend is packaged into plastic foil film packages using a vacuum packager (Multivac A300/16 SN: 1570). Package weight is customized to the finished product application and packages are stored under cool dry conditions prior to distribution.

STORAGE

The dry product can be stored under cool dry conditions in the final product packaging for up to 12 months at ambient temperature (22°C) without any bacteriocin activity decrease below 2,500 AU/g.
Based on the minimum product specifications and the accelerated shelf-life study, the predicted shelf-life at 22°C of bacteriocin activity was 153 weeks (*ca.* 2.9 years) and 323 weeks (*ca.* 6 years). These data fully support the claimed product shelf-life of at least 1 year when stored at 22°C. These studies are continuing as it is expected that the shelf-life stability, as measured in real time, may be longer than 12 months.

PROCESS CONTROL FLOW CHART FOR THE PRODUCTION OF MICOCIN X



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Griffith Laboratories (2008b) Process control flow chart for the production of Micocin X.

GRIFFITH LABORATORIES
the FOOD architects

Product Specifications

Micocin X
Version: 1.0

Last Change: 20 August 2008

A dry-formulated pasteurized bacterial culture of *Carnobacterium maltaromaticum*. The product is prepared by lyophilizing or spray-drying a culture of *C. maltaromaticum* in the presence of maltodextrin to increase stability and product shelf life. The product is manufactured in accordance with current good manufacturing practice (cGMP) for foods, and in accordance with all applicable environmental and biosafety regulations.

Physical Specifications	Specification Limits	Test Method
Appearance	Light tan-coloured free-flowing homogenous powder	Visual inspection
Residual moisture	<5.0%	AOAC 925.45.B 44.1.03

Chemical Specifications

Bacteriocin activity (AU/g)	2,500	SOP 2.10

Microbial Specifications

Total Plate Count (CFU/g)	$<1.0 \times 10^4$	MFHPH-18
Yeast Molds (CFU/g)	<10 /g	MFHPB-22
Coliforms (CFU/g)	<10 /g	MFHPB-34
Staphylococcus aureus (CFU/g)	<10 /g	MFHPH-21
Escherichia coli (CFU/g)	<10 /g	MFHPB-34
Salmonella sp. (CFU/25 g)	Absent in 25 g	MFHPB-20

Packaging: Plastic foil film packages containing variable quantities depending on final application.

Storage Conditions: Store in a dry, cool room at ambient temperature.

Shelf Life: 12 months under ambient storage conditions (22°C) in original sealed packaging.

757 Pharmacy Avenue, Toronto, ON M1L 3J8
Tel (416) 288-3050, Fax. (416) 288-3481
www.griffithlabs.com

UNIVERSITY of GUELPH
LABORATORY SERVICES
Agriculture and Food Laboratory

FINAL Report
Submission# **09-027754**
Reported: 2009-Apr-24

Submitted By:

GRIFFITH LABORATORIES
DENISE CARLSON
757 PHARMACY AVE
TORONTO, ON M1L 3J8

Phone: 800 263-4476
Fax: 416 288-3481

Owner:
WAN YIEN

Received Date: 2009-Apr-15
Quotation #: QE0050-05

Biogenic Amines

Date Authorized: 2009-Apr-24 16:15

Sample ID	Client Sample ID	Specimen	Sampling date/ time	Test	Result		Note
0001	1	Cheese		Tyramine	Not detected	ppm	
0002	2	Cheese		Tyramine	Not detected	ppm	
0003	3	Cheese		Tyramine	Not detected	ppm	
0004	4	Cheese		Tyramine	Not detected	ppm	
0005	5	Cheese		Tyramine	Not detected	ppm	
0006	6	Cheese		Tyramine	1.0	ppm	
0007	7	Cheese		Tyramine	6.3	ppm	
0008	8	Cheese		Tyramine	17	ppm	
0009	9	Cheese		Tyramine	11	ppm	
0010	10	Cheese		Tyramine	Not detected	ppm	
0011	11	Cheese		Tyramine	Not detected	ppm	
0012	12	Cheese		Tyramine	Not detected	ppm	
0013	13	Cheese		Tyramine	Not detected	ppm	
0014	14	Cheese		Tyramine	Not detected	ppm	
0015	15	Cheese		Tyramine	Not detected	ppm	
0016	16	Cheese		Tyramine	Not detected	ppm	
0017	17	Cheese		Tyramine	6.5	ppm	
0018	18	Cheese		Tyramine	Not detected	ppm	

Comments:

Samples 09-027754-0006, -0007, -0008, -0009 and -0017 showed a peak with a retention time very close (2.9 min) to that observed for tyramine in both standards and Quality Control samples (2.7 min). Additional investigation could not determine if this peak was tyramine, an interfering compound or a combination of both. The results reported for these samples assume that the peak in question is only tyramine.

Results corrected for recovery from QC samples. Tyramine recovery from cottage cheese = 51%.

000448

Griffith Laboratories (2009) Tyramine formation. Laboratory Report. Report Number: 09-027754.

The following is the coding for the cottage cheese Biogenic Amine samples:

Micocin II samples
1 - Day 0 - A
2 - Day 0 - B
3 - Day 0 - C
4 - Day 7 - A
5 - Day 7 - B
6 - Day 7 - C
7 - Day 14 - A
8 - Day 14 - B
9 - Day 14 - C

Uninoculated samples
10 - Day 0 -A
11 - Day 0 -B
12 - Day 0 -C
13 - Day 7 - A
14 - Day 7 - B
15 - Day 7 - C
16 - Day 14 - A
17 - Day 14 - B
18 - Day 14 - C

	Reference Amount (g or ml)	Tyramine content (µg/g)	Tyramine per reference amount (mg)
Sliced turkey with Micocin	55	133.0000	7.32
Sliced ham with Micocin	55	74.0000	4.07
Sliced roast beef with Micocin	55	78.0000	4.29
Control sliced roast beef	55	82.7000	4.55

This is our data, content is average of the 3 points at the end of shelf-life.

Pages 000451 - 000849 have been removed in accordance with copyright laws. Please see appended bibliography list of the references that have been removed from this request.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Memorandum of Telephone Conversation

Date: September 8, 2009

Between: Moraima Ramos-Valle HFS-255
Bianca Farias HFS-255 (ORISE Fellow)

and

George A. Burdock, Ph.D. Burdock Group Consultants (407-802-1409)
Agent for Griffith Laboratories

Subject: Submission for *Carnobacterium maltaromaticum*

FDA representatives called Dr. Burdock regarding his submission dated August 28, 2009 which requested new food uses for *Carnobacterium maltaromaticum*, the subject of GRN 159. Ms. Ramos informed Dr. Burdock that we received his submission but some items need to be amended before filing the submission as a GRAS notice.

(1) Ms. Ramos asked Dr. Burdock to please revise the GRAS exemption claim, to reflect that the notifier is taking responsibility for the GRAS determination. Dr. Burdock agreed to revise the GRAS exemption claim according to the GRAS proposed rule criteria.

(2) Page seven and eight of the submission are marked confidential. We noted that even though page seven was stamped confidential in the submission, it was not in GRN 159. We explained that we do not consider any of the information to be confidential and that the materials in GRN 159 are already available to the public. Dr. Burdock agreed to resend those pages without the confidential stamp.

(3) Ms. Ramos asked Dr. Burdock to please include the consumption information available in the submission, as part of the GRAS exemption claim section.

