Summary & Glossary of NAS Comprehensive GRAS Food Ingredient Survey-The Use of Substances "**Generally Recognized as Safe**" ("**GRAS**") A Brief, Non-technical summary 7/20/73

Summary and Glossary of NAS Comprehensive GRAS Food Ingredient Survey

The Use

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Substances "Generally Recognized as Safe"

("GRAS")

A brief, non-technical summary

July 20, 1973

The purpose of this discussion is to review in a cursory, non-technical way, the background, purpose, values, and limitations of a major effort to gather data relating to the use of food ingredients which are generally recognized as safe ("GRAS").

Not only this summary discussion, but the full report should be read carefully by those intending to make any use of the data.

1. Background and Purpose

A review of the safety and appropriate classification of substances "generally recognized as safe" ("GRAS")[1] for their intended use in food, requires (1) identifying each substance, and (2) gathering for each substance all available data on its toxicity and occurrence in foods. Both kinds of data are necessary, since the safety of a substance is determined by considering both its toxicity--how little or great its inherent capacity to cause harm--and the amount of the substance to which we are exposed.

Determining exposure requires two primary types of information: First, how much of each GRAS substance is used in each clearly defined food category? Second, how much is eaten of each food category in which the GRAS substance is used?

2. Survey Procedure

As part if the GRAS review, a special subcommittee of the National Academy of Sciences conducted a survey designed to provide information on the probable and possible intake of such food ingredients. The subcommittee used both its own facilities and those of several industry groups. This took the form of a complex, comprehensive survey of the chemical and food processing industries to determine the exact identity and specifications of the

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(1) See Glossary of Terms for definition of underlined words

substances added to various foods. The survey obtained confidential information from each participating firm on each GRAS ingredient used, the food categories in which used, and the usual and maximum levels of use in each food category. Responding firms indicated the importance they attached to each ingredient, the earliest date of use, and the poundage of the ingredient they committed to the food supply. The survey provided much additional data on toxicology, natural occurrence, and other information relevant to the evaluation of safety. The Committee made use of other surveys which covered specialized ingredient areas, such as flavors, the ingredients used in chewing gum and certain candies, and brewed beverages. A separate survey covered infant foods.

These usage data were reviewed for consistency, accuracy, and appropriateness, referred to the originators for correction or confirmation where necessary, tabulated in a way to preserve confidentiality and collated to provide information of more direct value in safety evaluation.

In order that information on the amounts of each ingredient used in food be applied to the estimation of possible human intake, the Committee obtained from the Market Research Corporation of America (MRCA) data from a survey of frequency of consumption of all food items eaten in or away from home. These data were reclassified to fit within the food categories employed in the Academy survey of

ingredient usage by the food industry. Data on portion size obtained from a USDA survey were employed to complete the calculation of "average" and "high" consumption of each food category used in the survey. The data finally presented on each GRAS substance included weighted means of the usual and maximum use in each food category, potential "average," and high intakes from each food category and the total diet by age, total poundage used in the food supply, technical effects for which used, and industrial importance.

3. Scope of the Survey

Within the limits of available time and funds, the Committee concluded that the survey achieved its intended purpose. Consistent and apparently valid information was obtained from firms responsible for 60 to 70 percent of the nation's processed food supply (and even a higher percentage for flavors and certain specialty foods).

4. Values

These surveys provided the first reliable data on the levels and manner of use of most ingredients on the original FDA "White List" and those used by prior sanction. It generated very useful detailed information, including rechecks, on the highest usages of ingredients, and the foods in which such high levels occurred.

The survey shows whether an ingredient was used by many firms or only a few; or used in many or few food categories. A related conclusion to which the surveys point is the familiar, but frequently

ignored, need to achieve variety and balance in the diet as the best way to insure adequate nutrition and to avoid an excess of any ingredient, whether naturally occurring or added.

