Composing Savory Flavors

How to combine low notes, middle notes and top notes for a successful flavor composition

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Years ago, I listened to music on a cheap transistor radio. Through its tiny speaker I could hear the basic melody and words to my favorite songs. Later, in college, I heard the same songs on real stereophonic equipment. It enabled me to hear the pulse of the low bass notes and the high notes from the guitar or singer.

Creating savory flavors can be likened to composing music. While it is possible to get the basic beef or tomato flavor across with middle notes, true-to-type flavor will incorporate top notes and low notes for an excellent flavor "composition."

Low Notes

The tongue perceives the basic four taste sensations: sweet, sour, bitter and salty. These are manifestations of well-known water-soluble, nonvolatile compounds.

Today, umami is often considered another basic taste sensation and is very important in savory flavor formulation. Roughly translated from Japanese as *delicious*, it refers to the enhancing properties of chemicals such as monosodium glutamate (MSG) and nucleotides. Umami is a particularly challenging flavor note mainly due to labeling restrictions. MSG has a very negative connotation with many consumers. Hydrolyzed vegetable protein (HVP) is a good source of free glutamate (especially wheat HVP), but is also perceived unfavorably. Nucleotides, most commonly in the form of a 50:50 blend of disodium inosinate and disodium guanylate (I+G), are an excellent source of umami and can be used synergistically with free glutamate sources. However, it gives consumers the impression of being very chemical. Fortunately, a wide variety of autolyzed yeast extracts (AYE) are commercially available and offer varying degrees of free glutamate and nucleotides. Many commodities have potentiation as well (e.g., tomato paste, Parmesan cheese powder and certain cultured products especially designed to potentiate with clean labels).

Also contributing low notes are certain sensations of feeling, such as the cooling of menthol in peppermint or the heat of capsaicin in cayenne pepper. The typical sources for low note tastes can be found in **T-1**.

Middle Notes

This is where the characterizing of the flavor occurs. Is it meat, vegetable, dairy?

Commodity powders are often used for middle notes. Chicken meat, pork stock, cheese powder and mushroom powder all taste to a varying extent like the products from which they were derived. While contributing some flavor, they often lack the impact to be considered flavors. However, in conjunction with low notes, they can possess the impact necessary to be flavorings for processed foods. Certain HVPs and AYEs are specially formulated to contribute characterizing flavor notes.

Of special interest are reaction flavors, especially for cooked or processed foods. These reactions use similar flavor precursors as those found in authentic foods and undergo similar processing conditions. For example, reactions involving selected amino acids and protein hydrozylates, with reducing sugars and other ingredients, can be reacted to generate chicken, beef or pork flavors. An example is listed in **Formula 3**. These reactions can form part or all of the middle notes and be added to the low notes to create identifiable meat flavors.

Enzyme hydrolysis is another procedure to develop intensified middle notes. Enzyme modified cheese (EMC) has much more flavor impact than cheese or cheese powder. Meats and vegetables can also be hydrolyzed or otherwise enzyme modified to increase their flavor impact. For more complexity, enzyme modification can be employed to create precursors for subsequent flavor reactions. The typical sources for middle flavor notes can be found in **T-2**.

Top Notes

Top notes are volatile, lipolytic flavor chemicals and extracts that primarily provide the aroma of flavors. A compound of top notes will smell delicious but lack taste and flavor. They add the attractive finishing touch to a flavor, including the smell of fried bacon, the piquant aroma of blue cheese, or freshness to a ripe tomato. In savory flavors, they provide the "cooked" notes, which will differentiate between boiled, fried, grilled or roasted beef. Herbs and spices and their extracts define a Cajun flavor; they are mixed with meaty notes to make a salami flavor.

For some meats, top notes provide the characterizing flavors. Chicken derives its flavor from controlled oxidation of unsaturated fatty acids to form unsaturated aldehydes. Branch-chained fatty acids provide the characterizing note of goat and mutton.

Some contributors of "low notes" **T-1**

Sweet

- Sucrose, other sugars, corn syrup derivatives
- Some amino acids (glycine, proline)
- Artificial sweeteners (aspartame, saccharine)

Sour

- Organic acids—citric, lactic, malic
- Inorganic acids—phosphoric

Salty

- Sodium chloride
- Potassium chloride and select other salts

Bitter

- Certain peptides
- Basic amino acids
- Botanical extracts such as quinine
- Sucrose octaacetate

Umami

- Monosodium glutamate
- Nucleotides
- Autolyzed yeasts
- Hydrolyzed vegetable protein
- Parmesan cheese, tomato paste, mushrooms, peas

Nonflavor sensations

- Heat—capsaicins from chili peppers, piperine from black pepper, gingerol from ginger
- Pungent—allyl isothiocyanate from mustard, horseradish
- Cooling—menthols
- Astringent—tannic acid
- Metallic bite—phosphoric acid

Some contributors of "middle notes" **T-2**

Meat powders
- Beef
- Chicken
- Pork
- Fish

Dairy powders
- Cheese
- Milk
- Cultured dairy
- Butter

Vegetable powders
- Tomato
- Mushroom
- Corn

Enzyme modified products
- Enzyme modified cheese
- Hydrolyzed meat
- Hydrolyzed vegetable protein

Reaction flavors

Combination enzyme modified and reaction

Yeast extracts

Hydrolyzed vegetable protein

Top notes can be derived from oleoresins and essential oils. Chemical compounds of volatile flavor chemicals are another source. Reactions, especially those reacted in oils such as grill flavors, are very effective. Pyrolysis is used to create smoke top notes. Milk fat is lipolyzed to form pungent short-chained fatty acids, such as butyric acids, and is used in many dairy flavors. See **T-3** for examples of top notes.