Dr. Burdock, agreed to make the necessary changes to the submission and resend the revised materials.

Later that day, Ms. Ramos received a phone call from Mr. Ray Matulka with the Burdock Group (407) 802-1400, ext. 164. asking for clarification on the page numbers in the submission that included the consumption information.

Bianca Farias

(b) (5)

(b) (5)

BURDOCK GROUP
Consultants

801 North Orange Avenue
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Orlando, Florida 32801
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e•gburdock@burdockgroup.com

September 10, 2009

Laura Tarantino, Ph.D.
Office of Food Additive Safety (HFS-200)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5100 Paint Branch Parkway
College Park, MD 20740-3835

RE: Viable and heat-treated *Carnobacterium maltaromaticum* CB1 GRAS Notification

Dear Dr. Tarantino:

In accordance with proposed 21 CFR § 170.36 (a notice of a claim for exemption based on a GRAS determination) published in the Federal Register (62 FR 18937-18964), I am submitting in triplicate, as the agent of the notifier, Griffith Laboratories, 757 Pharmacy Ave., Toronto, Ontario M1L 3J8 Canada, a GRAS notification for the use of viable and heat-treated *Carnobacterium maltaromaticum* CB1 as a preservative, at a maximum inoculation concentration of viable *C. maltaromaticum* CB1 at 1x109 colony forming units/day to ready-to-eat meat products, meat, poultry and fish products, frozen meals, processed fruit salads and vegetable salads, sauces, and soft cheese and cheese spread-type products. Heat-treated *C. maltaromaticum* CB1 will be used in ready-to-eat meat products, meat, poultry, fish and mixtures, fruits and vegetables, soups and stews, sauces and dressings, and cheese and cheese spread-type products. The GRAS expert panel dossier, setting forth the basis for the GRAS determination, as well as *curriculum vitae* of the members of the GRAS panel, is enclosed.

Best regards,

(b) (6)

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition

000851

1. GRAS Exemption Claim

A. Claim of Exemption from the Requirement for Premarket Approval Pursuant to Proposed 21 CFR 170.36(c)(1)

An independent panel of recognized experts (hereafter also referred to as the "Expert Panel") was requested by Griffith Laboratories, 757 Pharmacy Ave, Toronto, Ontario M1L 3J8 Canada, to critically evaluate the available safety information on viable and heat-treated *Carnobacterium maltaromaticum* CB1 meeting appropriate food grade specifications and manufactured in compliance with current Good Manufacturing Practices (cGMP). The Expert Panel determined the product described in the previous sentence is generally recognized as safe (GRAS) and; on the advice of the Expert Panel, Griffith Laboratories also declares this same product is GRAS and therefore, exempt from the requirement of premarket approval, under the conditions of its intended use as described below. The basis for this finding is described in the following sections.

Signed,

(b) (6) [redacted]

Date 10 Sep 09

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition
801 N. Orange Avenue Suite 710
Orlando, FL 32801

000852

(i) Name and Address of the Notifier

Griffith Laboratories
757 Pharmacy Ave
Toronto, Ontario
M1L 3J8 Canada

Agent of the Notifier:

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition
Burdock Group
801 N. Orange Ave. Suite 710
Orlando, FL 32801
Telephone: 407-802-1400
Facsimile: 407-802-1405
Email: gburdock@burdockgroup.com

(ii) Common Name of the Notified Substance

The common name of viable and heat-treated *Carnobacterium maltaromaticum* CB1, for the purposes of this GRAS Notification has been defined as:

"bacterial culture" or "*Carnobacterium maltaromaticum*"

(iii) Conditions of Use

Viable *Carnobacterium maltaromaticum* CB1 may be used as an ingredient in the food groups shown in Table 1 as a preservative, at levels up to $1x10^9$ colony forming units (cfu) *per* gram, as a preservative to inhibit growth of *Listeria monocytogenes*.

Table 1. Food groups selected for viable *C. maltaromaticum* CB1 supplementation

Food Category	Intended use level (cfu/g)
Ready-to-eat meat products	$1x10^4 - 1x10^9$
Meat, poultry and fish products	$1x10^4 - 1x10^9$
Frozen meals	$1x10^4 - 1x10^9$
Processed fruit salads and vegetable salads	$1x10^4 - 1x10^9$
Sauces	$1x10^4 - 1x10^9$
Soft cheese and cheese spread-type products	$1x10^4 - 1x10^9$

cfu = colony forming units

Heat-treated *C. maltaromaticum* CB1 may be used as an ingredient in the food groups shown in Table 2 as a preservative to inhibit growth of *Listeria monocytogenes*, at up to 5000 ppm, with typical use at between 1000 – 5000 ppm.

Table 2. Food groups selected for heat-treated *C. maltaromaticum* CB1 supplementation

Food Category	Intended use level (ppm)
Ready-to-eat meat products	1000-5000
Meat, poultry, fish and mixtures	1000-5000
Fruits and vegetables	1000-5000
Soups and stews	1000-5000
Sauces and dressings	1000-5000
Cheese and cheese spread-type products	1000-5000

ppm = parts *per* million

(iv) Basis of GRAS Determination

Pursuant to 21 CFR § 170.3, the use of viable and heat-treated *C. maltaromaticum* CB1 as an ingredient in food categories shown in Table 1 and Table 2, respectively, which could result in a maximum 90th percentile consumption of *C. maltaromaticum* CB1 at 1.4×10^{11} cfu *per* day from either of the two sources, has been determined GRAS by scientific procedures for its intended conditions of use. In general, a consumption analysis[1] was conducted for this GRAS determination based on a list of foods generated by searching the NHANES (2003-2004) database using descriptor words. Only those foods which represented a target food were selected for inclusion into the analysis. The consumption calculations in this GRAS determination include use of viable or heat-treated *C. maltaromaticum* CB1 product to be applied to food categories stated the previous GRAS dossier[2], in addition to the new food categories in this GRAS determination. The amount of *C. maltaromaticum* CB1 expected to be on the product at the time of consumption was then multiplied by the amount of each food consumed *per* day, averaged for the population of eaters, then extrapolated out the US population. Viable and heat-treated *C. maltaromaticum* would not be added to the same food product, and therefore the levels of consumption would not be additive in nature. The use of viable *C. maltaromaticum* CB1 in the foods stated in Table 1 resulted in a mean and 90th percentile daily intake of 3.4×10^{10} cfu/day (5.4×10^{8} cfu/kg/day) and 1.1×10^{11} cfu/day (1.7×10^{9} cfu/kg/day), respectively. These numbers incorporate the growth characteristic of this bacterium on certain food products and the absence of growth on other food products, and that for certain food products *C. maltaromaticum* will be degraded during the cooking process. This results in an aggregate intake that does not exceed the original *per capita* consumption estimate for *C. maltaromaticum* of 1.41×10^{11} cfu/day.

