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Section 8	SENSORY ANALYSIS	Section 8

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8.1 Introduction

Sensory analysis of seafood is a critical tool used by FDA to protect consumers from seafood that has become adulterated due to decomposition. To stand up in court; the integrity of the sensory program depends on the credibility of the sensory analysts and the manner in which the analyses are conducted, reported, and interpreted for regulatory purposes.

It takes many years of experience, with daily involvement, to properly recognize spoilage odors and flavors in seafood products and, more importantly, to avoid rejecting products due to odors and flavors that may be present but are not caused by decomposition. Incorrect decisions by FDA can be extremely costly to the importer/owner of rejected product and failing to detect adulterated product is costly to consumers.

Section 402 (a)(3) of the Food, Drug, and Cosmetic Act states that a food is deemed to be adulterated if it consists in whole or in part of any filthy, putrid, or decomposed substance. It is this section of the Act that lends itself to the findings of the sensory analyst.

The primary focus of this section is to expose the analyst to sensory techniques and the evaluation of a variety of seafood products. Both actual and authentic samples (whose stages of decomposition are defined) are used.

8.2 Basic Considerations for Selecting Objective Sensory Analysts

A. Personality Factors

Sensory evaluation encompasses the sciences of psychology, anatomy, physiology, and psychophysics. Psychology is as important as the sciences when training people. Certain personality factors are critical for successfully conducting sensory activities. The personality traits listed below are outlined in the ISO; Technical Committee 34 for Sensory Evaluation document General Guidance for the Recruitment and Training of Panel Leaders; the book, Sensory Evaluation Techniques; and the manual, from Sensory Spectrum's course on panel leadership.

- Good communicator,
- Nurturing,
- Non-threatening,
- Sensitive.

B. Ability to Recognize Basic Tastes

Sensory analysts should demonstrate that they have the ability to perceive basic odors and tastes and be able to describe their findings in a consistent manner. One area that is important in selection and training is the ability of the analyst to distinguish between the four basic tastes which are bitter, sour, salt, and sweet.

Taste Exercise

Purpose: To demonstrate basic taste sensations to candidates for later testing purposes.

Equipment Needed:

- One gallon spring/filtered water.
- Four 500 mL graduated glass or Nalgene flasks with covers.
- Four 2-ounce plastic cups with lids for each participant.
- Cups for rinsing and spitting.
- Gram scale.

- Compounds [sucrose (sugar), citric acid, NaCl (salt), and caffeine].
- Ballots (see 8.6 Appendix: Sensory Scale).

Exercise Set-Up:

- Prepare the four basic taste solutions one or two days prior to screening.
- Add compound to flask, then fill to 400 mL with filtered water.
 1. Sweet: 20.0 g sucrose.
 2. Sour: 0.2 g citric acid.
 3. Salty: 1.4 g NaCl.
 4. Bitter: 0.2 g caffeine.
- Store bulk solution in cooler/refrigerator.
- Label the side of the cups with the number associated with solution, 1 each per participant: 1= sucrose, 2 = citric acid, 3 = NaCl, and 4 = caffeine.
- Let compound sit over night and shake to dissolve. Fill the 2 oz. cups half full and cover. The analyst should have enough solution to make up 15 to 20 cups.
- Make sure solutions are at room temperature when presented.

Screening Exercise:

- Remove cups from cooler one to two hours prior to screening. It is important that the solutions be evaluated at room temperature.
- Present the four basic tastes.
- Pass out ballots and read instructions to participants.
- Have them go through the samples in order and ask them to pay attention to where they are sensing the solutions on their tongue and how long it takes to detect. Ask them to save some for re-tasting.

8.3 Understanding of Terminology

Sensory analysts should be familiar with definitions of some of the terms used in the sensory analysis of seafood, including the following:

Note – the terms odor and aroma are used interchangeably. List compiled by NMFS National Sensory Branch.

Appearance All the visible characteristics of a substance/sample.