Some contributors of "top notes" **T-3**

Animal fats
- Chicken
- Lamb
- Pork

Volatile flavor chemicals

Flavor chemical compounds

Fat reactions
- Grill

Spice and herb
- Whole
- Oleoresins
- Essential oils
- Spice blends

Pyrolysis products (smoke)

Lipolyzed butter oil

Formula 1. Grilled Beef Flavor

Low notes:

AYE	12.00%
I+G (50:50 disodium guanylate and disodium inosinate)	.50
Lactic acid powder (60:40 lactic acid & calcium lactate)	1.50
Salt	20.00

Middle notes:

Beef extract powder	20.00
Beef stock powder	20.00
Roasted yeast extract	10.00

Top notes:

Liquid grill	.25
Oil-based smoke flavor	.01
Onion oil (10%)	.20
Oleoresin black pepper	.05

Carriers:

Maltodextrin	14.49
Vegetable oil	1.00
Total	**100.00%**

Formula 2. Cheddar Cheese Flavor

Low notes:

High nucleotide yeast extract	3.50%
Brewers yeast extract	6.00
Lactic acid powder	10.00
Salt	20.00

Middle notes:

Cheddar cheese powder	30.00
EMC	5.00
Whey powder	21.00

Top notes:

Lipolyzed butter oil	3.60
Butyl butyryllactate	.20
Isovaleric acid	.20
Ethyl butyrate	.20
Caproic acid	.20
2-Heptanone	.10
Total	**100.00%**

Example Savory Formulations

Three example formulas of savory flavors—a grilled beef, a cheddar cheese and a chicken reaction—are given. The formulas are broken down into low, middle and top notes.

The grilled beef (**Formula 1**) is created using umami with I+G, along with salt and lactic acid to form the low notes. In addition, AYE contributes low levels of free glutamates as well as a pleasing brothy background flavor. Middle notes are derived from beef stock and beef extract. A roasted yeast extract with meaty characteristics is also added. The top notes are from smoke flavor, grill flavor, onion oil and black pepper oleoresin. Maltodextrin is a carrier, and vegetable oil aids in dispersing the top notes during blending.

The cheddar cheese formula (**Formula 2**) uses lactic acid in its low notes, as well as AYE to provide potentiation, or umami, in the form of AYE and high-nucleotide yeast extracts. Brewers yeast contributes a bitter note that works well in aged cheese flavors. A cheese powder

provides the middle notes. An EMC is added to boost the impact of the middle notes by adding savory, proteolytic notes. Whey powder contributes mild dairy flavor and makes a good carrier. The top notes are derived from lipolyzed butter oil and a select flavor chemicals blend adapted from Merory.[1]

Formula 3 is a water-soluble liquid. This multistage reaction commences with a Maillard reaction between amino acids and reducing sugars at 90–95°C. The completed reaction is a yellow-brown liquid, with meaty and chicken flavor characteristics. These are the middle notes.

The product of the first reaction is then added to a mixture of salt, sucrose, and umami-contributing MSG and I+G. This increases the total flavor impact and increases the chicken and meaty character. Reacting this new mixture (at a lower temperature than the first reaction) deepens and enriches the flavor, as well as adding some mild roasty notes.

Heating the mixture produced above with chicken fat provides the top notes. This adds flavorful carbonyl compounds and greatly increases the aroma, as well as rounding out the flavor. The final result is a very nice fatty, brothy chicken flavor.

Make and taste these flavors. Evaluate the flavors at 1% in water warmed and salted to taste. Try making the flavor separately in its three components, taste each of them and then combine the notes. Experiment with the relative proportions of the notes. Observe what happens when a flavor is missing its top notes or bottom notes. Try doubling the top notes, or add different tastes in the bottom notes. Vary the reaction conditions. By experimentation, arrive at the optimal level of the three notes. Now you're composing savory flavors!

Formula 3. Reaction flavor example (Adapted from PD Thomas, 1972, US Patent 3,660,114)

First, react middle notes:

Formula 3A. Chicken middle notes reaction

Water (*aqua*)	61.50%
L-Cysteine Hydrochloride	13.00
Glycine Hydrochloride	6.70
Dextrose	10.80
L-Arabinose	8.00
Total	**100.00%**

Adjust to pH 7.0 with sodium hydroxide; react at 90–95°C for 2 h; cool to 20–25°C to stop reaction

Then, add low notes:

Formula 3B. Chicken middle and low notes reaction

Formula 3A—chicken middle notes reaction	7.50%
Monosodium glutamate	10.00
I&G (disodium guanylate and disodium inosinate)	.50
Sucrose	11.40
Salt	11.30
Water (*aqua*)	59.30
Total	**100.00%**

Mix and adjust to pH 6.8; react at 70–72°C for 4 h; cool to 50°C

Complete with top notes:

Formula 3C. Chicken middle, low and top notes reaction

Formula 3B—chicken middle and low notes reaction	97.00%
Chicken fat	3.00
Total	**100.00%**

Heat mixture at 50–55°C for 15 min; cool

Evaluate at 1% in hot water

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Reference

1. J Merory, "Formula MF811968" *Food Flavorings: Composition, manufacture, and use.* AVI, Westport, CT, 192 (1968)