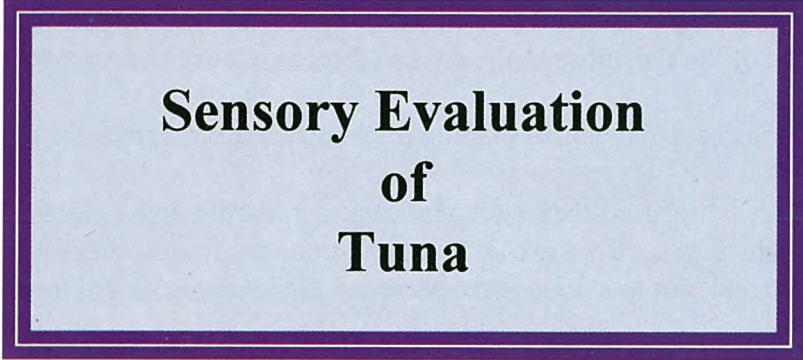


CHAPTER 4



Sensory Evaluation of Tuna

Decomposition of Seafood

Decomposition of seafood is a direct result of temperature and/or handling abuse. This can occur on board the fishing vessel, during transportation and at the packing plant. The manufacturer needs to be vigilant in the purchase, grading and handling of seafood to avoid placing decomposed seafood into commerce.

Testing for Decomposition

While there are chemical tests for the end products of decomposition (eg histamine) none are as totally encompassing as the sensory approach. This analyst or grader invokes senses (sight, touch, taste, smell) in a subjective testing and rating of the seafood products, for example he/she must bring the flesh of the fish close to the nose to discern odours of decomposition.

A number of countries have developed grading or classification schemes for decomposition.

The USFDA have developed a scheme of sampling raw, frozen and canned tuna, whereby a sample size of 24 units is generally used. If 2 or more units are found defective, a second lot of 24 units are sampled and sent to a reference center, and the lot is rejected if the defect rate is ≥ 1 defect per 12 units.

The Canadian DFO has developed a grading scheme for raw tuna which is outlined in GMP 1.2 (Chapter 2). They have also developed a canned tuna standard (based on the Codex standard) which encompasses sensory evaluation. The part dealing with sensory assessment is given below:

1. Taint

A unit will be considered tainted when any of the following conditions exist:

a) Rancid

Odour characterized by the distinct or readily detectable persistent odour of oxidized oil, (this may be characterized by a pungent sensation in the nasal passage); or

Flavour characterized by distinct flavours present individually or in combination as follows:

bitter, sour, metallic flavours detected at the sides and back of the tongue leaving a lingering aftertaste.

b) Abnormal

Distinct and persistent odours and/or flavour that are burnt or acrid, (e.g as associated with excess scorch).

c) Contaminated

Odours and/or flavours resulting from contamination by solvents, soaps, fuel, oils, grease, etc. that are organoleptically detectable.

2. Decomposition

A unit will be considered decomposed when any of the following conditions exist:

a) Persistent, distinct and uncharacteristic odour characterized by:

- i) fruity (aldehyde odours similar to pineapple or other fruits);
- ii) vegetable odours - (e.g. turnip and cabbage-like but not associated with packing medium);
- iii) sour, yeasty fermented odours;
- iv) ammonia odours, hydrogen sulphide odours; or
- v) other pungent odours such as putrid or faecal.

b) Persistent, distinct and uncharacteristic flavours characterized by:

- i) sweet fruity flavours (e.g. pineapple-like); or
- ii) vegetable flavours (e.g. turnip and cabbage-like but not associated with packing medium); or
- iii) putrid or sour or faecal flavours.

c) Texture

Breakdown of muscle structure characterized by muscle fibres no longer being detectable resulting in the presence of small particles and/or granular, gritty or pasty texture exceeding 20% of the drained content.

d) Appearance

- i) Discolouration characterized by persistent flushed pink, orange or green colours in the flesh exceeding 5% drained contents.
- ii) True Honeycombing exceeding 5% of drained contents.

3. Unwholesome

a) Critical Foreign Material

A lot will be considered defective when any of the following conditions exist:

the presence of any material which has not been derived from tuna (and packing media) and which poses a threat to human health (such as glass, etc); or

distinct and persistent odour or flavour of any material which has not been derived from tuna (and packing media) and which poses a threat to human health (such as solvents, fuel oil, etc.).

b) Foreign Material

A unit will be considered defective when the following condition is found:

the presence of any material which has not been derived from tuna (and packing media) but does not pose a threat to human health (such as insect pieces, sand, etc.).

c) Other Defects

A unit will be considered defective when any of the following conditions exist:

- i) Struvite Crystals (magnesium ammonium phosphate crystals)
Any struvite crystal greater than 5mm in length.
- ii) Sulphide Blackening
Staining of the meat exceeding 5% of the drained contents.