The surveys also provided data on the importance of each ingredient, and on the amounts used in the total food supply from which average per capita use can be estimated. While not directly valuable in safety evaluation, this is an extremely useful bench mark against which to compare the reasonableness of other data.

These efforts provided information which is less than perfect, but the best available on food consumption by current categories of processed food and by age. Furthermore, these new results provide consumption data for those individuals who, "eating in a rut," consume a particular food category more often than 90 percent of the population.

The procedures used in these surveys have resulted in several benefits. Among these are a consistent, comprehensive classification of "technical effects" for which GRAS substances and food additives are used, and the definition of food categories more adapted to modern processed foods than the traditional nutritional or commodity classifications.

The results of the survey will be of substantial value in providing for industry guides to good manufacturing practice in ingredient usage. Finally, it is clear that this must be a recurrent, orderly process, and these surveys have set a useful pattern for the future.

5. Limitations, Cautions, and Restraints

Though valuable, these survey data are complex and subject to a number of uncertainties. To understand their values and limitations and avoid misinterpretation and invalid conclusions, those who wish to use the information in the exhibits or the tables should first read thoroughly the report and exhibits prepared by the Committee.

The most important caution to be observed is to recognize the cumulative effect of the several conservative assumptions made in the compilation of the data. The result is a substantial overestimate of possible intake. The reported data indicate usage in some food--rarely all foods--in a food category. Such data are valid only when and if the ingredient is actually used in that category; yet the calculations conservatively assume usage applies to all foods in a category. Furthermore, an ingredient may be partially lost in processing due to evaporation, washing away, or other causes.

The survey can only indicate indirectly whether a particular ingredient is used in many foods within a given food category, in which case there would usually be many responses on that ingredient, or is used only in a few foods (usually specialty foods). For example, the

use of sulfur dioxide is confined to some dried fruits. It is not used in fresh, canned, or frozen fruits or juices. Caramel is used only in some gravies, not in cream and other sauces; yet its level of use, only in those foods in which it is used, could be taken to apply to the whole sauce and gravy category. Such errors should be avoided.

Whether an ingredient is used in many or few foods within a category depends upon the availability of alternative ingredients. No, or few, alternatives mean wide use. Many alternatives mean greatly restricted use, although this is not clearly apparent since the reported level of use appears to apply to all foods in a category even though this would seldom, if ever, be the case.

A distinction must be drawn between those tables based on the frequency with which foods are consumed by the average of the total population ("Total Sample") as compared with those tables ("Eaters Only") which are based solely on those who consume the food at some time within the survey period. The latter disregards those in the population who did not consume the food during that period. (Consumption of any one food category reduces the consumption of other food categories due to restrictions on total calorie intake.) Thus, levels of consumption based on "eaters only" can be valid only for a single or a few food categories. "Eaters only" intake figures cannot be added across all categories, since no one eats everything. Such an assumption would result in a wholly impossible total calorie intake.

The same logic makes the levels in the "Eaters Only" tables not usually applicable even to all foods within a single food category. From the level of each ingredient used in at least some foods within each food category, the frequency with which each category is consumed, and the portion size when consumed, the tables calculate the possible daily intake of the ingredient through each food category. The sum of such possible intakes from all food categories provides an estimate of possible total daily intake. For the reasons just discussed, this estimate is usually highly inflated. The extent of such inflation can be gathered by comparing that figure of possible daily intake with the per capita daily intake obtained from the poundage figures committed to food, the completeness factor of the survey (at least 60 percent), and the population.(2) The ratio is low (i.e., the exaggeration of possible daily intake compared with the per capita is small) where an additive is broadly used and where there are few alternatives. The ratio (the exaggeration) is high where an additive is used infrequently, as only in specialty foods, or where there are many alternatives for obtaining the same technical effect.

