Waxes

Processing

Identification

Chemical Names
Ammonium oleate (Ammonium soaps) Beeswax and shellac are complex mixtures of aliphatic acids, esters, and other components.
Other Names:
Ammonium Soaps, Beeswax, Shellac

CAS Numbers:
Ammonium oleate: 544-60-5
Beeswax: 8012-89-3
Shellac: 9000-59-3
Other Codes:
Beeswax: INS 901

Recommendation

Synthetic / Non-Synthetic:	National List:	Suggested Annotation:
Ammonium soaps=synthetic (Consensus) *Beeswax=non-synthetic (Consensus)* *Shellac=some reviewers considered it technically possible to produce shellac that could be considered non-synthetic under OFPA, others considered all sources synthetic. All agreed that bleached shellac was synthetic.*	*Ammonium soaps:* *Not allowed in 95%+* *Not allowed in 50%+* *(Consensus)* *Beeswax:* *Not Allowed in 95%+* *(OMRI Recommendation)* *Allowed in 50%+* *(OMRI Recommendation)* *Not Allowed in 50%+* *(Dissenting opinion)* *Shellac:* *Not Allowed in 95%+* *Not Allowed in 50%+* *(Consensus)*	*Organically grown raw fruits that are coated with fruit waxes that contain non-organic beeswax cannot be sold as 'Organic Fruit' unless all components of the wax are organically produced or appear on the National List for non-organic ingredients included for use in foods labeled as organic and containing no less than 95% organic ingredients. 'Organic' claims made on fruit treated with beeswax must appear with the modifier 'produced' or 'grown' to make it clear to consumers that the fruit was not organically handled. Fruit coated with any other substance--including, but not limited to, paraffin or other petroleum derivatives, fungicides, shellac, or soaps--cannot be labeled as organic in any way. (OMRI Recommendation)* *Dissenting Opinion* *Same as recommendation, except that fruit coated with any non-organic ingredient that is not on the National List cannot be labeled as organic in any way. (Non-organic beeswax may not be used to wax fruit labeled as organic.)*

Characterization

Composition Unable to be exhaustively characterized. Ammonium soap is usually composed of ammonium oleate: C17H33COONH4 but will also contain a number of other ammonium salts of fatty acids. Shellac is made up of a complex mixture of polar (unsymmetrical electron distribution) and non-polar components. 70% hard resin, 30% soft resin and wax.
Beeswax is composed of esters of straight-chain monohydric alcohols with even-numbered carbon chains esterified with straight chain acids. One such ester is myricyl palmitate:

Properties:
Waxes are more resistant to hydrolysis than fats, requiring higher temperatures and stronger alkaline conditions. Natural waxes also contain paraffin, hydroxylayted and unsaturated fatty acids, secondary alcohol and ketones. They are widely distributed in nature. In animals, waxes cover the surfaces of hair, wool and feathers; in plants waxes cover the surface of stems, leaves and fruits. Fruit waxes as a rule contain cyclic compounds of the triterpinoid type. For example, ursolic acid is found as the white coating on the surface of apples and grapes (Aurand, Woods, and Wells, 1992).

Shellac is hard, tough, amorphous resin that has good water resistance and produces high lustrous finishes. Soluble in alcohols aqueous solutions of alkali, organic acids and ketones.

Ammonium soap is a yellowish-brown paste that softens at 50-55°F., melting point of 70-72°F., and is soluble in water at 80°F.
Beeswax is yellowish to brownish-yellow, soft to brittle, wiht a melting point of 60-65°F. The wax is glossy and hard but plastic when warm. It is practically insoluble in water, partially soluble in alcohol, and soluble in hot alcohol.

How Made:
Shellac is made from the resinous secretions of the Laccifer (Tachardia) lacca (Kerr) insect (order Homoptera, family Coccidae). These are scale-like insects feeding on resiniferous trees. The resin is harvested, dried and crushed. The refining process involves dissolving the resin in alkali, centrifuging, and/or removal of wax, bleaching with sodium hypochlorite bleach, and precipitating the final product with sulfuric acid. Often, synthetic plasticizers are added to the final mixture. There are several variations of the above process.
Ammonium soap is made from the reaction between oleic acid and ammonium hydroxide, or an excess 28-30% ammonia solution (Stumpt, cited in Merck).
Beeswax is secreted by the bee's glands below its abdomen. Wax is collected from the combs of bee colonies. It may be heated to a melting point in the collection process, but generally no chemicals are used specifically to extract the wax.