4. Lot Acceptance

A lot will be considered unacceptable if it fails to meet the following final product requirements:

- 1) any single instance of critical foreign matter occurs; or
- 2) the total number of sample units found defective for taint, decomposition or wholesomeness, individually or in combination, exceeds the acceptance number for the sample size designated in the sampling plans; or
- 3) the total number of sample units found defective for decomposition exceeds the acceptance number shown in parentheses for the sample size designated in the sampling plans; or
- 4) the total number of sample units found defective for standards of identify (colour, style of presentation) exceeds the acceptance number for the sample size designated in the sampling plans.

5. Sampling of lots for examination of the product shall be in accordance with the FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods (AQL 6.5) (CAC/RM 42-1969) except that acceptance numbers for decomposition shall be reduced in accordance with the sampling plans.

Following the Canadian DFO scheme for canned tuna fish, a guide to organoleptic analysis of canned tuna and a procedure for sensory evaluation of canned tuna is attached. Additionally the Canadian DFO has developed Procedures for the Assessment of Prospective Canned Tuna Inspectors, this is also as attached. Finally, tables of tuna quality indicators are attached with descriptors as developed by the NMFS. This includes quality indicators for raw and pre-cooked product, as well as canned product, which will be helpful in the grading and processing of tuna, particularly as this stage has been deemed a CCP in the HACCP guideline.

Organoleptic Analysis of Canned Tuna Products

Organoleptic Analysis involves the employment of one or more of the physical senses (sight, touch, taste, smell) for subjective testing and rating of food products.

Physical Requirements of Organoleptic Examinations

1. Work in an area that is free of distractions. Don't try to examine a product in a room where other types of analyses are being conducted.
2. Work in an area that is free of foreign odours.
 - a) No smoking at any time.
 - b) Cosmetic odours should be avoided.
 - c) Don't attempt to smell something that is held in another person's hands.
3. A slight positive pressure should be maintained in the testing area so that extraneous odours cannot enter into the testing area. Proper ventilation also removes product odours.
4. Separate participant if possible.
 - a) One person's reaction may affect another's judgement.
5. Lighting should be uniform, as near natural light as possible and not influence the appearance of product being tested.
6. Product to be tested should be a room temperature or slightly above. (This can vary some depending on product).

Other considerations:

1. Be as knowledgeable as possible about the product being examined.
2. Examine only one species or fish product at a time.
3. Take periodic rest breaks during the examinations.
4. Conduct all determinations independently of other examiners and immediately record results.

Procedure for Sensory Evaluation of Canned Tuna
(Developed by NMFS Western Inspection)

General Sensory Guidelines

- a) Use all your senses; sight, smell, touch and taste.
 - b) Rinse with distilled water in between samples.
 - c) Take slow, shallow sniffs.
 - d) When tasting samples, make sure the sample reaches the back and sides of the mouth and keep the sample in the mouth for a few seconds.
1. Open Can
 - a) Only one can per analysis should be open at one time. Do not open cans ahead of time.
 - b) Before you open the can check the exterior of the can for critical defects, i.e., sweller, leakers., major dents, etc. If the can is damaged severely or swollen, it should not be used for sensory analysis.
 2. Observe the liquid
 - a) Check the liquid to see if it is clear, cloudy, etc.
 - b) Smell liquid before draining. This is to see if there are any odours in the head space.
 3. Drain liquid
 - a. Drain the liquid into a container, and smell the liquid.
 - b. You may be able to detect odours of decomposition in the liquid.
 4. Examine the tuna in the can
 - a) Smell the tuna.
 - b) Check the appearance of the tuna, colour, texture, etc.
- Developed by NMFS Western Inspection
5. Empty the tuna on to a tray
 - a) The tray must be large enough that you are able to spread the tuna evenly on the tray.