One cannot take the possible or potential daily intake, even what is perhaps misleadingly called the "average," from the "total sample" table, multiply by the population and the days per year, and expect to

(2) This is the NAS #1/#2 ratio in Exhibit 58.

obtain the annual food use of an ingredient. This is an impermissible use of the data because of the multiple exaggerations reviewed above. The intake tables inevitably reflect some point at the upper tail of the distribution curve.

From this it follows that the intake values labeled "high" or "very high" could be obtained only as a result of a highly improbable combination of circumstances; selection from a food category of only those foods containing a particular ingredient, no wastage or loss of the ingredient, consumption of the food category at unusually high frequency or high levels of use of the ingredient or both, and no use of alternative ingredients. Improbable in itself for one food category, this is virtually impossible for more than a few food categories simultaneously.

Because one could not possibly seek all possible technical effects in a single food, and because of the multiple alternatives frequently available, one cannot add all substances used in any food category to obtain the total amount of substances potentially occurring at one time in any food or category.

The figures indicated by an asterisk to signify three responses or less lack statistical solidity and reflect very limited, therefore sometimes extreme, use. The data base for some food categories and population groups is also narrower than the ideal.

It is clear there is no final way to be absolutely certain of either accuracy or completeness in the survey. Overall, the survey is as complete as was practical because of the diminishing returns for additional effort expended.

6. Opportunities

This survey points out the desirability of having (1) better food consumption rather than use or disappearance data, (2) more extensive analysis of foods to establish what components remain in them relative to what was introduced, (3) determination of the effects of preparation and plate waste on ingredient loss, (4) better understanding of food category use by specific population groups, (5) estimates of intake from all sources, natural and added, and (6) future surveys to refine and update these data.

The present information deserves substantial additional analysis. A cursory inspection reveals food consumption patterns in processed foods which are age-dependent or of nutritional interest. It seems probable that the ingredients used for different technical effects tend to group within definable usage and total annual poundage levels. As examples, salt and the three sweeteners--sucrose, dextrose, and corn syrup--make up the four most used GRAS substances. Flavors constitute the bulk of those used in least volume. A better appreciation of such patterns of use could lead to an understanding of where it would be desirable from either an economic or a public health point of view to concentrate research on new alternatives.

GLOSSARY

ACCEPTABLE DAILY INTAKE (ADI)

Daily dose of a chemical that appears to be without appreciable risk on the basis of all the facts known at the time. "Without appreciable risk" is taken to mean the practical certainty that injury will not result even after a lifetime of exposure.

ANNUAL POUNDAGE

The total number of pounds used per year by each participating firm or in total by all reporting firms

AVERAGE DAILY INTAKE

Estimated amount of a GRAS substance that may be ingested daily through consumption of foods to which the substance has been added

CONSUMPTION LEVEL

The level, in grams per day, of a food category consumed by the average person ("total sample") or consumed only by those who, within the survey period, ate food from that category at least once ("eaters only")

DAILY INTAKE

Estimated daily ingestion in milligrams of a particular ingredient

EATERS ONLY

See CONSUMPTION LEVEL

FAO/WHO JOINT EXPERT COMMITTEE

A committee of toxicologists and other scientists appointed for their individual qualifications and not representing government agencies or industries. Brought together under the joint sponsorship of the Food and Agriculture Organization and the World Health Organization for the purpose of defining specifications for food additives, appraising their safety-in-use, and setting such limitations or requirements for further information as seem appropriate to them.

FEMA

Flavor and Extract Manufacturers' Association

FEMA GRAS LIST

See GRAS LIST

FINAL FOOD

The food as consumed distinguished from intermediate and incomplete stages of processing or preparation, such as dry mixes, concentrated syrups, raw meat or vegetables, etc.

FLAVORING ADJUNCT

A substance which does not itself contribute flavor, but which is used in association with flavoring ingredients to improve their effectiveness in use. This includes solvents, fixatives, antioxidants, etc.

