



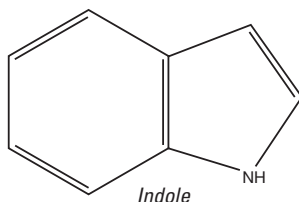
Flavor Bites: Indole

How this potentially repellent material can impart useful effects in dairy, seafood, fruit, fermented and other flavors

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Gamalost (also: Gammelost) is an ancient Norwegian cheese with an incredibly ugly appearance. It is formed by the action of almost every conceivable bacteria and mold on coagulated cows' milk. This "evil" cheese lasts forever and was undoubtedly created with long Viking sea voyages in mind. I have to confess that I love this odd cheese, and not surprisingly, I have rarely been able to find it outside Scandinavia. Gamalost has a unique taste of almost pure indole set against a cheesy background—it is what could only be described politely as an acquired taste.

Indole (FEMA# 2593), also sometimes called benzopyrrole, is an ingredient that is widely found in nature, but interestingly not often used in flavors. The problem lies in its aroma. Smelled pure (and without the cheesy character of Gamalost) it is strongly fecal, and generates an almost instinctive sense of revulsion. It is produced in nature by the bacterial decomposition of proteins (containing the essential amino acid tryptophan) in natural foods such as cheese and meats. It is also found in several fragrance raw materials derived from flowers, particularly jasmine absolute (FEMA# 2598) at around 0.16% and neroli oil (FEMA# 2771) at around 0.1%. These natural products can be useful alternatives to pure indole in flavors, but can only be used effectively in flavors that can accommodate their major ingredients. Skatole (FEMA# 3019), also called 3-methyl indole, is a useful alternative to indole. It has a rather



similar odor, but is perhaps a little more fecal and less interesting in fruit flavors.

Indole can be used in flavors at two very distinct concentration levels. At higher levels (for example, in cheese flavors) its character is quite evident, but the effect is not unpleasant because it blends into a recognizable and attractive complex aroma. At distinctly lower levels (for example, in raspberry flavors) the fecal character is not at all evident and the effect is a subtle, but highly attractive, sweetening and rounding out of the flavor.

Dairy Flavors

Cheddar cheese: In cheddar and other similarly sharp cheese flavors, indole provides a vital, overtly animalic component of the overall character at around 150 ppm. A lower level, around 50 ppm, is more appropriate in milder cheese flavors. (Note: The dose rates given in this article are the levels suggested in flavors intended for use at 0.05% in a ready to drink beverage or in a simple bouillon.)

Washed rind cheese: Indole can be used at very high levels—even up to 500 ppm—in flavors with the character of washed rind cheeses such as Epoisses de Bourgogne.

Butter: Use levels as low as 0.1 ppm can be surprisingly useful in fresh butter flavors. Although higher levels detract from the fresh effect, very high levels up to 20 ppm can be used in cooked butter flavors.



Although useful levels of indole vary dramatically depending on the type of beer flavor, 1 ppm can add depth and a degree of heaviness.

Yogurt: A trace, at around 0.01 ppm, of indole can be helpful in yogurt, fresh milk and cream flavors.

Meat and Seafood Flavors

Liver: Indole is a significant part of the overall character of this flavor, and should be used at around 10 ppm.

Chicken: Although lower levels of indole are better in chicken flavors, up to 5 ppm can be used.

Beef: Using indole at around 2 ppm can add interesting effects in these flavors.

Pork: Good effects can be obtained from around 5 ppm in pork flavors, especially processed pork.

Hydrolyzed protein: Indole is very helpful in recreating the elusive character of hydrolyzed vegetable protein; 10 ppm is a good starting level.

Shrimp: A use level of 5 ppm is a good indication for seafood flavors in general. However, this ingredient is particularly useful in cooked shrimp or and crab flavors.

Fruit Flavors

Strawberry: While indole adds depth and naturalness to strawberry flavors, it should be used with caution; levels at around 0.1 ppm are typical. However, with careful formulation it is possible to add up to 5 ppm.

Raspberry: Indole can be used at varied levels in raspberry flavors, with 1 ppm as a good starting level.

Blackberry: Similar to raspberry flavors, but with a higher starting use level, at around 2 ppm.

Blackcurrant: Indole is particularly useful in blackcurrant flavors, with 3 ppm as the ideal use level.

Apricot: The addition of 0.3 ppm of indole can be helpful in apricot flavors, especially in those requiring a jammy note.

Peach: Peach flavors are usually fresher and more subtle than apricot flavors. As such, one can try using around 0.2 ppm of indole in these flavors.

Passion fruit: Even more subtle levels, of around 0.1 ppm, are needed in this flavor category.

Cherry: 0.1 ppm of indole is a good starting level in cherry flavors.

Grape: Concord grape flavors can tolerate relatively high levels of indole, around 2 ppm.

Bitter orange: The effect of this material in flavors, based on or containing bitter orange oil, is quite interesting, with 1 ppm as a good starting level. However, care should be exercised when adding indole to citrus flavors to ensure that internal reactions do not cause the flavor to alter significantly on storage.

Fermented Flavors

Beer: Although useful levels of indole vary dramatically depending on the type of beer flavor, 1 ppm can add depth and a degree of heaviness.

Wine: Similar or slightly higher levels of the material work well in red and white wine flavors.

Whiskey: Indole up to 2 ppm adds body and malt character to whiskey flavors.

Other Flavors

Vanilla: Indole adds to the natural character of vanilla beans and can be used, with care, at levels up to 10 ppm.

Chocolate: Similarly high levels to those in vanilla can work well in chocolate flavors, especially milk chocolate.

Hazelnut: Indole is useful in many nut flavors, and a good starting level in hazelnut and walnut flavors is 3 ppm.

Peanut: Peanut flavors, can benefit from more than 5 ppm of this raw material.

Black tea: Up to 5 ppm of indole

can add realism to tea flavors that are intended for use alone. However, the material should probably not be used in flavors whose primary purpose is to freshen a natural tea extract, as that may already contain a surfeit of indole.

Dried mushroom: Very high levels of indole, around 10 ppm, can help to recreate the character of dried cep (porcini) mushrooms.

Coffee: A use level of 10 ppm is a good starting level in coffee flavors.

Malt: In malt flavors, one can try adding around 5 ppm of indole to

add body and improve the natural character.

Licorice: Similar levels work well in licorice flavors.

Toffee: Indole use levels around 20 ppm can work well in toffee and caramel flavors.

Egg: Indole is a vital component of egg flavors, and can be used at use levels of up to 50 ppm to give the elusive character of egg yolks.

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