An overall eaters only consumption for the mean and 90th percentile of the heat-treated *C. maltaromaticum* CB1 product added to the foods in Table 2 was determined to be 1.4 g/day (22.6 mg/kg/day) and 3.0 g/day (47.2 mg/kg/day) respectively, with the bulk of the weight being attributed to the addition of maltodextrin[3]. The calculated amount of heat-treated *C. maltaromaticum* CB1 product applied *per* gram of food is 0.3125 mg. Multiplication of the maximum concentration of added bacterial powder (3.2×10^{7} cfu/g of ingredient) times the maximum consumption level of 3.0 g/day equals 9.6×10^{7} cfu/day. The consumption estimates a maximum of 9.6×10^{7} cfu/day consumed across all food categories to which the heat-treated *C.*

[1] The revised consumption analysis was conducted using INHANES (2003-2004) survey data, and the mean and 90th percentile consumption values are based on the weight of the respondents that participated in the survey.
[2] Previous GRAS dossier included ready-to-eat (RTE) meat products and fresh comminuted, processed meat products; however, the original GRAS dossier was amended for use only in RTE products.
[3] Heat-treated *C. maltaromaticum* ingredient contains 72-76% maltodextrin.

maltaromaticum CB1 will be added, and a maximum consumption of 3 grams of bacterial powder *per* day, which does not exceed the consumption estimate of 1.41×10^{11} cfu/day as stated in the GRAS dossier FDA notification letter (GRN 000159).

The safety of the viable and heat-treated *C. maltaromaticum* product as a preservative is supported by isolation of the bacteria on food products already consumed by the population, prior use of the bacteria in sausage fermentation, and animal studies, as outlined in this GRAS dossier and GRN 000159.[4] This determination is based on the views of experts who are qualified by scientific training and experience to evaluate the safety of substances used as ingredients in food.

Isolation of *C. maltaromaticum* CB1 from foods already in use by the US population at levels similar to the concentration added to the food groups outlined in Table 1 and Table 2, allows for a categorical exclusion from the need for an environmental assessment, as indicated by 21 CFR § 25.32(r). Therefore, to the submitter's knowledge, no extraordinary circumstances exist that require submission of an environmental assessment.

(v) Availability of Information

The data and information that serve as a basis for this GRAS determination are available for Food and Drug Administration's (FDA) review and copying at a reasonable time at the office of:

George A. Burdock, Ph.D.
Diplomate, American Board of Toxicology
Fellow, American College of Nutrition
801 N. Orange Ave. Suite 710
Orlando, FL 32801
Telephone: 407-802-1400
Facsimile: 407-802-1405
Email: gburdock@burdockgroup.com
Alternatively, copies of data and information can be provided to FDA upon request, by contacting Dr. Burdock.

2. Detailed Information about the Identity of the Notified Substance

A. Identity

C. maltaromaticum CB1 is naturally selected non-genetically modified bacteria. The general descriptive characteristics of *C. maltaromaticum* CB1 are presented in Table 3.

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[4] The notice, filed October 14, 2004, listed seven *Carnobacterium maltaromaticum* strains for use in ready-to-eat and fresh comminuted meat products. An amendment dated January 27, 2005, limited the use to ready-to-eat meat products to conform with USDA regulations. An amendment, dated April 8, 2005, limited the subject of the notice to *Carnobacterium maltaromaticum* strain CB1 and provided information on the identity of this strain.

Table 3. General description and analytical information of viable *C. maltaromaticum* CB1

Bacterial name	*Carnobacterium maltaromaticum* CB1
Growth characteristics	Gram-positive, non-motile, non-spore forming rods occurring singly or in short chains. Colonies as pinpoint, convex, white, circular and nonpigmented when grown at 25°C for 24 hours on Trypticase Soy Agar. Optimal temperature for growth is 30°C, with a range between 6 – 40°C, with an optimal pH range from 6.0 – 7.0. It is facultatively anaerobic, with folic acid, riboflavin, panthothenate and niacin required for growth. Catalase and oxidase are not produced during growth, while arginine and esculin are hydrolyzed, with variable gas production
Packaging	The standardized, viable cell blend will be packaged into plastic foil film packages, flushed with nitrogen and the package weight will be customized to the finished product application such that between 10^3 and 10^4 viable *C. maltaromaticum* cells per gram of finished product will be achieved.
Storage	Store at ambient temperature (22°C)
Labeling	"*Carnobacterium maltaromaticum*" or "bacterial culture"
Functionality in Food	Inhibition of *Listeria monocytogenes* growth

Common or Usual Name:

The common name of *C. maltaromaticum* CB1 has been defined as "bacterial culture" or "*Carnobacterium maltaromaticum*".

B. Composition

The *Carnobacterium maltaromaticum* CB1 product (viable and heat-treated) contains *C. maltaromaticum* CB1 cells, fermentation medium and maltodextrin (an excipient for freeze drying). Maltodextrin and the fermentation medium materials have been designated as approved food additives or Generally Recognized As Safe (GRAS) for use in food manufacture.

C. Method of Manufacture of *Carnobacterium maltaromaticum* CB1

Viable and heat-treated *C. maltaromaticum* CB1 is manufactured by Griffith Laboratories in accordance with current good manufacturing practice (cGMP) for foods, and in accordance with all applicable environmental regulations to result in pure culture fermentation.

Viable *C. maltaromaticum* CB1 manufacturing procedures and specifications were described in detail in GRAS GRN 000159 and will not change with the added food categories. A detailed manufacturing flowchart is provided in Figure 1.

In the generation of the heat-treated *C. maltaromaticum* process modification of this food ingredient, immediately following the fermentation and pasteurization steps, there are two interchangeable processing methods to remove water: 1. lyophilization and milling, or alternatively, 2. evaporation and spray-drying. The fermentation medium is incubated at 25°C for 12-14 hours to achieve a cell density of 1×10^9-10^{10} cfu/ml. Following fermentation, maltodextrin[5] is added on a specific w/v[6] basis as a manufacturing aid to assist water removal. The fermented medium is pasteurized (*i.e.*, heat-treated, although the heat treatment does not

[5] Maltodextrin is a polysaccharide, produced from starch and is easily digestible. 21 CFR §184.1444 states that maltodextrin can be used in food with no limitation other than good manufacturing practice.
[6] w/v = weight *per* volume.

degrade all *C. maltaromaticum* cells, to yield a maximum viable cell density $\leq 1\times10^4$ cfu/g) and the product is either lyophilized and milled or alternatively, evaporated and spray-dried. The product concentrates are tested against product specifications, and once approved, packaged for commerce. A graphical depiction of the manufacturing process is shown in Figure 2.