- b) Smell the can as soon as you empty the can. At this point you may be able to pick up odours of decomposition, fuel, and chemicals from the can.
 - c) Smell the tuna before you spread it out. This will sometimes give you an indication of quality or contamination.
 - d) Place the can face down on the tray. This will trap odours inside the can so that the next analyst will be able to smell the odours.
 - e) Gently spread the tuna evenly on the tray. At this time you are checking for honeycomb, or other foreign material.
6. Gently break up tuna in your fingers, at the same time smell the tuna.
- a) Keep the tuna which you have already examined separate from the unexamined portion of the can.
 - b) Your first opinion is usually the right opinion.
 - c) You should evaluate the can on the odors present, if you are still not able to make a decision, we recommend that you taste the tuna.
 - d) When you taste the tuna, roll the tuna around your mouth, the front, middle, and back.
 - e) Keep the tuna in the mouth for a few seconds.
 - f) After a few seconds spit out the tuna. Rinse your mouth with distilled water. Record your results.
 - g) If you get an off taste or off odour you should clear your senses for the next sample. Rinse your mouth until the taste is gone, to clear your nose you should sniff a glass of distill water.

Department of Fisheries and Oceans

Procedures For the Assessment of Prospective Canned Tuna Inspectors

1. Each Inspector will examine 165 samples of canned tuna. These will be set out in 11 sessions of 15 samples each. The first session will consist of both white and light meat tuna. Two of the remaining 10 sessions will consist of only white tuna (albacore). The other 8 sessions will consist of only light meat tuna (skipjack, yellowfin or tongol).
2. The results of the first session will not be used to determine an Inspector's score. It will only serve as a practise session to refamiliarize Inspectors with the product.
3. A worksheet will be provided for each session on which Inspectors will record whether each of the samples is, in their opinion, of acceptable or reject quality.
4. The samples are only to be assessed on the basis of odour and flavour and should be rejected by Inspectors if they contain indicators of taint and/or decomposition that are distinct and persistent.
5. For those samples that are rejected, Inspectors will indicate the reasons(s) for rejection (taint and/or decomposition) on the worksheet. Also, each Inspector is asked to record the degree of sureness associated with each decision to accept or reject the sample. This designation of sureness will not affect the decision of A or R. Results are recorded as A or A? And R or R?
6. Although it will not be used to determine their score, Inspectors will be asked to record on their worksheets (for sessions consisting of light meat tuna), the species of the fish.
7. In order to determine an Inspector's score, their individual results (whether they accepted or rejected a sample) will be compared with those of an expert panel consisting of three Inspectors of canned tuna who have a proven record of assessing the product in a consistent and correct manner.
8. The prospective canned tuna Inspectors and the expert panel will examine the product at the same time, moving to samples in random sequences as position are available. No information regarding the origin of the individual samples or previous inspection results will be provided to the expert panel or the Inspectors prior to the sessions. However, information regarding the packaging medium will be provided as this is available to Inspectors during routine inspections and is important in the decision making process.
9. There will be no communication among inspectors while they are examining the product. After all 15 samples have been evaluated in a session, the worksheets are to be handed to the workshop coordinator. The prospective canned tuna Inspectors will then leave the room until they are asked to return for the next session.

10. A break of at least 15 minutes will be provided between sessions.
11. To ensure good sanitation assessment sessions:
 - a) Inspectors will wash their hands before examining the product, and
 - b) portions of samples for tasting will be transferred from the coded sample dish to the Inspector's sampling dish by a stainless steel fork. All tasting will be done from the Inspector's dish using his/her own tasting fork.
12. Inspectors must refrain from using perfume or scented lotions while they are attending the assessment.
13. The number of samples to be assessed will be limited to a maximum of 105 per day.
14. Inspectors will only be evaluated against those samples that the expert panel have unanimously accepted or rejected.
15. Inspectors will not be given their score until they have examined all 165 samples.
16. An Inspector's score will be expressed as a percentage of the total number of times their individual results of the expert panel. When they are given their score, Inspectors will be also advised of the number of samples that were used to determine this score as well as the percentage of samples they scored both too easily and too harshly.
17. To qualify as a canned tuna Inspector, Inspectors must attain an overall minimum score of at least 80% with individual scores for the reject and accept samples of no less than 70%. They must also have attained a minimum overall score of at least 75% with individual scores of at least 70% for the reject and accept samples on a previous assessment held at least six months previous to the current reassessment.
18. To retain their status as a canned tuna Inspector, an Inspector must be reassessed every two years and must attain, at that reassessment, a minimum overall score of at least 80% with individual scores for the reject and accept samples of no less than 70%.

