Using the Categorizing Technique to Make Flavors

By Frank Fischetti, Jr., Craftmaster Flavor Technology, Inc., Amityville, New York

I believe that the skills of a creative flavorist can be taught. We do it at Craftmaster. I know it is done elsewhere. How does one learn to develop flavors? There are two ways: inspiration and technique. Let's just talk about technique. We'll look at what a flavor compound is. We'll define "flavor development," and we'll look at the "categorizing technique" for flavor development.

Flavor Development Vocabulary and Categories

Vocabulary: A **flavor compound** is composed basically of two parts: a flavor portion and a diluent portion. The function of the **flavor portion** is:

- To characterize the desired flavor by simulating it and giving it a name.
- To maintain the character (character fixation).
- To enhance the flavor impression and its acceptability (palatability).
- To make the flavor difficult to simulate or duplicate.

The functions of the **diluent portion** are:

- To make the flavor applicable (that is, to determine the form of the flavor).
- To regulate costs.
- To regulate strength (the greater the amount of solvent, the weaker the flavor).
- To achieve physical fixation.
- To act as a carrier (solvent for the flavor portion).
- To act as a carrier for the color, if any.
- To keep the flavor homogeneous (that is, keep solids in solution).
- To prevent or inhibit chemical reactions.
- To act as a vehicle for presentation of the flavor portion.
- It can be the extraction menstruum. (The solvent remains in the tinctures and fluid extracts, but is removed almost totally from the solid extracts and entirely from the oleoresins.)
- It can act as a preservative.

I'd like to define two terms—character fixation and physical fixation—that are not usually considered flavor terms. **Character fixation** in a flavor is the use of relatively high-boiling solids at high concentrations, that is, above their threshold values. Examples include vanillin, oxanone (p-hydroxy phenyl-2-butanone), heliotropin and maltol. They are usually used in combinations. Since they are used above their threshold concentrations, when diluted down at the use level, they are still above their threshold and the perception of the flavor doesn't appear to change. **Physical fixation** in a flavoring compound is the use of relatively high-boiling-point materials to decrease the vapor pressure, thereby making the compound less heat labile. We use these materials whenever we have flavor intended for use at temperatures above the boiling point of water. Examples of these materials would be vegetable oils and isopropyl myristate.

Categories: The flavor portion of a flavor compound is composed of three parts which I call categories. Understanding the definitions and applications of these categories is essential to the categorizing technique we use for creative flavor development. These are the three categories:

- Flavor character.
- Flavor contributory.
- Flavor differential.

A **flavor character item** is a material that when smelled or tasted is reminiscent of the named flavor, more or less characteristic. It may be an essential oil, botanical, organic chemical or combination of them. For example, 3-methoxy-2-isobutyl pyrazine is a character item for bell pepper and/or pea flavor. Ethyl-2-methyl butyrate is a character item for

This is the second of three articles adapted from Frank Fischetti's speech "A Novel Approach to Flavor Development" presented at the Society of Flavor Chemists symposium "Flavors '94" in March 1994.

 0272-2666/95/0001-0023$04.00/0

apple, as trans-2-cis-6-nonadienal and cis-3-nonenal are each individually for cucumber. A flavor character item could also be a combination, such as cis-3-hexenol and lactic acid (cis-3-hexenyl lactate) in a green strawberry. Other examples include oxanone:ionone at a ratio of 6-7:1 for raspberry, 1-octen-3-ol at 1-3 ppm for mushroom and benzaldehyde:γ-decalactone at a ratio of 1:1-1:4 for peach. The function of the flavor character item is to create or simulate the named flavor. If you want to call it grape, the character items must help create the grape impression.

A **flavor contributory item** is an additive that when smelled and/or tasted helps to create, enhance or potentiate the named flavor. A flavor contributory item is not necessarily by itself reminiscent of the named flavor. However when used in conjunction with flavor character items, it tends to bring the compound closer to the named character. Thus, a flavor contributory item is not characteristic but it is essential by acting together with flavor characteristic items to produce a definite character. Again, it can be an essential oil, botanical extract, aromatic chemical or combination, artificial or natural. Examples include: acetaldehyde in orange oil; ethyl butyrate in strawberry or grape; hexenal, hexenol and linalool in blueberry; hexalactone in peppermint; ethyl-3-hydroxy butyrate in a concord grape flavor; alcohols (octanol C_6-C_{12}), methyl ketones and lactones in coconut; and trans-2-hexenal, ethyl-3-methylbutyrate and ethyl-2-methylbutyrate in cranberry. The function of the contributory item is to create naturalness in a flavor. It can also be used to add lift/impact to the flavor, but mostly to bring the flavor closer to the named flavor.