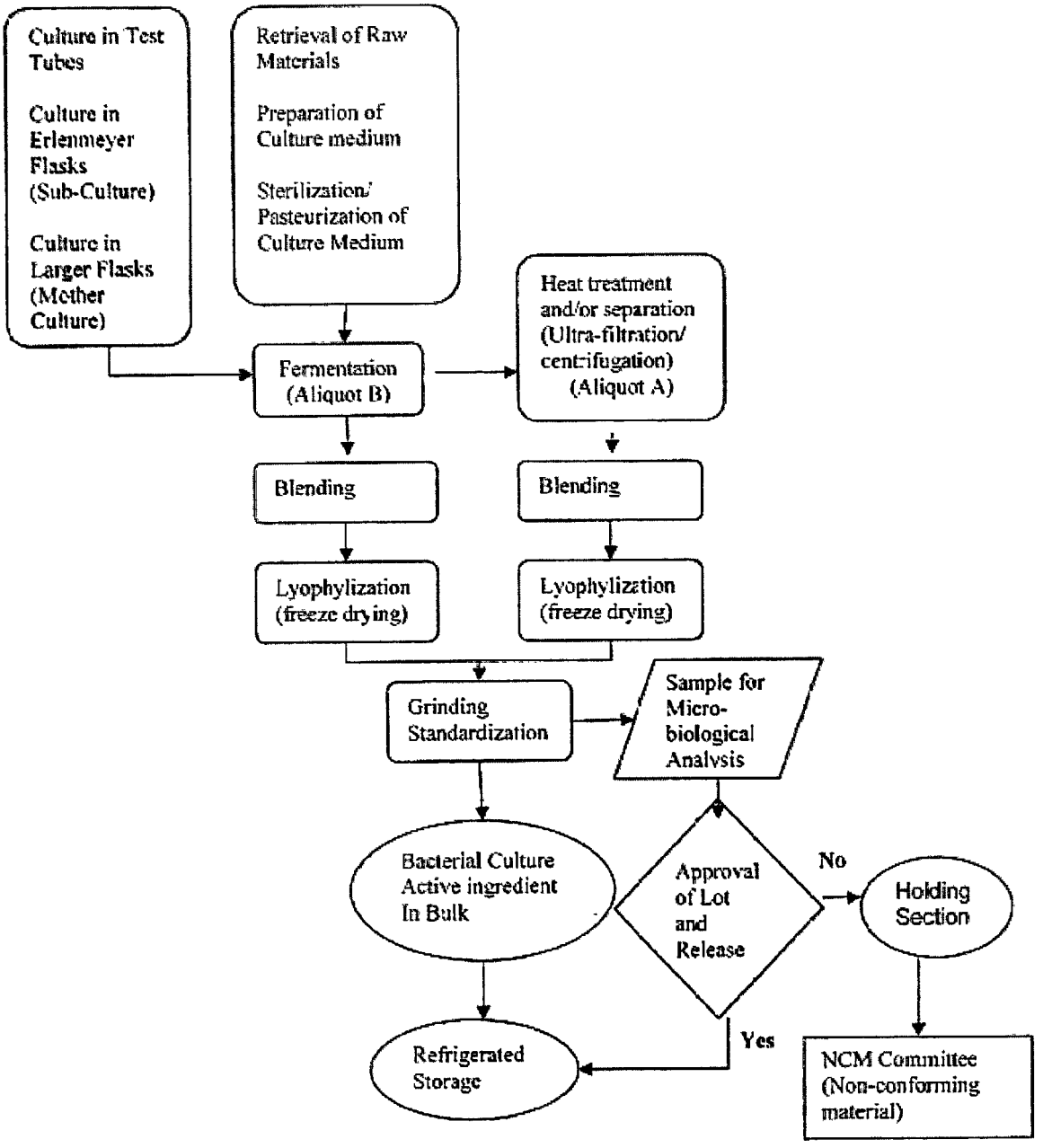

Figure 1. Schematic of the viable *C. maltaromaticum* CB1 manufacturing process

000857

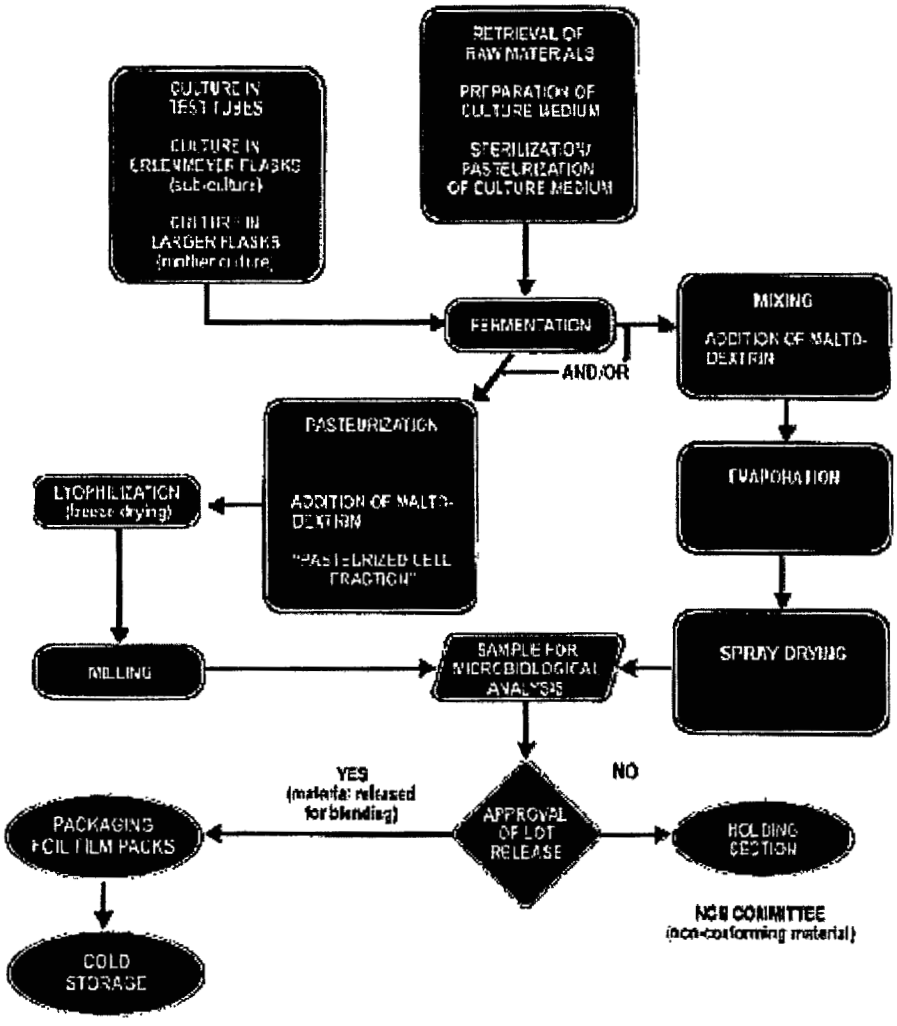

Figure 2. Process control flow chart for the production of heat-treated *C. maltaromaticum* CB1

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D. Specifications for Food Grade *Carnobacterium maltaromaticum* CB1

Viable *C. maltaromaticum* CB1 specifications were described in detail in GRAS GRN 000159 and will not change with the added food categories. Information regarding heat-treated *C. maltaromaticum* CB1 product specifications is provided in Table 4.

Table 4. Heat-treated C. *maltaromaticum* CB1 product specifications

Specification	Specification Limits	Test Method*
Physical Specifications		
Appearance	Light tan-colored free-flowing homogenous powder	Visual inspection
Residual Moisture	<5.0%	AOAC 925.45.B 44.1.03
Microbial Specifications		
Total Plate Count (CFU/g)	$<1.0\times10^4$	MFHPH-18
Yeast Molds (CFU/g)	<10/g	MFHPB-22
Coliforms (CFU/g)	<10/g	MFHPB-34
Staphylococcus aureus (CFU/g)	<10/g	MFHPH-21
Escherichia coli (CFU/g)	<10/g	MFHPB-34
Salmonella sp. (CFU/25g)	Absent in 25 g	MFHPB-20

*Test methods are available upon request; CFU = Colony Forming Unit

3. Self Limiting Levels of Use

The quantity of viable *C. maltaromaticum* CB1 is self-limiting, inhibiting its own growth to approximately 10^9 cfu/g.