Tuna Quality Indicators*

The following are descriptors which can be used to describe quality of raw tuna.

Appearance: Raw

Species	Pass	**B. Pass	B. Fail	Fail
Yellow Fin	translucent pale red colour firm texture	brownish yellow	opaque greenish faded	very opaque green grey soft mushy
Skip Jack	dark red brownish translucent shiny firm	pale pink sl. green iridescent softer sticky	dark brown grey/green dark green opaque cooked app.	iridescent/ green pasty grainy opaque belly burn mushy liquefaction
Albacore	light beige ivory pale pink/ translucent red-brown/ translucent shiny firm	sl. iridescent sl. green pink/brown mushy dry cooked app. opaque soft yellowish	iridescent soft/mushy grey/pink grey opaque blue-purple/ pink grainy	iridescent/heavy opaque belly burn liquefaction green brown

*Developed by NMFS

**B = Border line

Odors: Raw

Product	Pass	B. Pass	B. Fall	Fall
Yellow Fin	sweet fresh neutral	stale sl. brine* sl. fishy oxidized caramel	mod. stale sour musty sl. rancid fruity	v. stale v. sour putrid v. rancid painty ammonia fuel
Skip Jack	gamey meaty seaweed neutral	oxidized stale storage caramelized lt. brine stale meat sl. musty	sl. rancid persistent sour heavy brine fruity	putrid rancid v. stale pungent sour fermented fruity fecal sweet cheesy acid ammonia fuel
Albacore	fresh gamey neutral watermelon	sl. stale/stale oxidized cardboard storage	sl. rancid fruity/nutty musty sour fermented sl. green (urine/sulfur)	v. sour v. rancid putrid cheesy fecal garbage pungent fermented fruity sweet pineapple ammonia fuel

* "Brine" refers to odours of brine in which frozen tuna are being thawed.

The following are descriptors which can be used to describe quality of pre-cooked tuna.

Texture/Appearance: Pre-cooked

Product	Clear Pass	B. Pass	B. Fail	Clear Fail
Yellow Fin	firm texture light-whitish colour	sl. greenish darker mixed colours	honeycomb heavy curd grainy mushy/soft	honeycomb. soft/mushy green red/pink curdy (feverish) grey colour
Skip Jack	light colour yellow/sl. green firm-texture	pink/greenish curds slight greenish meaty mushy	mushy/pasty dry texture	mushy/pasty meaty honeycomb very dark colour feverish (mahogany)
Albacore	light-pale off white colour ivory colour firm turkey like texture-white meat	sl. caramelize lt. greenish dry texture sl. brown grey	tan/orange mod. green tough chewy	brown dark green tough/chewy honey comb heavy orange

Odors: Pre-cooked

Species	Pass	B. Pass	B. Fail	Fail
Yellow Fin	lt. turkey lt. chicken neutral	sl. oxidized sl. stale frozen storage sl. green*	sl. sour stale rancid sl. ammonia	fruity/pineapple sour yeasty rancid painty pungent putrid fuel
Skip Jack	dk. turkey dk. chicken neutral meaty gamey beefy	sl. oxidised oxidized cardboard stale	rancid sour musty urine ammonia yeasty painty	painty rancid urine ammonia musty sour cheesy putrid fecal pungent garbage fruity fuel
Albacore	lt. turkey lt. chicken neutral	sl. sulfide sl. caramel sl. oxidized sl. stale cardboard	sour rancid sulfide/heavy painty shellfish frz. storage	sour putrid green/heavy rancid painty sulfide/heavy fruity fecal sharp peppery pungent fuel

* "Green" odors refers to the phenomena occurring in tuna after PRE-COOKING and retorting. Greening is associated with high levels of TMAO and causes sensory changes characterized by green color, sulphur/urine odors and sulfide flavours.

Flavours: Pre-cooked

Product	Clear Pass	B. Pass	B. Fail	Clear Fail
Yellow Fin	turkey > pre-cooked chicken	sl. oxidized neutral	sour rancid stale	sour bitter fuel
Skip Jack	salty bitter (slight) tangy turkey > dark chicken meat gamey	bitter (sl) salty sl. oxidized stale smoky scorched sl. tang	bitter rancid sour persistent	biting-histamine sour (persistent) bitter rancid/pungent v. salty fuel
Albacore	neutral turkey-light meat chicken	sl. caramelize sl. oxidized sl. stale oxidized sl. green	sour bitter sl. rancid mod. sulfide froz. storage scorched metallic (heavy)	sour bitter sulfide (strong) fuel

The following are descriptors which can be used to describe quality of canned tuna products.