**Analyst/
Assessor** Any person taking part in a sensory test.

Bilgy	The aromatic associated with anaerobic bacterial growth, which is illustrated by the rank odor of bilge water. The term “bilgy” can be used to describe fish of any quality which has been contaminated by bilge water on board a vessel. Bilge water is usually a combination of salt water, fuel, and waste water.
Bitter	One of the four basic tastes; primarily perceived at the back of the tongue; common to caffeine and quinine. There is generally a delay in perception (two-four seconds) and a lingering sensation in the mouth.
Briny	The aroma associated with the smell of clean seaweed, a beach and/or ocean air.
Brothy	Aromatic associated with boiled meat usually accompanied by a umami sensation in the mouth.
Burnt	Aromatic associated with heated, scorched, or blackened substances.
Cardboardy	Aromatic associated with slightly oxidized fats or frozen fish that has taken on a “cold storage” off flavor; reminiscent of wet cardboard.
Carry-over	A decrease in sensitivity to a given stimulus resulting from exposure to previous samples containing the same stimulus.
Chalky	In reference to texture, a product which is composed of small particles which imparts a drying sensation in the mouth. In reference to appearance, a product which has a dry, opaque, chalk like appearance.
Cheesy	Sour aromatic associated with aged cheese and butyric acid. Sometimes found in advanced decomposition of fish.
Chemical	A general term associated with many types of aromatic compounds such as solvents, cleaning compounds, and hydrocarbons.
Chickeny	Aromatic associated with cooked chicken white meat and breast.
Cucumber	The aroma associated with fresh cucumber, similar aromas can be associated with certain species of very fresh raw fish.
Decompose	To break down into component parts.
Decomposed	Fish that has an offensive or objectionable odor, flavor, colour, texture, or substance associated with spoilage.
Distinct	Capable of being readily perceived.

Feedy	“Feedy” is used to describe the condition of fish that have been feeding heavily. After death, the gastric enzymes first attack the internal organs, then the belly wall, then the muscle tissue. If the enzymes have penetrated into the flesh, they are capable of causing sensory changes characterized by soft, foul smelling, discolored muscle tissue. This odor may be associated with dimethyl sulfoxide (DMS), and may be attributed to certain zooplankton as it passes through the food chain. The odour of “feedy” fish has been described as similar to certain sulfur containing cooked vegetables, such as broccoli, cauliflower, turnip, or cabbage.
Fecal	Aroma associated with feces. Sometimes found in very advanced decomposition of seafood.
Fermented	Sour, fruity aromatic associated with rotting fruit, vegetables, meat or seafood.
Firm	A substance that exhibits moderate resistance when force is applied in the mouth or by touch.
Fish	Means any of the cold-blooded aquatic vertebrate animals commonly known as such. This includes Pisces, Elasmobranchs and Cyclostomes. Aquatic mammals, invertebrate animals, and amphibians are not included.
Fishy	Aroma associated with aged fish, as demonstrated by trimethylamine (TMA) or cod liver oil. Seafood exhibiting this characteristic is of poor quality but may or may not indicate decomposition, depending on other aromatics present.
Flavor	Sensory perceptions when food is placed in the mouth resulting from the stimulation of basic tastes, aromatics, and feeling factors.
Freshness	Concept relating to time, process, or characteristics of seafood as defined by a buyer, processor, user, or regulatory agency.
Fruity	Aroma associated with slightly fermented fruit. Term is used to describe odors resulting from high temperature decomposition in certain species of fish and is often described as cloying and sickly sweet/sour. Most times there will also be an underlying sour odor. One reference is propyl butyrate.
Gamey	The aroma and/or flavor associated with the heavy, gamey characteristics of some species such as mackerel. Similar to the relationship of fresh duck meat as compared to fresh chicken meat.
Glossy	A shiny appearance resulting from the tendency of a surface to reflect light.

Grainy	A product in which the assessor is able to perceive moderately hard, distinct particles. Sometimes found in canned seafood or products that have been in frozen storage.
Grassy	Green, slightly sweet, aromatic associated with freshly cut grass or very fresh, high-quality finfish. This aromatic is most prevalent in fresh water fish.
Intensity	The perceived magnitude of a sensation.
Iridescent	An array of rainbow like colours, similar to an opal or an oil sheen on water.
Masking	The phenomenon where one sensation obscures one or several other sensations.
Mealy	Describes a product that imparts a starch-like sensation in the mouth.
Mercaptan	Aromatic associated with sulfur compounds, reminiscent of skunk, brewing coffee, and rubber.
Metallic	Aroma and/or taste associated with ferrous (iron) sulfate, rust, or tin cans.
Moist	The perception of moisture being released from a product. The perception can be from water or oil.
Moldy	Aroma associated with moldy cheese or bread, or a wet moldy basement.
Motor oil	A heavy greasy aroma, often oxidized and turpeny.
Mouth coating	The perception of a film in the mouth.
Mouth filling	The sensation of a fullness dispersing throughout the mouth. A umami sensation, as stimulated by mono sodium glutamate (MSG).
Mushy	Soft, thick, pulpy consistency. In seafood little or no muscle structure discernible when force is applied by touch or by mouth.
Musty	The aromatic associated with a moldy, dank cellar or attic.
Nosefeel/ burn	Chemical “feeling” factor described as a warmth or burning or irritating sensation in the nasal passages when a product is sniffed.
Odor	Sensation due to stimulation of the olfactory receptors in the nasal cavity by volatile material. Same meaning as aroma.