4. Basis of GRAS Determination

The determination that *Carnobacterium maltaromaticum* CB1 is GRAS is on the basis of scientific procedures, as outlined in the attached **Dossier in Support of the Generally Recognized as Safe (GRAS) Status of Viable and Heat-treated *Carnobacterium maltaromaticum* CB1 as a Food Ingredient**. On the basis of the data and information described in the attached dossier and other publicly available information, there is consensus among experts qualified by scientific training and experience to evaluate the safety of substances added to food, that there is reasonable certainty that viable and heat-treated *Carnobacterium maltaromaticum* CB1 is GRAS under the intended conditions of use.

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September 14, 2009

Laura Tarantino, Ph.D.
c/o Ms. Moraima Ramos-Valle
Office of Food Additive (HFS-255)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5100 Paint Branch Parkway
College Park, MD 20740-3835

Re: *Carnobacterium maltaromaticum* CB1 GRAS Notification Request

Dear Dr. Tarantino,

We recently received a phone call from your office (Ms. Moraima Ramos-Valle (301) - 436-1248) concerning the GRAS Notification letter submitted by Burdock Group on behalf of Griffith Labs (dated 21August, 2009). During that conference call, three requests were identified:

1. Please provide the company's name that requested the GRAS determination.
2. Please remove the "business confidential" notation from the two figures in the GRAS Notification letter (and if necessary, alter the figures so that they do not provide detailed, proprietary information).
3. Provide a summary of the consumption methodology in the first few pages of the GRAS Notification letter.

We determined that the best way to address your requests was to revise the GRAS Notification letter, which is enclosed.

If you have any additional questions concerning this GRAS, please let me know.

Sincerely,

(b) (6)

Ray A. Matulka, Ph.D.

000860

Note to File

Subject: receipt of materials that make submission filable (GRN 305)

The Food and Drug Administration, Office of Food Additive Safety (OFAS), Division of Biotechnology and GRAS Notice Review (DBGNR) received a GRAS determination on September 1, 2009, made by Griffith Laboratories for the use of *Carnobacterium maltaromaticum* in foods including meat and poultry dated August 21, 2009. The notifier was notified by phone on September 8th, 2009 that some sections of the GRAS exemption claim were incomplete making his submission not filable.

On September 17, 2009, OFAS received the materials that make the submission complete and suitable for filing; therefore DBGNR considers this date to be the receipt date for the submission.

(b) (6)

Moraima J. Ramos Valle

(b) (6)

SUBMISSION END

Reference List for Industry Submission, GRN 000305

Pages	*Author*	*Title*	*Publish Date*	*Source*	*BIB_Info*
000117 - 000117	Carlson, Denise R.; Stiles, Michael E.; Smith, David C.; McMullen, Lynn M.	Fate of Listeria monocytogenes in a processed meat with sodium lactate and diacetate and a biopreservative	2007	NA	NA
000228 - 000232	Ahn, C., Stiles, M.E.	Antibacterial activity of lactic acid bacteria isolated from vacuum-packaged meats	1990	Journal of Applied Bacteriology	Volume 69, pgs 302-310
000233 - 000240	Ahn, Cheol; Stiles, Michael E.	Plasmid-Associated Bacteriocin Production by a Strain of Carnobacterium piscicola from Meat	August 1990	Applied and Environmental Microbiology	Volume 56, Number 8, pgs 2503-2510
000241 - 000249	Amezquita, A.; Brashears, M. M.	Competitive Inhibition of Listeria monocytogenes in Ready-to-Eat Meat Products by Lactic Acid Bacteria	2002	Journal of Food Protection	Volume 65, Number 2, pgs 316-325
000250 - 000256	Azuma, T.; Bagenda, D.K.; Yamamoto, T.; Kawai, Y.; Yamazaki, K.	Inhibition of Listeria monocyogenes by freeze-dried piscicocin CS526 fermentate in food	2007	Letters in Applied Microbiology	Volume 44, pgs 138-144
000257 - 000272	Brillet, Anne; Pilet, Marie-France; Prevost, Herve; Cardinal, Mireille; Leroi, Francoise	Effect of inoculation of Carnobacterium divergens V41, a biopreservative strain against Listeria monocytogenes risk, on the microbiological, chemical and sensory quality of cold-smoked salmon	2005	International Journal of Food Microbiology	Volume 104, pgs 309-324
000273 - 000282	Buchanan, Robert L.; Klawitter, Lori A.	Characterization of a Lactic Acid Bacterium, Carnobacterium Piscicola LK5, with Activity Against Listeria monocytogenes at Refrigeration Temperatures	1992	Journal of Food Safety	Volume 12, pgs 199-217

NA- Not applicable

Pages	Author	Title	Publish Date	Source	BIB_Info
000283 - 000292	Buchanan, R.L.; Klawitter, L.A.	Effectiveness of Carnobacterium Piscicola LK5 for Controlling the Growth of Listeria monocytogenes Scott A in Refrigerated Foods	1992	Journal of Food Safety	Volume 12, pgs 219-236
000293 - 000293	Carlson, Denise R.; Stiles, Michael E.; Smith, David C.; McMullen, Lynne M.	Fate of Listeria monocytogenes in a processed meat with sodium lactate and diacetate and a biopreservative	2007	NA	NA
000294 - 000383	Carr, Frank J.; Chill, Don; Maida, Nino	The Lactic Acid Bacteria: A Literature Survey	2002	Critical Reviews in Microbiology	Volume 28, Number 4, pgs 281-370
000384 - 000386	Chmelar, D.; Matusek, A.; Korger, J.; Durnova, E.; Steffen, M.; Chmelarova, E.	Isolation of Carnobacterium piscicola from Human Pus -- Case Report	2002	Folia Microbiologica	Volume 47, Number 4, pgs 455-457
000387 - 000393	Collins, M.D.; Farrow, J.A.E.; Phillips, B. A.; Ferusu, S.; Jones, D.	Classification of Lactobacillus divergens, Lactobacillus piscicola, and Some Catalase-Negative, Asporogenous, Rod-Shaped Bacteria from Poultry in a New Genus, Carnobacterium	Octiber 1987	International Journal of Systematic Bacteriology	Volume 37, pgs 310-316
000394 - 000401	Collins, M. D.; Rodrigues, U.; Ash, C.; Aguirre, M.; Farrow, J.A.E.; Martinez-Murcia, A.; Phillips, B. A.; Williams, A. M.; Wallbanks, S.	Phylogenetic analysis of the genus Lactobacillus and related lactic acid bacteria as determined by reverse trascriptase sequencing of 16S rRNA	1991	FEMS Microbiology Letters	Volume 77, pgs 5-12
000402 - 000412	Coventry, M. J.; Gordon, J. B.; Wilcock, A.; Harmark, K.; Davidson, B. E.; Hickey, M. W.; Hillier, A. J.; Wan, J.	Detection of bacteriocins of lactic acid bacteria isolated from foods and comparison with pediocin and nisin	1997	Journal of Applied Microbiology	Volume 83, pgs 248-258
000413 - 000421	di Cagno, Raffaella; Surico, Rosalinda F.; Siragusa, Sonya; de Angelis, Maria; Paradiso, Annalisa; Minervini, Fabio; de Gara, Laura; Gobbetti, Marco	Selection and use of autochthonous mixed starter for lactic acid fermentation of carrots, French beans or marrows	2008	International Journal of Food Microbiology	NA