A **flavor differential item** is neither characteristic nor essential. It is an additive or combination of additives that when smelled and/or tasted has little if any character reminiscent of the named flavor. A flavor differential item is added to give the flavor what I call individuality or difference. These items are usually imaginative, and I believe they make the difference between flavors and flavor chemists. These items are added to create different effects such as sweetness, sourness, woodiness, earthiness, fruitness, whatever difference you want. They add considerable difficulty to the task of anyone trying to duplicate your flavor. Consider, for example, castoreum and zingerone added to a vanilla flavor (non-kosher, of course), cardamom to a grape flavor, chamomile to a banana flavor, civet in fruit flavors, ambrette seed in berry flavors. You can see why this could cause a problem for someone trying to duplicate your product. If I put olibanum oil in an orange or pineapple flavor, the analyst must first decide what materials are there. Where did they come from? What are their contributions, if any? Or better, how important are they to the flavor? (Sneaky, huh? These obfuscating agents are added to obscure, confuse or muddle.) The functions of the differential items are to impart imagination, a sense of individuality and personality to the flavor. They can be used to create a difference or to create confusion. (Items in this category probably characterize the flavor chemist as much as they characterize the material.)

Categorizing: A Flavor Development Technique

Now it is possible that these materials can perform different functions in one flavor. For example, ethyl oleate can be used in a butter flavor. It is a contributor to the butter flavor and at the same time a diluent for it. Benzyl alcohol in a nut flavor can be contributory and/or diluent for it. They can serve different functions in different flavors. For example, ethyl oenanthate is a character item for grape of the brandy type (*Vinus vinifera*), contributory for grape of the concord type (*Vinus labruska*) and a differential item in coconut and butter flavors. Can you see what I have done? In my mind I have a picture of ethyl oenanthate with many different functions (associations) which I call "hooks." These hooks give me a way to recall the contribution(s) that ethyl oenanthate can make, and they give me an excellent recall of ethyl oenanthate. I give it a name; I can recall it better. I give it a function; I can recall it better. Once you get this idea in your mind, it gives you great flexibility. We are actually forming multiple associations for ethyl oenanthate—the more associations, the greater retention. Our minds are not filing cabinets that store information the way it comes in. Instead, we edit the information heavily, cut it up into pieces, and file the edited extracts in multiple parts of our

mind, depending on what they are associated with. We synthesize and integrate new information into old knowledge.

What is the significance of such a classification? It is a starting point for analysis/synthesis of a flavor. It gives a format or outline for flavor creation and development. It offers a way to examine each of the parts of a flavor. Analysis of a thing means separate attention to each of its component parts. The analysis of a flavor refers to the separation of the whole into its parts so as to reveal the characteristics of those parts and their relationship to each other and the whole. In this way, it is possible to develop an understanding of the behavior of the whole as a function of its parts. Synthesis refers to the putting together of parts into a whole. We can localize our ideas on the different sections; we can modify, move and exchange, and thereby create new flavors. As a matter of fact, before I begin to create a flavor I use a checklist that among other things asks the following questions:

- What is the flavor's name?
- What is the application for this flavor?
- What is the diluent (solvent)?
- What are the character items?
- What are the contributory items?
- What are the differential items?

These questions will be answered before I begin any work. This checklist allows one to pay attention to the relationships of the parts. The beauty is that it doesn't detract from your creativity. As a matter of fact, it increases it. It forces you to look for alternative solutions. Remember: creativity is concerned with bringing about new ideas and updating old ones.

Even though I break a flavor apart like this, I must still balance these parts. What do I mean by flavor balance? I mean the combination of flavor and diluent portions such that the diluent portion does not stick out. No single component note may override any of the other notes. The flavor should be dilutible and still maintain a lot of its character. It should not change character with dilution over a reasonable range. We should see a strength change but not a character change. Again, another advantage of this categorizing is that it is the only way we can retain a flavor experience. We give it a name; we can recall it better.

Three words that describe the above process are recording, retrieving and recombining. They also happen to be three words that describe creativity. We can position our thoughts in a place to recall ideas better. With memory and retention, we tend to recall together things in the same category (or things that are associated together). We categorize our tasting and smelling and we remember them better.

What is flavor creation? Flavor creation is like any other form of creativity. See this article's sidebar for some collected thoughts on creativity, showing how creativity is a process of recording, retrieving and recombining. A new idea is the reassociation of existing ideas or parts of ideas to form a new combination. If there is not much information

The Word on Creativity

Here are some quotes on creativity to stimulate your reading of the books listed in the following bibliography.

