cis-4-Decenal

This unique ingredient can find good use in citrus, as well as a surprisingly wide range of non-citrus profiles.

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Although decanal (FEMA# 2362, CAS# 112-31-2) is a vitally important contributor to the character of sweet orange peel oil, and virtually all compounded orange flavors, the aldehydic profile of this molecule used alone does not ring quite true—it is far too simplistic. The aldehydic profile it generates is distinctly too one-dimensional. Adding the other saturated aldehydes found in orange, such as octanal (FEMA# 2797, CAS# 124-13-0), creates some complexity and improves the situation a little, but much of the problem still remains. To fully solve the problem we need to look toward decanal's unsaturated relatives.

We have already considered the helpful role that can be played by *trans*-2-decenal (FEMA# 2366, CAS# 3913-81-3)[a]. This molecule can certainly add interesting further complexity, but the most important and useful unsaturated derivative of decanal that is found naturally in orange oil is 4-decenal (FEMA# 3264). This chemical is commercially available in both *cis* (CAS# 21662-09-9) and *trans* (CAS# 65405-70-1) forms. The two molecules smell undeniably similar: citrus and aldehydic, with notable power and freshness. In my opinion, the *cis* form has a slight edge, with a fresher, more natural profile.

The most obvious area of application is in citrus flavors, especially orange, but this unique ingredient can also find good use in a surprisingly wide range of non-citrus profiles.

The dose rates given throughout this article are the levels suggested for use in flavors that are intended to be dosed at 0.05% in a ready-to-drink beverage or in a simple bouillon.

[a]Read more about the use of *trans*-2-decenal in flavors in John Wright's "Flavor Bites: *trans*-2-Decenal" on Page 34 of the November 2010 issue of *P&F*; *www.perfumerflavorist.com/magazine/pastissues/*.

Citrus Flavors

Orange: The ideal level of use can vary somewhat depending on the type of character that is desired; slightly higher levels work very well in peely flavors, and lower levels are probably preferable in more juicy flavors. A level of 10 ppm is a good starting point.

Grapefruit: The same variations in respect of use rate and profile apply to grapefruit flavors, and the only difference is that the best starting point is a little lower, around 8 ppm.

Yuzu: A level of 8 ppm of *cis*-4-decenal adds impact and freshness to yuzu flavors and helps cut down on the need to make use of the prohibitively expensive natural essential oil.

Mandarin and tangerine: A slightly subtler addition works best in both mandarin and tangerine flavors, with similar caveats to orange in respect of peely and juicy profiles. A level of 5 ppm is a good place to start.

Lemon and lime: In both lemon and expressed lime citrus profiles the ideal level of use is quite low, around 2 ppm, but this is enough to noticeably add to the impression of freshness.

Meat Flavors

Chicken: *cis*-4-Decenal is not the main fatty molecule in chicken flavors, but it nevertheless forms an important part of the overall profile and specifically contributes to the impression of white rather than dark meat. The best level of addition is very dependent on the character that is desired, but 30 ppm is a reasonable starting point.

Bacon: Bacon flavors can tend to be very unpleasantly simplistic, depending overmuch on dithiazines, but they always have an interesting aldehydic fatty component. A similar level, around 30 ppm, can also be good in this category.

Beef: Levels can also vary in beef flavors, higher in roast and grilled flavors and lower in stewed flavors, but they are generally much lower than in chicken and bacon, around 10 ppm.

Lamb: A level of 10 ppm is also a good level of use in most cooked lamb and mutton flavors, adding a welcome contrast and brightening effect to the dominant fatty nuances.

Vegetable Flavors

Rice: Rice flavors are often so simple that they can appear to be centered around just one ingredient, and the use

of this chemical at 40 ppm in cooked rice flavors is especially helpful, adding realism and a welcome extra dimension.

Tomato: In tomato flavors, *cis*-4-decenal plays quite a different role. In this general category of flavors, it serves to vastly improve the effect of *cis*-4-heptenal (FEMA# 3289, CAS# 6728-31-0), a very commonly used ingredient which can be quite harsh when used alone. Levels of use vary considerably, from up to 30 ppm in fresh tomato flavors down to a much more subtle 2 ppm in cooked profiles.

Potatoes: This molecule is a very useful ingredient in potato chip flavors, where it adds a degree of freshness at levels in the region of 20 ppm, and also in french fry flavors, where it is particularly useful because it has moderate heat stability, at levels around 30 ppm.

Mushroom: *cis*-4-Decenal can play a part in most cooked mushroom flavors, adding authenticity, but it is especially useful in cooked chanterelle mushroom flavors. Twenty ppm is a good starting level in chanterelle flavors.

Coriander leaf: Clearly this ingredient is not exactly vital in fresh coriander leaf flavors, but this is another category where most commercial flavors are way too simplistic, and *cis*-4-decenal adds an interesting and complementary note to the dominant *trans*-2 unsaturated aldehydes.

Other Flavors

Seafood: *cis*-4-Decenal can be quite helpful in most seafood flavors, but it is especially good in crab flavors at around 20 ppm. Clam flavors are something of a small niche in the flavor world, but they can accommodate an even higher level, around 30 ppm.

Peanut: The best level in peanut flavors is 15 ppm, where this ingredient adds a degree of realism and freshness, counteracting the fatty character of some of the other ingredients.

Hazelnut: The ideal level of *cis*-4-decenal in hazelnut and praline flavors is 10 ppm, lower than that in peanut flavors but still a significant contributor.

Whisky: Just a subtle addition, around 5 ppm, is all that is required in whisky flavors, adding authenticity and rounding out the dominant ingredients, giving a little freshness and lift.

Cognac and brandy: Five ppm is also effective in cognac and brandy flavors, providing added realism and complexity, and also giving a similar subtle lift and impact to the profile.

Bread: All fresh-baked bread and pizza base flavors can benefit from a similar subtle addition of this ingredient, at around 5 ppm. The effect is notably enhanced in freshly baked caraway flavored bread and, in this example, the best level is higher, nearer 10 ppm.

Açaí berries: The flavor of açaí berries can represent an interesting challenge, with their hints of smoky phenols, violet ionones and quite strong aldehydic notes. *cis*-4-Decenal is only needed at a low level, around 5 ppm, but it helps this unusual cocktail of aromas blend together.