FLAVORING ADJUVANT

Synonym for FLAVORING ADJUNCT

FLAVORING INGREDIENT

Often simply called a "flavor," is any substance added to food, drugs, or other products taken in the mouth, the clearly predominant purpose and effect of which is to provide a particular flavor in the final product

FOOD

"1. a: material consisting essentially of protein, carbohydrate, and fat used in the body of an organism to sustain growth, repair, and vital processes and to furnish energy; also: such food together with supplementary substances (as minerals, vitamins, and condiments)" (1)
This is used here in the sense of human food. In the law, the term "food" includes beverages, chewing gum, and the components of all food articles.

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(1) Webster's Seventh New Collegiate Dictionary, p. 324. Springfield, Massachusetts: G. & C. Merriam Company (1969)

FOOD ADDITIVE

General Definition
Any minor ingredient added to food, or residues of which are found in food, resulting from its use to achieve a particular technical effect

Legal Definition(2)
"Any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and including any source of radiation intended for any such use), if such substance is not generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures (or, in the case of a substance used in food prior to January 1, 1958, through either scientific procedures or experience based on common use in food) to be safe under the conditions of its intended use; . . ."

FOOD ADDITIVES AMENDMENT

An act of Congress, passed in 1958, amending the Federal Food, Drug, and Cosmetic Act. The amendment established requirements for premarket clearance for safety and functionality of all substances intended for use in food with certain exceptions. The exceptions include substances that qualified scientists generally recognize as safe, other substances covered by a "prior sanction" (q.v.), color additives, and pesticidal residues.

FOOD ADDITIVES versus FOOD

The distinction between a food, a food ingredient, and a food additive or GRAS substance is not always clear. It may depend on relative amount and purpose. For example, the sugar in a piece of hard candy is the major ingredient and is a "food." Sugar in a cake is certainly an "ingredient" present for nutritional, as well as major functional reasons. Sugar added to a cup of coffee is a "food additive" in the general sense; a GRAS ingredient, in the legal sense, added solely to achieve sweetness.

(2) Federal Food, Drug, and Cosmetic Act As Amended, Chapter II--Definitions, Section 201[321](s)

FOOD CATEGORY

One of 34 categories into which all foods have been classified for the purposes of this survey. Categories consist of foods closely related in purpose, structure, process, composition, or properties.

GOOD MANUFACTURING PRACTICE

Procedures, facilities, equipment, and personnel training, which taken together and properly applied, define the conditions for safe and effective processing of food

GRAS

The acronym for "generally recognized as safe." It is a slight adaptation and incomplete rendering of the language of the Food Additives Amendment of 1958 to the Federal Food, Drug, and Cosmetic Act. It refers to ". . . a substance . . . generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown . . . to be safe under the conditions of its intended use; . . ." The total, much longer definition is given in Section 201 of the Act. (See also FOOD ADDITIVE.)

GRAS LIST

A much used, but inaccurate term for all substances used in food on the basis that they are GRAS, rather than regulated additives. There has not been any single "GRAS List." The FDA published two intentionally incomplete lists ("White Lists"); the flavor and chewing gum industries published a series of lists (the "FEMA GRAS List"), the brewing industry prepared a comprehensive unpublished list, the FDA presumed some substances to be GRAS without publication and issued "no objection letters," usually unpublished on some other substances, and there undoubtedly were, as the law allows, some private, unpublished determinations that a use of a particular substance was GRAS. Aside from these groups, USDA and FDA had in earlier years approved by "prior sanction" a large number of substances not necessarily covered by these later GRAS actions.

IMPORTANCE

Commercial importance in the sense of how unique are the properties of the ingredient, and how easily can it be replaced by another ingredient or change of process

INGREDIENT

A component or constituent of food. The term is usually used in the sense of an ingredient which is intentionally made a part of food. Constituent often means a naturally occurring component.