Off odor	Atypical (usually unpleasant) characteristics often associated with deterioration or transformation of a flavor product. Off odors and flavors most often linger in the nose and/or mouth.
Opaque	Describes product which does not allow the passage of light. In raw muscle tissue of fishery products, this is usually due to the proteins losing their light reflecting properties due to falling pH. Fish flesh becomes more opaque as it deteriorates.
Oxidized	Aromatic associated with old oil that is stale or cardboardy. Leaves a lingering off flavor in the mouth or nasal cavity that is moderately lingering and coating.
Pasty	A product which sticks together like paste in the mouth when mixed with saliva. Forms a cohesive mass which may adhere to the soft tissue surfaces of the mouth or fingers.
Persistent	Existing without significant change; not fleeting.
Pungent	An irritating, sharp, or piercing sensation felt in the nose, mouth or throat.
Putrid	Aroma associated with decayed, rotting meat. Aroma is lingering and often gives a heavy, cloying nose and throat feel.
Quality	A degree of excellence. A collection of characteristics of a product that confers its ability to satisfy stated or implied needs.
Rancid	Odor or flavor associated with rancid oil. Gives a mouth-coating sensation and/or a tingling perceived on the back of the tongue. Sometimes described as “sharp” or “painty”.
Reference	Either a sample designated as the one to which others are compared, or another type of material used to illustrate a characteristic or attribute.
Resinous	Medicinal, woody aromatic, usually with a nose-feel. Pine is an example.
Rotting	Aroma associated with decayed vegetables, in particular the sulfur containing vegetables, such as cooked broccoli, cabbage, or cauliflower.
Rubbery	A resilient material which may be deformed under pressure, but returns to its original form once the pressure is released.
Salty	The taste on the tongue associated with salt or sodium.
Sensory	Relating to the use of the sense organs.

Slimy	A fluid substance which is viscous, slick, elastic, gummy, or jelly-like.
Solvent	A general term, used to describe many classes of solvents, such as acetone, isopropyl alcohol, turpentine, etc.. May be reminiscent of chemical solvents, plasticizers, and lighter fluid or paint aromas.
Solventy	Odor and/or nose “feel” or flavor associated with solvents such as acetone.
Sour	An odor and/or taste sensation, generally due to the presence of organic acids.
Stale	Odor associated with wet cardboard or frozen storage.
STP	Sodium tripolyphosphate. Can produce a soapy, alkaline feel and taste in the mouth.
Sulfury	Odor or flavor associated with sulfur-based materials such as matches, old garlic, onions, rotten eggs, broccoli, cabbage, mercaptans, or rubber.
Sweet	The taste on the tongue associated with sugar or sucrose.
Taste	One of the senses, the receptors for which are located in the mouth and activated by compounds in solution. Taste is limited to sweet, salty, sour, bitter and sometimes umami.
Terminology	Terms used to describe the sensory attributes of a product.
Throatburn	Or “throatfeel.” Degree to which an irritating and/or burning sensation is felt in the throat.
Translucent	Describes an object which allows some light to pass, but through which clear images can not be distinguished (i.e. milk glass). Very fresh, raw fish flesh is very translucent.
Transparent	Describes a clear object, which allows light to pass and through which distinct images appear (i.e. clear glass).
Turpenes	An oily compound found in citrus peel and resinous plants (pine). Imparts a sharp, lingering, chemical type sensation.
Umami	Taste produced by substances such as monosodium glutamate (MSG) in solution. A meaty, savory, or mouth filling sensation.
Vegetable	(old, fermented, or rotten) Odor associated with cooked or slightly spoiled sulfur-containing vegetables such as cooked broccoli, cabbage, or cauliflower.