Colours: Canned

Product	Clear Pass	B. Pass	B. Fail	Clear Fail
Yellow Fin	light - white/yellow colour	sl. green	darker green grainy/meaty grey colour	feverish red/pink curdy honeycomb orange heavy green
Skip Jack	light colour - beige firm texture pink/beige	soft/meaty sl. grainy mushy darker beige cloudy free liquid	mushy/pasty med. brown curds iridescent	yellow/brown color feverish pink/red mushy iridescent
Albacore	light colour grainy texture	light/mod green sl. orange sl. caramel	heavy green heavy caramel orange	heavy green honey comb tough texture

Odours: Canned

Product	Clear Pass	B. Pass	B. Fail	Clear Fail
Yellow Fin	Chicken (lt. meat) neutral	sl. oxidized sl. fishy sl. metallic	sl. sour sour rancid sweet/fruity painty	rancid cheesy sweet/fruity very sour heavy green (urine/sulfur) putrid fruity fecal pineapple fuel
Skip Jack	chicken> dark turkey> meat neutral sl. soy meaty gamey	oxidized sl. stale musty/stale stale soy sl. metallic cardboard fleeting sl. scorch	rancid painty sour	rancid putrid, fecal very sour old brine musty fruity sweet/sour cheesy pungent fuel
Albacore	chicken turkey (light meat) neutral sl. sulfide sl. stale sl. metallic sl. caramel	sl. sulfide sl. caramel sulfide stale sl. caramel sl. metallic sl. green sl. crustacean musty mod. green oxidized sl. fishy	musty sour strong sulfide heavier schored rancid heavy green	sour putrid fecal fruity cheesy strong sulfide heavy scorched fuel urea rancid heavy green

Flavours: Canned

Product	Clear Pass	B. Pass	B. Fail	Clear Fail
Yellow Fin	Chicken (lt meat) neutral	oxidized	sl. sour sour bitter	heavy green urine/sulfur bitter sharp (histamine) fuel
Skip Jack	chicken > dark turkey > meat soy capon	sl. bitter oxidized sl. stale dry taste sl. grainy sl. scorched sl. metallic (tangy)	rancid bitter/strong med. sour	rancid strong bitter very sour fuel
Albacore	chicken turkey (light meat) neutral soy vegetable (broth)	sl. sulfide sl. scorched sl. metallic sl. caramel oxidized sl. fishy sl. crustacean	sour rancid heavy green fruity bitter	sour fruity rancid heavy green fuel bitter heavy caramel heavy sulfide pineapple fruity sharp/bite pungent sweet/sour astringent fecal fruity

Vocabulary Definitions

Term	Extend Definitions	Examples
Amine	Aromatic associated with the class of nitrogen-containing compounds, the amines. May be ammoniacal, fishy, or somewhat proteinaceous character like wet wool, wet dog fur.	Anchovies (fishy/amine)
Ammonia	Aromatic characteristic of unscented ammonia.	Old urine, household ammonia
Astringent	The chemical feeling factor on the tongue or other 1% alum in water skin surfaces of the oral cavity describes as puckering/dry and associated with tannins or alum.	Unripe banana, strong tea.
Bitter	Taste on tongue stimulated by solutions of caffeine, quinine, and certain other alkaloids.	Quinine, Allspice, Mace, Thyme, Oregano, Hop Tea
Caramelized	Sweet aromatic, characteristic of browned sugars and some other carbohydrates.	English toffee (Callard & sweetened condensed milk. Bowser) Candy Kitchen
Cardboardy	Aromatic associated with slightly oxidized fats and oils, reminiscent.	Wet cardboard, wet paper filters.
Cheesy	Aromatic associated with ripened cheese, sour aromatic with organic acid notes such as butyric and isovaleric.	Cheddar, Swiss cheese
Chemical	A very general term associated with many different types of compounds, such as solvents, cleaning compounds, and hydrocarbons. Having a distinctly "chemical" nature, perhaps foreign to food products.	Magic Marker (odor only)
Chicken, Dark Meat Cooked	Aromatic associated with freshly cooked chicken meat, dark muscle (thigh or leg)	Baked/boiled chicken thigh or leg
Chicken, White Meat, Cooked	Aromatic associated with cooked chicken white meat breast.	Baked/Broiled chicken breasts
Cold Storage	See: Cardboardy	
Crustacean	The slightly sweet aromatic associated with crabs, lobsters and shrimp.	Fresh cooked crab meat, lobsters