NA- Not applicable

Pages	Author	Title	Publish Date	Source	BIB_Info
000422 - 000429	Donald, B.; Gibson, D. M.	Preliminary observations on the flora of fresh vacuum packed salmon steaks	1992	Quality Assurance in the Fish Industry	pgs 107-114
000451 - 000458	Herbin, Sabine; Mathieu, Florence; Brule, Fabienne; Branlant, Christiane; Lefebrvre, Gerard; Lebrihi, Ahmed	Characteristics and Genetic Determinants of Bacteriocin Activites Produced by Carnobacterium piscicola CP5 Isolated from Cheese	1997	Current Microbiology	Volume 35, pgs 319-326
000459 - 000471	Holzapfel, Wilhelm H.; Gerber, Elizabeth S.	Lactobacillus divergens sp. nov., a New Heterofermentative Lactobacillus Species Producing L(+)-Lactate	1983	Systematic and Applied Microbiology	Volume 4, pgs 522-534
000472 - 000493	Huss, Hans Henrik; Jeppesen, Vibeke From; Johansen, Charlotte; Gram, Lone	Biopreservation of Fish Products-- A Review of Recent Approaches and Results	1995	Journal of Aquatic Food Products Technology	Volume 4, Number 2, pgs 5-26
000494 - 000500	Jack, Ralph W. ; Wan, Jason; Gordon, Jonathan; Harmark, Kim; Davidson, Barrie E.; Hillier, Alan J.; Wettenhall, Richard E. H.; Hickey, Malcolm W.; Coventry, M. John	Characterization of the Chemical and Antimicrobial Properties of Piscicolin 126, a Bacteriocin Produced by Carnobacterium piscicola JG126	August 1996	Applied And Environmental Microbiology	Volume 62, Number 8, pgs 2897-2903
000501 - 000506	Jensen, R.L.; Pedersen, K.S.; Loeschcke, V.; Ingmer, H.; Leisner, J.J.	Limitations in the use of Drosophila melanogaster as a model host for gram-positive bacterial infection	2007	Letters in Applied Microbiology	Volume 44, pgs 218-223
000507 - 000517	Joffraud, Jean-Jacques; Cardinal, Mireille; Cornet, Josiane; Chasles, Jean-Sebastien; Leon, Sandrine; Gigout, Frederique; Leroi, Francoise	Effect of bacterial interactions on the spoilage of cold-smoked salmon	2006	International Journal of Food Microbiology	Volume 112, pgs 51-61
000518 - 000527	Kelly, W.J.; Asmundson, R.V.; Huang, C.M.	Isolation and characterization of bacteriocin-producing lactic acid bacteria from ready-to-eat food products	1996	International Journal of Food Microbiology	Volume 33, pgs 209-218
000528 - 000574	Klaenhammer, Todd R.	Genetics of bacteriocins produced by lactic acid bacteria	1993	FEMS Microbiology Reviews	Volume 12, pgs 39-85

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000575 - 000580	Lai, Sandra; Goodacre, Royston; Manchester, Lesley N.	Whole-organism Fingerprinting of the Genus Carnobacterium using Fourier Transform Infrared Spectroscopy (FT-IR)	2004	Systematic and Applied Microbiology	Volume 27, pgs 186-191
000581 - 000593	Lai, Sandra; Manchester, Lesley N.	Numerical phenetic study of the genus Carnobacterium	2000	Antonie van Leeuwenhoek	Volume 78, pgs 73-85
000594 - 000607	Laursen, Birgit Groth; Bay, Lene; Cleenwerck, Ilse; Vancanneyt, Marc; Swings, Jean; Dalgaard, Paw; Leisner, Jorgen J.	Carnobacterium divergens and Carnobacterium maltaromaticum as spoilers or protective cultures in meat and seafood: phenotypic and genotypic characterization	2005	Systematic and Applied Mcirobiology	Volume 28, pgs 151-164
000608 - 000615	Laursen, Birgit Groth; Leisner, Jorgen Johannes; Dalgaard, Paw	Carnobacterium Species: Effect of Metabolic Activity and Interaction with Brochothrix thermosphacta on Sensory Characteristics of Modified Atmosphere Packed Shrimp	2006	Journal of Agricultural and Food Chemistry	Volume 54, Number 10, pgs 3604-3611
000616 - 000637	Leisner, Jorgen J.; Laursen, Birgit Groth; Prevost, Herve; Drider, Djamel; Dalgaard, Paw	Carnobacterium: positive and negative effects in the environment and in foods	2007	FEMS Microbiology Reviews	Volume 31, pgs 592-613
000638 - 000643	Lewus, Catherine B.; Kaiser, Alan; Montville, Thomas J.	Inhitbition of Food-Borne Bacterial Pathogens by Bacteriocins from Lactic Acid Bacteria Isolated from Meat	June 1991	Applied And Environmental Microbiology	Volume 57, Number 6, pgs 1683-1688
000644 - 000651	McCabe-Sellers, Beverly J.; Staggs, Cathleen G.; Bogle, Margaret L.	Tyramine in foods and monoamine oxidase inhibitor drugs: A crossroad where medicine, nutrition, pharmacy, and food industry converge	2006	Journal of Food Composition and Analysis	Volume 19, pgs S58-S65
000652 - 000670	McCabe Beverly J.; Frankel, Eric H.; Wolfe, Jonathan, J.	Tyramine Content of Foods and Beverages in micrograms/g or micrograms/mL	2003	Handbook of Food-Drug Interactions	Appendix D.1, pgs 457-473

NA- Not applicable

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000671 - 000680	Mejiholm, O.; Boknaes, N.; Dalgaard, P.	Shelf life and safety aspects of chilled cooked and peeled shrimps (Pandalus borealis) in modified atmosphere packaging	2005	Journal of Applied Microbiology	Volume 99, pgs 66-76
000681 - 000689	Miller, A.; Morgan, M.E.; Libbey, L.M.	Lactobacillus maltaromicus, a New Species Producing a Malty Aroma	July 1974	International Journal of Systematic Bacteriology	Volume 24, Number 3, pgs 346-354
000690 - 000696	Milliere, J.B.; Lefebvre, G.	Carnobacterium piscicola, a common species of French soft cheeses from cow's raw milk	1994	Netherlands Milk and Dairy Journal	Volume 48, pgs 19-30
000697 - 000702	Milliere, J.B.; Michel, M.; Mathieu, F.; Lefebvre, G.	Presence of Carnobacterium spp. in French surface mould-ripened soft-cheese	1994	Journal of Applied Bacteriology	Volume 76, pgs 264-269
000703 - 000706	Mora, Diego; Scarpellini, Mauro; Franzetti; Laura; Colombo, Silvia; Galli, Antonietta	Reclassification of Lactobacillus maltaromicus (Miller et al. 1974) DSM 20342T and DSM 20344 and Carnobacterium piscicola (Collins et al. 1987) DSM 20730T and DSM 20722 as Carnobacterium maltaromaticum comb.nov.	2003	International Journal of Systematic and Evolutionary Microbiology	Volume 53, pgs 675-678
000707 - 000709	Nissen, Hilde; Holck, A.; Dainty, R.H.	Identification of Carnobacterium spp. and Leuconostoc spp. in meat genus-specific 16S rRNA probes	1994	Letters in Applied Microbiology	Volume 19, pgs 165-168
000710 - 000721	Paludan-Muller, Christine; Dagaard, Paw; Huss, Hans Henrik; Gram, Lone	Evaluation of the role of Carnobacterium piscicola in spoilage of vaccum- and modified- atmosphere-packed cold-smoked salmon stored at 5 degrees C	1998	International Journal of Food Microbiology	Volume 39, pgs 155-166
000722 - 000728	Pilet, Marie-France; Dousset, Xavier; Barre, Rachel; Novel, Georges; Desmazeaud, Michel; Piard, Jean-Christophe	Evidence for Two Bacteriocins Produced by Carnobacterium piscicola and Carnobacterium divergens Isolated from Fish and Active Against Listeria monocytogenes	March 1995	Journal of Food Protection	Volume 58, Number 3, pgs 256-262