Specific Uses:
Waxes in general are used as fruit coatings. Each of the constituents considered have multiple uses. There are multiple uses for shellac. For this discussion, shellac will be considered as a fruit wax to reduce shrinkage and decomposition. It is also used as a floor polish and a dessert topping. It is a confectionary glaze, in candy, as an excipient in pharmaceuticals, a coating for supplements, as a leather dressing, in candles and edible inks. Ammonium soap is used as a flowing and solidifying agent. Beeswax is used for vegetable and fruit coatings, in candy and confections, to make candles and as a sealant.

Action:
Waxes coat the plant surface and function to limit water loss and impede the invasion of pathogens. Fruit that is damaged during or after harvest, or has had the cuticle removed by detergents is more susceptible to insect and fungal damage if it is not waxed. Waxes also serve as a physical barrier to reduce gas exchange and decrease shrinkage and spoilage. Finally, fruit waxes serve cosmetic purposes, causing many fruits to have a shiny high-gloss surface (Kays, 1991).

Combinations:
Shellac is used as a hard protective coat, and will rapidly harden if not kept in a solvent. Aqueous lac will also be combined with various synthetic preservatives such as phenol, or the mixed methyl and propyl esters of p-hydroxybenzoic acid (Sankaranarayanan, 1989). It is almost always used with pure ethyl alcohol, but will occasionally isopropyl alcohol is used as a solvent. Often used with wood resins. Ammonium soap is used as a flowing and solidifying agent with wood resin and shellac. Other fatty acids and other salts of fatty acids may be combined with ammonium oleate. Some formulations may contain no ammonium oleate at all, using potassium oleate (softsoap) as the primary surfactant / emulsifier instead. Ammonium soap is also often combined with ethyl alcohol.

A number of formulations are made with synthetic substances that have not been considered by the NOSB. These substances include ethyl acetate, petroleum derived paraffin, synthetic fungicides such as morpholine. A number of surfactants are also used--various ethoxylated polyethylenes, such as polysorbate 60--as well as triethanolamine. They will also be combined with preservatives, and oils from animal or plant sources.
Ammonium soaps (potassium soaps as well) are also mixed in with shellac so that the shellac resin will disperse over the fruit (surfactant). Beeswax will often contain propolis, pigments, and other non-wax substances that compose up to 6% of the total.

Status

OFPA
6517(c)(1)(B)(iii) Shellac could be considered non-synthetic, used in handling, and not organically produced.
6518(c)(1)(b)(i) Ammonium soaps are a soap, which is on the list of exempt synthetics for production.

Regulatory

Waxes used on fresh produce are considered ingredients by FDA and are required to be labeled as follows:

21 CFR 104(b)(22) Wax and resin ingredients on fresh produce when such produce is held for retail sale, or when held for other than retail sale by packers or repackers shall be declared collectively by the phrase ``coated with food-grade animal-based wax, to maintain freshness'' or the phrase ``coated with food-grade vegetable-, petroleum-, beeswax-, and/or shellac-based wax or resin, to maintain freshness'' as appropriate. The terms ``food-grade'' and ``to maintain freshness'' are optional. The term lac-resin may be substituted for the term shellac.

Beeswax is listed as GRAS, but shellac is not (see below).

Beeswax and shellac are substances approved for use as fruit coatings on citrus at 21 CFR 172.210, as are fatty acids. However, salts of fatty acids are not. The listing of salts of fatty acids at 21 CFR 172.863 does not include reference to ammonium salts of fatty acids.

Status among Certifiers
Petroleum-derived waxes and waxes that contain synthetic fungicides or preservatives are prohibited. Most certifiers require labelling.

Historic Use
Established but controversial. Long used in packing organic citrus fruits, particularly for export. Use in post-harvest handling of organic pome fruits and fruit vegetables such as cucumbers, summer squash and bell peppers is a relatively recent phenomenon. Some certifiers have at various times had a restricted application only to 'non-edible plant parts' with the implicit allowance for citrus but no other uses.