Vegetable	(fresh) Green and/or planty odor or flavor associated with fresh cut non-sulfur containing vegetables.
Watermelon	Aroma characteristic of fresh cut watermelon rind. Similar odors are sometimes found in certain species of very fresh raw fish.
Yeasty	Also called “Fermented.” Aroma associated with yeast and fermented products such as rising bread or beer.

8.4 Training

A. Introduction to Products

FDA seafood sensory analysts are evaluated for their ability to make correct regulatory decisions in five categories of seafood products. These include:

- Fresh/frozen Shrimp
- Fresh/frozen raw Finfish (other than scombrototoxic-forming species)
- Fresh/frozen raw scombrototoxic-forming species
- Canned Tuna
- Processed Seafood (other than canned tuna)

1. Shrimp

Raw shrimp is considered to be one of the easiest products for new analysts to learn to differentiate decomposition odors from the natural odors associated with the product. Other raw invertebrates are not difficult if the analyst is exposed to these products that may have unique odors. This is not to be confused with processed products, such as canned or cooked and peeled shrimp, that are considered much more difficult to assess because some of the odors have been driven off by processes such as cooking. Processed seafood may also have various additives that could confuse the inexperienced analyst.

2. Finfish

The second product category is fresh/frozen raw finfish. Product forms of the fish vary from whole (in-the-round), headed and gutted, steaks, fillets to chunks. Again, this category may be fairly easy for a training sensory analyst to learn to decipher odors and make good regulatory assessments as to the decomposed state of the fish.

3. Scombrototoxic Species

The third category includes finfish species such as tuna, mahi mahi, mackerel, escolar, etc. These fish are differentiated from other finfish because of unique spoilage patterns that may occur, especially with high temperature abuse, that may not produce much odor or have the typical “spoilage” odors that one may associate with time/temperature abuse. These odors are much more difficult to recognize and may call for many years of experience examining fish to become proficient at making good decisions.

4. Canned Tuna

The fourth category is canned tuna. Again, proficiency in this category tends to be more difficult due to the packing of various species, each having a unique odor, as well as the addition of various ingredients and additives. Processors use a wide variety of vegetable broths of different concentrations and various sources of hydrolyzed proteins that impart odors that could be confused with decomposition odors. Further, scorching from the retorting operation could also be confused with decomposition odors.

5. Other Processed Seafood

The last category is all other types of processed seafood that includes products such as cooked or canned seafood, smoked fish, pickled fish, dried fish, fish sauces and pastes, fish treated with chemicals or additives other than sulfites or phosphates, etc. Because of the lack of daily or weekly exposure to these products, many analysts do not gain enough experience to be able to recognize spoilage odors in these products. Inexperienced analysts could incorrectly associate spoilage with the odors and flavors of some of the ingredients added to such products.

B. Exercises

If possible, examples of all five product categories should be used to provide the trainee with a wide range of products to be able to assess their quality using the sessions provided below. The instructor should have significant experience in all five categories as a journeyman sensory analyst. Authentic sample packs should be prepared by the National Experts and sent out to provide consistency in the standard to be applied within the product examples to be covered during the training sessions. This will allow for minimum variability within the sample packs.

1. Demonstration Session

Purpose

This exercise is designed to provide a complete range of product samples from each of the categories listed above from very fresh to very decomposed and to show the cut-off point between acceptable and unacceptable product.

Procedure

The analyst will examine a set of samples arranged in order from the least to the most spoiled. Sample quality will be rated on a 10-centimeter unstructured line scale (see 8.6 Appendix: Sensory Scale). For all samples examined, the trainee will indicate his/her opinion by placing a vertical mark on the 10-centimeter line. If the sample is the very highest quality possible (extremely fresh), the vertical line is placed at the very left end of the 10-centimeter line. If the quality is the lowest possible (extremely decomposed), the vertical line is placed at the very right end of the line. Positions from the extreme left end of the line to the mid-point indicate the sample passes for decomposition whereas those to the right of the mid-point indicate the sample fails for decomposition. As the position of the mark moves from the left to the right of the line, the quality of the sample declines. The vertical line dividing the line scale in half demarcates pass from fail and is not used.

Discussion

The discussion of each set of samples will take place immediately with the instructor to examine the analyst's results and establish which degree of spoilage defined the accept/reject level for each type of product examined. The analyst also is to be familiar with the sensory terms listed above to be able to describe their findings and the reason for their decisions.