Diesel	A chemical aroma note associated with petroleum products.	
Earthy	Aromatic characteristic of damp soil or slightly undercooked boiled potato	Damp potting soil, undercooked boiled potato, spinach
Estery	Ripe fruit character associated with esters; typically sweet aromatic.	Aged apple cider Fermented, overripe apples
Fecal	An unpleasant aroma associated with complex protein decomposition	
Fermented	Aromatic associated with fermented fruits, vegetables. (Can be yeasty) or grains.	Overripe pineapple, cantaloupe, overripe orange juice
Fish oil	Aroma/flavour associated with slightly rancid fish oil; similar to oil found in mackerel.	Oil of canned sardines
Fishy	Aromatic associated with Triethylamine and old fish	Temperature abused mackerel
Fruity	Aromatic associated with a mixture of non-specific fruits: berries, apples/pears, tropical, melons; usually not citrus fruits	Fruit punch, Juicy Fruit gum
Fuel Oil	A general term to describe the aroma of fuel oils such as diesel oil or kerosene.	
Gamey, Fish	The aromatic associated with heavy, gamey, characteristics of some cooked fish such as Atlantic Mackerel, as opposed to a delicate aroma of fish such as sole. Analogous to the relationship of the heavy, gamey characteristics of fresh venison compared to fresh cooked beef, or duck to chicken.	
Hydrogen Sulfide	Aromatic associated with rotten egg and sewage.	Hard boil egg yolk
Iodine	Typical of the chemical iodine.	
Lactic Acid	A sour aroma note.	Brine from Sauerkraut
Metallic	(1) Aromatic associated with metals, tinny or iron;	Canned tomato juice or plum tomatoes, left open
	(2) A flat chemical feeling factor stimulated on the tongue by metal coins.	Iron tablet

Mouldy	Aromatic characteristic of mould growth or mildew.	Mouldy cheese
Musty, wet	Aromatic characteristic of damp/wet basements or turned soil.	Damp cloth stored in plastic bag, old books
Oxidized	A general non-specific term related to various characteristics of oxidized foods-such as stale, cardboard, rancid, painty, tallow.	Old oil
Painty	Aromatic associated with oxidized oil; similar to the aromatic of linseed oil and oil based paint.	Oil based paints
Pungent	Irritating sharp sensation upon exposure to certain volatiles.	Vinegar, onion, garlic
Putrid	Aromatic associated with anaerobic protein decomposition; decaying vegetation or animal.	Rotten flesh
Rancid	Aromatic associated with oxidized fats and oils.	Old oils, aged potato
Refrigerator/ Freezer	Off/flavour associated with a product that has absorbed odors from refrigerator or freezer.	Dairy products stored uncovered in refrigerator or freezer
Rotten vegetables	Cooked cabbage, cauliflower.	Cooked cabbage
Scorched	Aroma/flavor associated with scorching.	
Sharp	Aromatic characterized by a clean, sour impression	Vinegar
Sour	(1) Basic taste on tongue stimulated by acids.	Unripe fruits, Citrus
	(2) Aromatic caused by lactic acid bacteria.	Sour milk
Sour aroma/ aromatic	A sharp aromatic associated with products that have a sour taste or are fermented.	Vinegar/yogurt
Stale	A general term that describes old product with lower fresh notes and perhaps early stages of oxidation; cardboard is preferred term.	Crackers, cereal or bread year-old beer left open 2-3 days
Sulfide/sulfur	Aromatic associated with hydrogen sulfide, rotten egg.	Rotten eggs, sewer gas, cabbage
Sweet	Taste on the tongue stimulated by sugars and high potency sweeteners.	Dextrose, glucose

Sweet Aromatic	Aromatic associated with materials which also have a sweet taste, such as molasses, caramelized sugar, cotton candy, maple syrup, maltol.	Maple syrup, marshmallows, vanilla beans, molasses
Turkey, Dark Meat, Cured	Aromatic associated with cured dark turkey meat.	
Turkey, white meat cured	Aromatic associated with cooked white turkey meat.	
Watermelon	An aromatic reminiscent of watermelon rind or cucumbers.	Shortening aged in hermetically sealed cans.
Yeasty	Aromatics associated with fresh yeast and yeast fermentation.	Fresh baked yeast bread, fresh yeast cake