International
IFOAM allows beeswax as a processing and handling aid. It is not clear if this use is considered as an ingredient or a processing aid. Shellac and ammonium soaps do not appear on the IFOAM list. (IFOAM, 1998).

OFPA 2119(m) Criteria

(1) The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems. As this is a processing material, the substance is not used in organic farming systems.
(2) The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment. See processor criteria 3 below.
(3) The probability of environmental contamination during manufacture, use, misuse or disposal of such substance. This is considered below under item (2).
(4) The effect of the substance on human health. This is considered in the context of the effect on nutrition (3) below as well as the and the consideration of GRAS and residues (5) below.
(5) The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. As this is not released into the agroecosystem, there is no direct effect.
(6) The alternatives to using the substance in terms of practices or other available materials. See discussion of alternatives in (1) below.
(7) Its compatibility with a system of sustainable agriculture. This is considered more specifically below in the context of organic handling in (6) below.

NOSB Processing Criteria

A SYNTHETIC PROCESSING AID OR ADJUVANT may be used if;

1. An equivalent substance cannot be produced from a natural source and has no substitutes that are organic ingredients.

Alternatives to any of the three substances discussed herein are definitely possible, primarily through altered practices. Management of product storage environments through temperature and humidity control, and modified or controlled atmosphere can extend storage life and prevent or delay the spread of infection of produce with pathogens. Careful handling of produce during harvest and post-harvest, to avoid physical damage, leaving the cuticle intact, contact with excess foreign material, or contact with spoiled product, can also reduce the possibility of opportunistic infections. Planned management of product flow to satisfy shorter shelf life through multiple pickings and picking to order. Biological control with antagonists such as Candida oleophila can also be part of an integrated system of post-harvest pathogen reduction. There may also be other materials available for coating produce, such as carnauba wax, but these materials might also be subject to some of the same considerations as discussed throughout this review. At present, the investigator and reviewers are unaware of any wax formulation that meets the current NOSB's recommendation.

2. Its manufacture, use and disposal does not contaminate the environment.
Shellac manufacturing employs several extraction and refining steps that involve the use of strong acids, bases, and oxidizing agents. Production and disposal of these synthetics may cause negative environmental consequences similar to that caused by other extracted materials.
The consequences of ammonium soap production and disposal are based on the oleic acid source (e.g. plant, animal, or synthetic), and the ammonium hydroxide reacted with the oleate. Ammonium Hydroxide is a very volatile alkali and dissipates rapidly.

   Beeswax has no apparent adverse consequences in the manufacture or disposal.

3. If the nutritional quality of the food is maintained and the material itself or its breakdown products do not have any adverse effect on human health.
Shellac may cause dermatitis. Ammonium hydroxide is irritating to the eyes and mucous membranes. Oleic acid has low oral toxicity but is mildly irritating to the skin, causes tumors when injected under the skin of rabbits at 62mg/kg body weight. Waxes may help to maintain the nutritional quality of fruit by preventing dessication and spoilage.

4. Is not a preservative or used only to recreate/improve flavors, colors, textures, or nutritive value lost during processing except in the latter case as required by law.
Fruit waxes are generally not considered to be preservatives. However, they provide results similar to preservatives, but the mode of action is primarily physical.

5. Is Generally Recognized as Safe (GRAS) by FDA when used in accordance with Good Manufacturing Practices (GMP), and contains no residues of heavy metals or other contaminants in excess of the tolerances established by FDA.
Ammonium oleate is not listed as GRAS. Formulators claim a clearance as a surface finishing agent from 21 CFR 170.3(o)(30) based on GRAS status for ammonium hydroxide 21 CFR 184.1139) and oleic acid's clearance for fruit coatings (21 CFR 172.360).