"Creativity involves the generation of alternatives."

"Creativity is the ability to look at the same thing as everyone else but to see something different."

"Creativity is a process, not an accident."

"There is nothing magical about creativity. It involves skills that can be taught/learned. It is not something you are necessarily born with, but something you can acquire."

"Creation: the recombining of the old and/or new ideas to form new combinations—useful and implementable combinations."

"Creation: something which did not exist before, but is composed of known elements."

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in memory, then not much can be recalled. If little can be recalled, then little can be recombined. The more we remember, the more we can recombine. You observe something occurring; you take this occurrence or attribute and put it someplace else. You've got a creation. For example, you observe a "green-note" in strawberry and you take this attribute and add it to raspberry.

Categorizing Flavor Materials at Craftmaster

How does one go about finding out what flavor materials go into what category? There is only one way to do it. You've got to taste it, smell it and characterize it yourself. There is just no other way to do it. We see many lists and many characterizations in the literature. These are useless unless you verify the character yourself. Why? Because they don't tell you the state of mind, the experience and the knowledge of the recorder.

The taste receptors can detect the five basic taste sensations: salt, sour, bitter, sweet and umani. However, the sensation of taste depends upon the recent history of the sensor, since tastes interact and the sensors rapidly adapt. The sensation of taste also depends upon factors such as the age, health and psychological set of the individual. Smell, like taste, also is easily confused. It adapts quickly. The sensation of smell is a function of the recent past history, health and psychological set of the individual. Without knowing the above, how can we trust the characterizations? What was the purity of the sample? What about contaminants? What instructions did the "taster" receive? We know that preference can be skewed depending on instructions given before tasting. If preference can be skewed, what about characterizations? "What did the taster taste before tasting the sample?" is an important question. And the phrasing of the questions or instructions is important. "How do you like this cherry component?" is a far different question than "What does this remind you of?" My personal favorite for a question that produces skewed responses goes something like "At what level do you think it tastes most like cherry?"

In our laboratory at Craftmaster Flavor Technology, we do categorizing by what I call the characteristic threshold values. By characteristic threshold values I do not mean the minimum perceptible amount of flavor detected by a certain percentage of panelists. In our lab, we define a characteristic threshold value as the taste a material has at 1, 5 and 10 parts per million.

Tasting: The material is evaluated in water, sometimes in sugar, acid and water, sometimes in salt solutions, sometimes in hydrolyzed vegetable protein solutions, or in any medium which seems applicable. However, it is always evaluated against an unflavored base. This prevents us from seeing things that aren't there. The combination of acid and sugar in water tastes fruity. You must determine that there is a difference between the flavored and unflavored base. This assures that we don't practice pathological flavor science; that is, we must determine that the effect is real.

We do not allow smelling per se. We simply give the samples to the tasters and ask: "What does it remind you of? What does this chemical make you think of? How can you use this material? What would you use this material in?" We never ask "What is it?" We are aware that there is a taste and smell component to a flavor, but we think it is more natural for someone to taste a flavor without smelling it.

We each taste each sample at least twice; it is amazing how variable we are. Why are we so variable?

- *Adaptation:* Sensitivity varies during stimulation. The longer and stronger the stimulation, the more sensitivity is reduced.
- *Diurnal rhythm:* Our body temperature fluctuates during the day and this influences sensitivity.
- *Weather conditions:* Panelists are more sensitive to odor/taste following a fall in atmospheric pressure.
- *Motivation and expectancy:* these also affect sensitivity.

We don't tell, at least on the first tasting, what the material is. We do this for a reason. As soon as we announce the identity of the material, it automatically becomes a separate entity. The panelists' characterizations become more concrete. We think they are doing a perceptual reconstruction job in their minds.

Panelists taste the material more than once because

repetition is indispensible in learning. The second tasting acts as a brush-up to reinforce the odor and/or taste. We want as many ideas as we can get, so we encourage divergent thinking (which refers to the process for the generation of ideas, concepts and approaches) as opposed to convergent thinking (which focuses on an answer). Let's face it. I want to find uses for these materials.

After we taste a material, each of us goes off to decide what character it has, if any. Where would we use it? Is it a character item, differential item or contributory item? At what concentration?