MAXIMUM USAGE LEVEL

Highest level used in any product

MEAT INSPECTION ACT

An act of Congress originally passed in 1907, amended and extended to permit continuous inspection of meat slaughtering and processing establishments by employees of the Department of Agriculture

MEDIAN USAGE LEVEL

The usage level of a particular ingredient in a food category which falls in the middle of the reported uses; i.e., half the uses are reported at a lower level and half the uses at a higher level

NAS

National Academy of Sciences

NONUSER FIRMS

Firms which manufacture or distribute, but do not commit the ingredient to food

NO-OBJECTION LETTER

Letters issued by FDA after 1958, by which FDA indicated that there would be no objection posed at the time of the letter to the use in food of the ingredient or ingredients named therein in accordance with the uses outlined

"ORGANOLEPTICALLY INTOLERABLE"

Offensive to the sense of taste or smell and therefore inedible; usually used to refer to a food which is spoiled or overflavored

PER CAPITA DAILY INTAKE

An average figure derived by simply dividing annual national food use of an ingredient by the population and days in a year

PORTION SIZE

The average size in grams of a portion of food determined from a survey conducted by the U. S. Department of Agriculture (or, in a few cases, from other sources)

POSSIBLE DAILY INTAKE

A figure derived from estimates of mean food consumption using "total sample" (see definition of CONSUMPTION LEVEL) and average food additive use for each food category, described in Tables 13A and B as "average intake level." Because of a series of conservative assumptions (see discussion in report), this represents a possible intake that would only infrequently be achieved.

POTENTIAL DAILY INTAKE

A figure derived from estimates of food consumption based on "eaters only" (see definition of CONSUMPTION LEVEL), or the 90th percentile frequency of consumption, or higher levels of food additive use, or some combination of these for each food category. These are described in the tables as "High A," "High B," or "Very High," or "Eaters Only." In addition to the conservative assumptions inherent in the calculation of "possible" intakes, these additional factors make the potential intakes unlikely for more than one or a few food categories.

POULTRY PRODUCTS INSPECTION ACT

This was an act of Congress passed in 1957 to provide for the inspection of poultry and poultry products and otherwise regulating the processing and distribution of such articles in interstate commerce.

PRIOR SANCTION

Action prior to 1958, by the FDA or USDA, to permit a substance to be used in food under the Food, Drug, and Cosmetic Act, the Poultry Products Inspection Act, or the Meat Inspection Act.

SPECIALTY FOODS

Foods of limited appeal, usually to particular ethnic, economic, or geographic groups, often more expensive and limited in distribution and consumption. The term implies lack of broad appeal or frequent use.

TECHNICAL EFFECT

The achieving of a desired characteristic in a food or food manufacturing process. For example, a desired nutritional content or antioxidant in a food product; ease of removal from a baking pan; or ease of extrusion for a pasta product.

TOTAL SAMPLE

See CONSUMPTION LEVEL

TOXICITY

Capacity of the substance to produce injury. The term includes capacity to induce teratogenic, mutagenic, and carcinogenic effects.

USAGE LEVEL

The level at which a particular ingredient is added to a food in a food category

USDA SURVEY

Refers to "Food Intake and Nutritive Value of Diets of Men, Women, and Children in the United States, Spring, 1965," a preliminary report by the Consumer and Food Economics Research Division, Agricultural Research Service, United States Department of Agriculture (see Exhibit 32B)

USER FIRMS

Firms which reported the use of an ingredient in food or in a food component

USUAL USAGE LEVEL

Normal or average concentration roughly weighted by annual product volume

WEIGHTED MEAN USAGE LEVEL

The average level at which a particular ingredient, if it is used, is added to foods within a food category weighted in proportion to the volume of the additive used by each firm; e.g., a firm which uses a million pounds of an additive counts in the average one hundred times more than a firm which uses only 10,000 pounds.

WHITE LIST

See GRAS LIST

YEAR OF FIRST USE (EARLIEST YEAR REPORTED)

First year in which an ingredient was introduced into commercial use