   Beeswax is listed as GRAS as follows:
   21 CFR 184.1973 Beeswax (yellow and white).
   (a) Beeswax (CAS Reg. No. 8012-89-3) is a secretory product of honey bees used as a structural material in honeycombs. Beeswax is prepared from honeycombs after removal of the honey by draining or centrifuging. The combs are melted in hot water or steam or with solar heat, and strained. The wax is refined by melting in hot water to which sulfuric acid or alkali may be added to extract impurities. The resulting wax is referred to as yellow beeswax. White beeswax is produced by bleaching the constituent pigments of yellow beeswax with peroxides, or preferably
   it is bleached by sun light.
   (b) The ingredient meets the specifications of the ``Food Chemicals Codex," 3d Ed. (1981), pp. 34-35, which is incorporated by reference. Copies may be obtained from the National Academy Press, 2101 Constitution Ave. NW., Washington, DC 20418, or may be examined at the Office of the Federal Register, 800 North Capitol Street, NW., suite
   700, Washington, DC 20408.
   (c) The ingredient is used as a flavoring agent and adjuvant as defined in Sec. 170.3(o)(12) of this chapter, as a

lubricant as defined in Sec. 170.3(o)(18) of this chapter, and as a surface-finishing agent as defined in Sec. 170.3(o)(30) of this chapter.
(d) The ingredient is used in food, in accordance with Sec. 184.1(b)(1) of this chapter, at levels not to exceed good manufacturing practice. Current good manufacturing practice results in a maximum level, as served, of: 0.065 percent for chewing gum as defined in Sec. 170.3(n)(6) of this chapter; 0.005 percent for confections and frostings as defined in Sec. 170.3(n)(9) of this chapter; 0.04 percent for hard candy as defined in Sec. 170.3(n)(25) of this chapter; 0.1 percent for soft candy as defined in Sec. 170.3(n)(38) of this chapter; and 0.002 percent or less for all other food categories.[43 FR 14644, Apr. 7, 1978, as amended at 49 FR 5613, Feb. 14, 1984; 50 FR 49536, Dec. 3, 1985]

Shellac is not listed as GRAS. The following tests are contained in the Food Chemicals Codex:
Food Chemicals Codex
Acid Values: Between 17 and 24
Arsenic (As): Not more than 3
Carnuba Wax: Passes test
Ester Value: Between 72 and 79
Fats, Japan Wax, Rosin, and Soap: Passes test
Heavy metals (as lead): Not more than 0.004%
Lead (Pb): Not more than 10 ppm.
Melting range: Between 62° and 65°
Saponification cloud test: passes test.

There are reports of pesticide residues in beeswax (Breed et al, 1995; Buren et al. 1992). The risk of residues would likely be lower in hives not treated with pesticides that forage on organic pollen and nectar sources, but this logical hypothesis is not supported in the literature and requires more research.

Shellac, Bleached
Acid Value: Between 73 and 89
Arsenic (as As) Not more than 1.5 ppm
Heavy metals (as Pb): Not more than 10 ppm
Loss on drying: Not more than 6%
Rosin: Passes test
Wax: Not more than 5.5%

Shellac, Bleached, Unwaxed
Acid Value: Between 75 and 91
Arsenic (as As) Not more than 1.5 ppm
Heavy metals (as Pb): Not more than 10 ppm
Loss on drying: Not more than 6%
Rosin: Passes test
Wax: Not more than 0.2%

6. Is compatible with the principles of organic handling.
As a processing material, waxes are not necessarily compatible with organic handling principles. Waxing fruit replaces the natural cuticle of wax found on fruit after it has been scrubbed off during fruit cleaning at the packing shed. These are non-food materials that are being applied to food products in order to replace natural oils or waxes removed from fresh produce, or to otherwise preserve produce in its harvested state for a longer than natural period of time.

While arguments are made that these materials are only applied to non-edible portions of fruit, such as the peel of citrus fruits, it is quite possible that these parts of the fruit are also eaten. (Use of citrus peel in a variety of baked goods and other recipes is actually quite common.) As such, it is safer to consider waxes as an ingredient. There is currently no mechanism in the marketplace for consumers to know with certainty whether the product they buy is treated with wax, despite the fact that produce must be labeled on its case as to any treatments. Were retailers of organic goods required, by certification or other regulations, to clearly indicate when fresh produce has been treated with waxes, these materials might seem more acceptable for use on certified organic produce.

Fruit wax serves to change cosmetic appearance and extend shelf life. The preservative action afforded by waxing of fresh produce is a convenience, but is not a requirement of a sustainable system of agriculture, and may in some cases be an encouragement of systems that are less sustainable, especially as it relates to mass production and long-distance transport of agricultural commodities.