Discussing: We hold discussions. Why? If in a sample there are many stimuli, the selection of one event or feature involves the exclusion of the rest. Discussions bring to the taster's mind other stimuli (notes or characters), ones that the taster may not have paid attention to. Discussions also identify other characterizations that the taster may not have noticed. Finally, general agreement suggests objectivity; similarity of description suggests similarity of perception. We judge things by our past experiences. When we discuss taste/odor, we are bringing in a lot of experiences from all the tasters. Research has shown that the most innovative, novel, fresh solutions tend to be among the last 50% of all ideas generated on a subject. The most obvious, unoriginal ideas tend to appear early among the first 50%. With discussions we hope to prove Linus Pauling's observation that "the more ideas you can generate, the more likely you are to produce an excellent one."[1]

We never ask "Do you like it?" Once tasters say "Yes, I like it" or "No, I don't like it," the test is over. What they are going to do from that point on is defend their ideas. Human beings invent justification for everything they do and think. As Benjamin Franklin said in 1691, "So convenient a thing is it to be a reasonable creature, since it enables one to find or make a reason for everything one has a mind to do."[2] We don't want this. We want as many ideas as we can get. We want each taster to see as many possibilities as he or she can, and tasters must do this themselves.

There is yet another reason for our discussions—recitation. Recitation is repeating to yourself what you have just learned. It is attempts at recall while you are learning. It is indispensable in learning. Tasting, thinking and holding discussions are, in my opinion, all a sequence of recitative steps in which the experience is renewed over and over again. One hopes it will go from the taster's short-term memory (where it remains for approximately 6-10 seconds, after which it is lost unless explicitly rehearsed) to long-term memory (where it can be retained).

Many papers show retention, recall and recognition are facilitated by the number of senses you bring to bear on the

original learning. If you smell it, if you taste it, if you discuss it and if you write about it, you retain it better, and that's exactly what I want the tasters to do. I want them to retain the character of the material, so we give them labels which I believe help them to learn. A taster translates the material's smell or taste impression into a series of words, and this verbalization is retained. Translating the impression into words places it in the taster's short-term memory. Discussing it, rehearsing it and taking notes about it moves it to the taster's long-term memory. (We are not sure if long-term memory stores the meaning of the words or just their sounds.)

It is said that people generally remember approximately 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say, and 90% of what they say as they do a thing.[3] The trick, then, is to get fully involved in the tasting of the materials.

Note Taking: As we hold our discussions, each taster takes notes in his/her own way. However, the notes about each flavor material must include the following information:

- The material's name.
- Its character (if it is in the flavor character category).
- Its contribution (if it is in the flavor contributory category).
- Its concentration level.
- The medium in which it is presented.

The first tasting is always blind; that is, we don't reveal the material's functionality. For the second tasting, we usually announce the material's name along with its functionality, such as ester, sulfur or nitrogen-containing. Why? If I give the tasters a sulfur compound without identifying it as such, they might reject it. But if I tell them it is a sulfur compound, then they will compare it to what sulfur compounds are supposed to be like and may not reject it. Admittedly I'm putting a bias into the system. I do it because I want to use these materials. I want their sensory perceptions to be retained. Giving a name and functionality to a flavor material not only stresses similarities in properties, but opens the possibility of exchanging one material for another in a given formula. Is the material behaving normally as materials in this functionality should? For instance, does a material characterized as roasted, nutty and moldy behave like the pyrazines, or is it different? Functionality stresses similarities, differences and transfer substitutions. For example, acetyl thiazole (peanut/popcorn), acetyl pyridine, acetyl furan, acetyl pyrrole and acetyl thiophene all have a similarity of character.

Revealing the functionality also acts as a "warm-up." Where the impression to be caught is very weak, the way not to miss it is to sharpen our attention for it by preliminary contact in a stronger form. A warm-up smell of a functional group similar to what you are about to taste (such as an ester warm-up for an ester material) not only tells you what the functional group is, but shows examples of it. (Anticipated information is perceived more readily. Preperception is the word used to designate the imagining of an experience before it occurs.) If you smell bee's wax and you know it, you'll also smell the honey-like notes, and the green, waxy kelp-like notes will also show up. We want to prevent "halo" or "horn" effects—the liking or disliking of a portion of a flavor material and thus judging the whole material on this one perception.

In the taster's notes we require information about the material's concentration because of interpolation. Interpolation requires that you try the material at different concentrations. (Just because a certain concentration appears in some analytical report, it doesn't mean that that concentration is sacred. Try others.) Trans-2-nonenal can taste woody, fatty or cucumber-like depending on concentration. δ-Decalactone can be peach at 1 ppm or coconut-like at 3 ppm. β-Ionone can be berry, floral or woody. β-Damasceneone can be minty, berry, apple or tea-like depending on concentration. We get less information from constant situations than from changing ones. Concentrations of 1, 5 and 10 ppm are the values and ranges found in natural products. For flavor values, 1-5 ppm indicates high flavor value, 5-20 ppm indicates medium flavor value and 20 ppm and greater indicates low flavor value.