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Pages	Author	Title	Publish Date	Source	BIB_Info
000729 - 000730	Rogosa, Morrison; Mitchell, Joyce A.; Wiseman, Ralph F.	A Selective Medium for the Isolation and Enumeration of Oral and Fecal Lactobacilli	1951	Journal of Bacteriology	Volume 62, pgs 132-133
000731 - 000747	Schillinger, U.; Stiles, M.E.; Holzapfel, W.H.	Bacteriocin production by Carnobacterium piscicola LV 61	1993	International Journal of Food Microbiology	Volume 20, pgs 131-147
000748 - 000754	Schobitz, R.; Zaror, T.; Leon, O.; Costa, M.	A bacteriocin from Carnobacterium piscicola for the control of Listeria monocytogenes in vacuum-packaged meat	1999	Food Microbiology	Volume 16, pgs 249-255
000755 - 000770	Settanni, Luca; Corsetti, Aldo	Application of bacteriocins in vegtable food biopreservation	2008	International Journal of Food Microbiology	Volume 121, pgs 123-138
000771 - 000786	Shaw, B.G.; Harding, Charmaigne D.	A numerical taxonomic study of lactic acid bacteria from vaccum-packed beef, pork, lamb and bacon	1984	Journal of Applied Bacteriology	Volume 56, pgs 25-40
000787 - 000796	Singh, Smita; Goswami, Pawas, Singh, Rameshwar; Heller, Knut J.	Application of molecular identification tools for Lactobacillus, with a focus on discrimination between closely related species: A review	2008	LWT - Food Science and Technology	pgs 1-10
000797 - 000825	Stiles, Michael E.; Holzapfel, Wilhelm H.	Lactic acid bacteria of foods and their current taxonomy	1997	International Journal of Food Microbiology	Volume 36, pgs 1-29
000826 - 000833	Stoffels, Geesje; Nes, Ingolf F.; Guthmundsdottir, Agusta	Isolation and properties of a bacteriocin-producing Carnobacterium piscicola isolated from fish	1992	Journal of Applied Bacteriology	Volume 73, pgs 309-316
000834 - 000844	Uhlman, L.; Schillinger, U.; Rupnow, J.R.; Holzapfel, W.H.	Identification and characterization of two bacteriocin-producing strains of Lactococcus lactis isolated from vegetables	1992	International Journal of Food Microbiology	Volume 16, pgs 141-151
000845 - 000849	Vescovo, Marisa; Scolari, Gianluigi; Zacconi, Carla	Inhibition of Listeria innocua growth by antimicrobial-producing lactic acid cultures in vacuum-packed cold-smoked salmon	2006	Food Microbiology	Volume 23, pgs 689-693

NA- Not applicable

AM

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December 18, 2009

ATTN: Dr. Stacey Williams
Office of Food Additive Safety (HFS-200)
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5100 Paint Branch Parkway
College Park, MD 20740-3835

Re: Request for electronic copy of Notification Documents

Dear Dr. Williams,

Thank you for returning my call in regard to the request by Dr. Zeitz at FSIS for electronic copies of GRN. 305 (*i.e.,* GRAS determination of *Carnobacterium maltaromaticum*). Enclosed are the 4 CDs that Dr. Zeitz requested, and the CD that you requested for FDA's records.

Please contact me if you have any questions concerning the documents enclosed in these CDs.

Sincerely,

(b)(6)

Ray A. Matulka, Ph.D.

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February 17, 2010

Stacey Williams, Ph.D.
Consumer Safety Officer
U.S. Food and Drug Administration
Center for Food Safety and Applied Nutrition
Office of Food Additive Safety
Stacey.Williams@fda.hhs.gov
Phone: 301-436-1291

Re: Initial Review Comments for GRN 000305

Dear Dr. Williams,

This letter is in response to your request email for clarification of some questions/comments from your review team received on February 3, 2010 via e-mail concerning GRN 000305. The questions are provided below as stated, with the reply following each question.

1. Does the number of 4.3 x 10^9 cfu/day reported in the last sentence on p. 14 refer to a mean value of consumed viable CB1 as described in GRN 159? Why are these EDI numbers reported on a *per capita* basis rather than for eaters only?

RE: The number (4.3×10^9 cfu/day) reported refers to the calculated mean EDI stated in the original GRAS (page 19) – utilizing the highest quantity of *Carnobacterium maltaromaticum* found on commercial meats in the published literature (5×10^7 cfu/g) when added to ready to eat (RTE) products and fresh, comminuted processed meat. The consumption of these products was calculated for eater's only from the CSFII, 1994-1996, 2000 USDA consumption intake data set. The heading in the original GRAS (page 19) should not have only specified "per capita", as both per capita and eater's only methods were described, with the eater's only data utilized to determine the calculated mean EDI (4.3×10^9 cfu/day).

FDA initially reviewed this data and in a conference call,[1] suggested that we alter the consumption analysis to indicate the maximal consumption of *C. maltaromaticum* if consumed on all meats, utilizing the *per capita* amount of meat consumed, as referenced on the USDA website at that time (2002 was the latest dataset). Utilizing the maximal growth at 1×10^9 cfu/g meat, multiplied by the average amount of meat eaten in the US *per* day (141g/day), yielded the maximum consumption of 1.41×10^{11} cfu/day.

[1] Conference call occurred on January 25, 2005, headed by Dr. Robert Merker at FDA/CFSAN.

2. Can you clarify how the daily intake values of 3.4×10^{10} cfu/day and 1.1×10^{11} cfu/day of viable CB1 (reported in the 2nd paragraph of p. 15) are obtained? The value of 1.1×10^{11} cfu/day, which represents the 90th percentile daily intake, is lower than the daily intake *per capita* consumption of viable CB1 (1.41×10^{11} cfu/day) reported in GRN 159. However, viable CB1 is added to more products in the current GRN notice.

RE: We took a realistic view of the potential for *C. maltaromaticum* growth on the additional foods to which *C. maltaromaticum* would be added. Manufacturing processes (e.g., canning, freezing, etc) would not allow for the growth of *C. maltaromaticum* to any appreciable extent. Because cooking food will kill *C. maltaromaticum*, the food products that would be heated would not contain high levels of viable *C. maltaromaticum* (if any at all). To be conservative, we analyzed the consumption from these foods at 1×10^4 cfu/g (the quantity added to the foods). These food products would include meats and meat products that are baked, boiled, fried, *etc.* The ready-to-eat meats specified in the original GRAS would still contain a maximum of 1×10^9 cfu/g *C. maltaromaticum*. A consumption analysis of these foods was conducted using the 2003-2004 NHANES data set. As a large number of people in the survey consumed a variable quantity of any of these food products, the relative average (and 90th percentile) amount of *C. maltaromaticum* consumed per person was found to be lower than the value calculated from the consumption of meat at the maximal growth concentration (1.41×10^{11} cfu/day).