2. Blind Discussion Session

This session consists of having the analyst, along with the instructor, examine a random set of samples that represent the same product examined during the demonstration session. The purpose of this exercise is to determine if the analyst can apply the criteria that was used to determine accept/reject levels and to reinforce the decisions made on the demonstration samples.

3. Practice Test Session

The purpose of this session is to collect data on the assessments made by the analyst using blind coded samples and to allow the trainee to practice what they have learned during the demonstration and blind discussion sessions. Results are discussed and the analyst will be allowed to go back and look at the samples.

4. Final Test Session

The purpose of this session is to assess the analyst's retention of the sensory training for each product type examined. The analyst is to assess the blind coded samples without the presentation of the standard reference samples beforehand.

C. Questions

1. What section of the FD&C Act talks about adulteration of seafood products by decomposition?
2. What are the four basic tastes?
3. What are the five seafood product categories that the sensory analyst is provided training to make classifications on the quality in seafood products?
4. Explain how the 10 centimeter unstructured line scale is used.

8.5 References

1. American Society for Testing and Materials Committee E-18 on Sensory Evaluation of Materials and Products. (1981). *Guidelines for the selection and training of sensory panel members (STP 758)*.
2. Department of Fisheries and Oceans, Canada, Inspection Branch. (1986 to 1995). Sensory methods in fish inspections (Notes from Sensory Training course given by the National Centre for Sensory Science, Inspection Branch, Department of Fisheries and Oceans, Canada).
3. Reilly, T. I. and York, R. K. (1993). *Sensory analysis application to harmonize expert assessors of fish products*. In: Sylvia, G., Shriver, A. L., and Morrissey, M. T. (Eds.), *Proceedings of Quality Control and Quality Assurance of Seafoods*, May 16-18, 1993, Newport, Oregon.
4. Compliance Program Guidance Manual 7303.842, Domestic Fish and Fishery Products Inspection Program and Compliance Program Guidance Manual 7303.844, Import Seafood Products. Retrieved from <http://www.fda.gov/ICECI/ComplianceManuals/ComplianceProgramManual/default.htm>
5. Compliance Program Guide Sec. 540.575, Fish – Fresh and Frozen – Adulteration Involving Decomposition and Sec. 540.252, Decomposition and Histamine Raw, Frozen Tuna and Mahi-Mahi; Canned Tuna; and Related Species. Retrieved from <http://www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm119194.htm>

8.6 Appendix: Sensory Scale

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8.7 Appendix: Answer Key

1. What section of the FD&C Act talks about adulteration of seafood products by decomposition?

Answer: Section 402 (a)(3).

2. What are the four basic tastes?

Answer: Sweet, Salty, Sour, and Bitter.

3. What are the five seafood product categories that the sensory analyst is provided training to make classifications on the quality in seafood products?

Answer: Fresh/Frozen Shrimp, Fresh/Frozen Finfish other than Scombrototoxic Species, Fresh/Frozen Scombrototoxic Species, Canned Tuna, and other Processed Seafood.

4. Explain how the 10 centimeter unstructured line scale is used.

Answer: The line scale is used to give a rating as to the quality of the sample being examined. If the quality of the sample is the highest possible, the analyst is to place a vertical line to the very left end of the 10 centimeter line scale. If the quality of the product is the very lowest possible, the vertical line is to be placed to the extreme right of the 10 centimeter line scale. Positions from the extreme left to the mid- point indicate the sample is passable for decomposition and whereas those to the right of the mid- point indicate the sample fails for decomposition. As the position moves from the left to the right of the line, the quality of the sample declines. The vertical line dividing the line scale in half demarcates pass from fail and is not used.

8.8 Document/Change History

Version 1.2	Revision	Approved: 02-02-10	Author: LMEB	Approver: LMEB
Version 1.3	Revision	Approved: 02-06-12	Author: LMEB	Approver: LMEB
Version 1.4	Revision	Approved: 02-14-13	Author: LMEB	Approver: LMEB

Version 1.2 changes

8.4 3. - “canned” changed to “processed

8.6 – Reference 4. and 5. added

8.8 – section added

Footer – web link updated

Version 1.3 changes:

Appendix 8.6 – form header removed

Version 1.4 changes:

Header – Division of Field Science changed to Office of Regulatory Science