7. There is no other way to produce a similar product without its use and it is used in the minimum quantity required to achieve the process.
   Not essential for fresh fruit and vegetable products. Fruit wax is applied at rates of approximately one gallon per 5,000 to 10,000 pounds of fruit. This translates to being between 0.08 to 0.17% of the weight of the waxed fruit.

Discussion

Condensed Reviewer Comments

None of the reviewers had a vested commercial or financial interest in any of the materials reviewed.

Reviewer 1
Shellac, ammonium soaps, and beeswax should be prohibited as materials for use on organic foodstuffs. Beeswax can be listed as a Regulated material, with the annotation stating that it can be used in non-food formulations, if it is from a certified organic source, or is shown to be free of pesticide residues.

Reviewer 2
After extensive review, I feel that only beeswax and carnauba wax (if approved as GRAS) are non-synthetic. Both shellac and ammonium oleate must be considered synthetic since both have been either chemically modified (and/or mixed with plasticizers as in the case of shellac) or manufactured by a chemical reaction that changes covalent bonding i.e., saponification reaction (hydrolysis) to manufacture oleic acid and then subsequent reaction with NH4OH (28%) to yield ammonium oleate. Also, please note the formula for ammonium oleate given in the third sentence of page 1- C18H37NO2- is incorrect. It should be C17H33COONH4 . Why? NH4+ is the ammonium ion and must be represented in its correct chemical structure. I agree that the remaining technical information is accurate and well represents the topic for review. If carnauba wax is GRAS I would recommend further review for its potential.

I do not feel as a function of NOSB processing criteria 2, 3, 1, and 6 that shellac and ammonium oleate should be allowed to be added to the National List Of Allowed Synthetics. Therefore I am in agreement with IFOAM for the use of bee's wax and I am in favor of the proposed annotation under status. I also agree with existing restrictions.

Relevant to the discussion I would like to add that technically the wax applied to fresh fruits and vegetables can be considered both as an ingredient and a preservative. I am in full agreement that all certified organic food products containing a wax should be labeled (i.e. bee's wax, carnauba wax).

Reviewer 3
Beeswax, candelilla wax and carnauba wax are approved to be used, assuming that no prohibited synthetics are added during the processing and refinement of these waxes. Their use should be restricted to uses that are necessary to extend shelf life and provide commercial availability of certain crops. Shellac and ammonium soaps should not be approved for use in organic production.

Reviewer 4
I am not basically "for" fruit waxes. I'd rather see handling and storage methods modified to avoid the use of them. I'm somewhat dismayed to find them on more and more produce (tomatoes, even!). However, if there is a lot of pressure from the industry, I guess that I don't see a downside to their use, either. I would definitely restrict the allowed waxes to a very few, and I would suggest finding an alternative to ammonia soaps.

Conclusion

Fruit wax could be considered an ingredient rather than a handling aid for a variety of reasons. The wax is often visible to consumers. The FDA has required cartons of waxed fruit to be labeled as such since 1993. Waxes will impart flavors in fruit, even those with peels that are ordinarily not eaten (Davis & Hofmann, 1973; Davis, Roe, and Bruemmer, 1973;

Burns and Echeverria, 1988; and Nisperos-Carriedo, Shaw, and Baldwin, 1990 cited in Baldwin, Nisperos-Carriedo, Shaw, and Burns, 1995), such as citrus. It can also be considered a preservative, because it prolongs shelf life. However, the preservative nature is as much physical as it is chemical.

The livestock committee may want to consider the development of standards for organic beeswax and shellac as part of the discussion of the apiculture standards. It is not clear if the ethyl alcohol used in a fruit coating would need to be organic or non-organic for the fruit to be labeled as 'organic.' A strict interpretation of the NOSB's recommendation could be interpreted as such. The NOSB may want to clarify this in the general consideration of fruit coatings.

For example, oranges waxed with carnuba, shellac, wood resin, non-organic ethyl alcohol and ammonium soap could be labeled as 'organically grown oranges coated with wax' but could not be labeled as 'organic oranges.' Under the current NOSB recommendation, fruit coated with carnuba wax, organic beeswax, organic ethyl alcohol and wood resin could be labeled as 'organic oranges--coated with organic wax' under the current NOSB recommendations provided the weight of the carnuba wax and wood resin does not exceed 5% of the total weight of the fruit plus other organic ingredients.

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