3. Are the intake values of 3.4×10^{10} cfu/day and 1.1×10^{11} cfu/day reported on a *per capita* basis or for eaters only?

RE: No, the intake values are reported on an eater's only basis, utilizing the NHANES 2003-2004 consumption database.

4. On p. 16, please provide a sample calculation to clarify how the amount of CB1 product applied per gram food comes to be 0.3125 mg.

RE: This statement was based on the calculated average amount of CB1 would be directly added to food, based on pilot studies. However, it was later decided to utilize the maximum amount of the product to be added to the foods (*i.e.,* the complete product as applied to the food, which included *C. maltaromaticum* plus maltodextrin) in the GRAS consumption assessment (5 mg/g food). Therefore, this calculation should be disregarded.

5. The first paragraph on p. 16 is redundant as it states 9.6×10^7 cfu/day is consumed 3 times in 3 consecutive sentences. Can you please clarify the language, so the rationale is apparent?

RE: To clarify the consumption of heat-treated *C. maltaromaticum*: The heat-treated *C. maltaromaticum* product is to be applied to food products at a concentration of 1 – 5 mg/g food. Utilizing the 2003-2004 NHANES consumption data set, the amount of heat-treated *C. maltaromaticum* product consumed would be 1.4 and 3.0 g/day at the mean and 90th percentile, respectively, when consumed from the foods to which it was added.

To place this amount in the perspective of the amount of maximum *C. maltaromaticum* (cfu/day) that would be consumed, the concentration of *C. maltaromaticum* stated in the ingredient specification information supplied in the previous GRAS dossier (3.2×10^7 cfu/g ingredient) was multiplied by the amount of ingredient consumed *per* day (3.0 g/day at the 90th percentile). Therefore, the quantity of *C. maltaromaticum per* gram ingredient multiplied by the amount of

ingredient consumed *per* day results in 9.6 x 10^7 cfu/day consumed at the 90th percentile from the foods specified in the dossier to which heat-treated *C. maltaromaticum* will be added.

6. Heat-treated CB1 is measured and added to food on a g. ingredient/100 g food basis. However, the intake estimate of this particular product is being reported on a cfu/day basis. Can you please clarify the rationale for reporting intake of heat-treated CB1 on a cfu/day basis rather than mg. ingredient/100 g food basis?

RE: Even though the heat killed bacteria is not viable and therefore technically not able to form colonies, the rationale for reporting intake of heat-treated CB1 on a cfu/day basis was to compare with the theoretical amount of maximal *C. maltaromaticum* consumed as defined in the original GRAS (1.41×10^{11} cfu/day) and conclude that this level of heat-treated *C. maltaromaticum* would still be within the levels determined to be safe if all added *C. maltaromaticum* were viable.

Please let me know if you have any additional questions.

Sincerely,

(b)(6)

Ray A. Matulka, Ph.D.

AM

Williams, Stacey

Subject: Conference Call with Stacey Williams of the FDA
Location: Dr. Burdock's Office

Start: Fri 3/12/2010 10:00 AM
End: Fri 3/12/2010 11:00 AM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Good Morning Ms. Williams,

Please add to your calendar a conference call with Dr. Burdock, Dr. Ray Matulka and Arlene Morales on Friday, March 12th, 2010 at 10:00 AM EST to discuss Griffith Labs GRAS Notification. Forward this information to anyone else you feel should be included in this call. If there is a conflict please email or call me to reschedule a more conducive time.

Call into our teleconference number 1-800-444-2801 (conference code: 7750457)

Sincerely,

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March 18, 2010

Stacey Williams, Ph.D.
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Center for Food Safety and Applied Nutrition
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Phone: 301-436-1291

Re: Clarification of questions regarding GRN 000305

Dr. Williams,

In a recent teleconference (March 12, 2010), you requested additional clarification to the following question and response:

Your question:
Can you clarify how the daily intake values of 3.4 x 10^{10} cfu/day and 1.1 x 10^{11} cfu/day[1] of viable CB1 (reported in the 2nd paragraph of p. 15) are obtained? The value of 1.1 x 10^{11} cfu/day, which represents the 90th percentile daily intake, is lower than the daily intake per capita consumption of viable CB1 (1.41 x 10^{11} cfu/day) reported in GRN 159. However, viable CB1 is added to more products in the current GRN notice.

Burdock Group response:
We took a realistic view of the potential for *C. maltaromaticum* growth on the additional foods to which *C. maltaromaticum* would be added. Manufacturing processes (e.g., canning, freezing, etc) would not allow for the growth of *C. maltaromaticum* to any appreciable extent. Because cooking food will kill *C. maltaromaticum*, the food products that would be heated would not contain high levels of viable *C. maltaromaticum* (if any at all). To be conservative, we analyzed the consumption from these foods at 1 x 10^4 cfu/g (the quantity added to the foods). These food products would include meats and meat products that are baked, boiled, fried, *etc*. The ready-to-eat meats specified in the original GRAS would still contain a maximum of 1 x 10^9 cfu/g *C. maltaromaticum*. A consumption analysis of these foods was conducted using the 2003-2004 NHANES data set. As a large number of people in the survey consumed a variable quantity of any of these food products, the relative average (and 90th percentile) amount of *C. maltaromaticum* consumed per person was found to be lower than the value calculated from the consumption of meat at the maximal growth concentration (1.41 x 10^{11} cfu/day).

[1]cfu = colony forming units

To further clarify the food products utilized in the consumption calculation, we utilized the food products described in the 2003-2004 NHANES data set for the addition of viable C. maltaromaticum, as indicated in APPENDIX 1 (Foods selected for the consumption of viable *C. maltaromaticum*) of the GRAS dossier. The amount of viable *C. maltaromaticum* expected to be consumed from the food (cfu/g food product) was also provided in APPENDIX 1. Manufacturing processes used in the production of certain food products (*e.g.*, canning, freezing, cooking, *etc.*) that would not allow the growth of *C. maltaromaticum* were taken into account to determine the consumption of *C. maltaromaticum*. Although these types of manufacturing processes would realistically destroy the *C. maltaromaticum* bacteria, to be conservative the amount of *C. maltaromaticum* ($1x10^4$ CFU/g) was retained for these food products. Those foods that could possibly provide for the growth of *C. maltaromaticum* (*e.g.*, RTE meats) still retained a maximum of $1x10^9$ cfu/g *C. maltaromaticum*. Utilizing the NHANES consumption database, the daily amount of *C. maltaromaticum* (average and 90th percentile) was calculated by the amount of *C. maltaromaticum* added to the food (or the maximal growth level) multiplied by the amount of that food product consumed. The mean and 90th percentile (weighted) intake values (mean at $3.4x10^{10}$ cfu/day and 90th at $1.1x10^{11}$ cfu/day) were calculated (utilizing the NHANES dataset for those foods to which *C. maltaromaticum* will be added) to be lower than the *per capita* consumption ($1.41x10^{11}$ cfu/day).

If you have any further questions regarding this clarification, or any other part of GRN 000305, please let me know.

Sincerely,

(b) (6)

for Ray A. Matulka, Ph.D.
Director, Toxicology