The taster's notes also must show information about the material in different mediums because of environment and interpolation. Again, you must interpolate because you cannot just accept the concentration levels given in pub-

lished reports. And you must try different environments because a material's flavor character varies, depending on the medium in which the material is shown. p-Tertiary butyl phenylacetate with acid is a great strawberry contributor, but without acid it is creamy milk chocolate. The combination of vanillin, isoamyl acetate and anethole tastes differently with and without acid. Benzaldehyde (at 5 ppm) with acid suggests cherry, but without acid the flavor is almond. Ethyl butyrate (at 5 ppm) with acid is fruity, and without acid is butterscotch.

Variability of a material's character is not really surprising since we already know that character depends on concentration and environment. What appeals to our attention far more than the absolute quality of an impression is its ratio to whatever other impressions we may have at the same time. This is another reason why we use more than one concentration, and why we use different mediums. In both cases we are essentially changing the ratio of flavor material to its environment and we see or perceive it differently, thereby learning more about the material.

There are four essentials for learning: motivation, attention, practice and reward. Motivation leads to attention, which produces sharper perceptions, better recording and better retention.

How do I motivate flavor chemists who have participated in a tasting? First, I make a note of the chemical and the flavor used in the tasting. Then, the next time the chemist makes a flavor of that type, the chemical had better be used in it. Let's assume that Mary just tasted a good strawberry item. The very next time she makes strawberry, this item must be used in it. If she doesn't use it, she won't believe it belongs in strawberry. This works very well and still allows our flavorists to be creative. I also believe that reaching agreement on a characterization acts as a reward to the participants. (Humans love social agreements.)

We also ask our tasters to predict on paper in their notes what they expect to happen when they add the material to a flavor. This way they are paying attention and helping to develop confidence in themselves. It allows them to learn (benefit) from experience. I don't want anyone to get "hung-up" on my characterizations and I don't want to get "hung-up" on anyone else's. I could hand out key words and suggest what character I think a material has, but I don't want to do that because I want the tasters to actually taste the materials and decide on their own what they would use it in, not what I would use it in. What they are doing is developing confidence in themselves.

Categorizing Contributory or Differential Items at Craftmaster

I could set before you a sample of a chemical called p-mentha-8-thio-3-one which is found in buchu oil, but when diluted down is tropical fruit, grapefruit, black currant or peach. When you taste a chemical and you have a lot of experience, it's quite easy to put it into these different categories. But what happens when the tasters are fairly

new and don't have a lot of flavor experience? How do you convince them that a given chemical is a contributory item or a differential item? It's quite easy to categorize a material if it has a definite character. However, it is very difficult to put it into these other two categories.

At Craftmaster Flavor Technology we do what I feel is quite clever. We take as many character items as we have in the laboratory (items such as aldehyde C-16 for strawberry, ionone for raspberry, ethyl-2-methylbutyrate for apple) and we set them up at the level where they are most characteristic. Then we simply add the material we are testing to them. The only stipulation we make is that the material we add is used at a level less than the character item. Then we compare the character item alone and with the new material added to it. Does it make a difference? Does it improve it? Detract? Does it do anything? If the change is beneficial we decide if it's a contributory or differential item. We have already determined in a previous test if the material is a character item.

With the above test we can categorize contributor or differential items. You see what else this does. It shows us additional uses for character items in flavors other than those for which they have a character. When you use character items in flavors for which they are not a character item, surprises such as the beneficial interaction (at low levels) of ketones and lactones become obvious (ionone and lactones). We are really doing two things by this method. We are practicing discrimination; that is, seeing the difference between two simuli. (Noticing any part whatever of a flavor is an act of discrimination.) We are also practicing differentiation; that is, seeing differences in the same material under different uses.

We learn about a flavor material by varying its concentrations. This shows us how a material changes in quality with concentration (such as δ-decalactone being peach at 1 ppm and coconut at 3 ppm). It is definitely a way to learn something about the flavor material's character. However, dissociating a flavor material from a mixture to learn about its individuality is the least effective way to learn. Tasting it in various combinations helps us learn about the flavor materials and analyze the compound of which it is a part. As William James said, "What is associated now with one thing and now with another tends to become dissociated from either and to grow into an object of abstract contemplation in the mind."[4]

References

Address correspondence to Frank Fischetti, Jr., VP Creative Flavors Department, Craftmaster Flavor Technology, Inc, 23 Albany Avenue, Amityville, NY 11701.

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