Note by Note Cooking

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Note-by-note cooking (NbNC) is a way of cooking that uses pure compounds to create dishes (This, 2014). As with molecular cooking in the 1990s, it is a big breakthrough, but of a different kind: where molecular cooking was implementing new tools and techniques imported from the chemistry and physics laboratory (mainly), NbNC uses new food ingredients. The cook needs to discover the various compounds, their sensory properties and their interactions with other compounds. It involves a sense of formulation, which is not intuitive and only comes from experience. To be able to create note by note flavours, cooks need a guide to know how to proceed.

Introduction

Where did the name of note by note cooking come from? Hervé This vo Kientza chose this name in 1997 to evoke the way musicians compose music using pure waves in electroacoustic or synthetic music (This, 2014). Here, with NbNC, the question is to invite chefs to compose their dishes in the same way, but with pure compounds instead of defined acoustic frequencies. The chosen name is interesting, because it brings cooking closer to another artistic discipline: perfumery. Indeed, perfumers call their working material “notes”, and they compose perfumes with notes and chords.

If the parallel with the notes found in perfumery seems appropriate, we cannot use the same definition for each category of notes in cooking. In perfumery, the base notes last for several days or even weeks, the middle notes last for one day and the top notes last for only a few hours (Poucher, 1993). Classifying notes according to these categories does not make sense in cooking, since a dish is consumed in minutes.

Another definition should be used for different categories of flavour compounds. The base notes will group all the compounds that have an action on the tongue (Macdonald, 2007). Among the best known are sucrose and sodium chloride, sour compounds like citric acid or acetic acid, and compounds having an effect on the trigeminal nerve, like piperine, menthol and many others. These compounds are found in all foods and compose the basis of taste.

We shall call middle notes the compounds that create the odorant profile of the food; they are fundamental for overall flavour, because they enable us to differentiate pork from beef, banana from apple, or salmon from shrimp. There are thousands of them, and their combined presence creates all the variations of flavour that can be found in nature.

The last category, the top notes, will only include very volatile compounds. These top notes are of great importance for the product’s fragrance. Some are much more subtle once in the mouth, while others will be used for their olfactory contribution but not tasted, as we will see later.

To be able to create note by note flavours, it is necessary to have in mind these three structural parts of flavour. This will help to proceed methodically and to be able to correct any errors in order to arrive at the desired result (Burdock 2009; InformedHealth.org 2006; Maarse 1991; Rowe 2000).

The Base Chord

The base chord contains all the compounds that create what chefs call “the balance” of a dish. These compounds are in direct interaction with the taste buds of the tongue and provoke sensations that everyone is able to recognize without any particular training: sweetness, saltiness, acidity, bitterness, spiciness, freshness, umami, fattiness, etc. (Poucher, 1993).

The evaluation of the base chord can be done by tasting (in particular when the nostrils are pinched). However, some complementary tools allow the results to be confirmed in order to obtain regularity in the making of a dish. A refractometer will give the precise percentage of sugar in a solution, a conductivity meter the salinity, and a pH meter the acidity or alkalinity. With the help of these tools, the search for balance is more efficient and the reproducibility of dishes assured.

Some of the most common sugars are D-glucose, D-fructose and sucrose, this last being our common table sugar.

For acidity, we can use malic acid (2-hydroxybutanedioic acid, the main acid of apples), citric acid (2-hydroxypropane-1,2,3-tricarboxylic acid, lemon), acetic acid (winegar), ascorbic acid (vitamin C), lactic acid (2-hydroxypropanoic acid, dairy products) or phosphoric acid, which is very interesting for its acidity but also to provide a “dry” taste. Each acid can be used alone for its taste, but combinations with other acids will create new acidities. In foods, we would never find a single acid but a combination of several of them. Of course, the right dilutions have to be used.

Salt is an essential flavour modifier, and a concentration of about 0.5% is common in the dishes we eat.
Bitternesses are generated mainly using quinine, while umami is a name that was given to the taste of sodium monoglutamate. Other compounds can have other taste effects, such as ethanol and sodium bicarbonate.

In traditional occidental cooking, black pepper is used daily in combination with salt: it brings not only taste and odour but also a pleasant sensation of heat that spices the dish, increases the flavours and gives a feeling of well-being due to a release of endorphins (hormones of pleasure) (Lee, 2012) related to ingestion. In fact, one compound in black pepper is mainly responsible for this sensation of heat: piperine (McNamara, 2005). Its effects are remarkable and can be used in almost any context, since it provides the “heat-sensation” without any flavour. One of its particularly interesting uses involves its integration into a fresh liquid or an ice cream. Well balanced, this provides first the freshness of the product and then some time later, the heat from the piperine. It makes the brain want to take another spoonful or sip to refresh this heat. This creates an endless cycle of satisfaction, where the pleasant heat is momentarily softened by the coolness and then comes back.

In contrast to piperine, menthol (5-methyl-2-(propan-2-yl)cyclohexan-1-ol) and eucalyptol (1,3,3-trimethyl-2-oxabicyclo[2.2.2]octane) create a cool sensation. They find their use in the creation of cocktails and drinks. They can also be used in perfumes on the edges of a glass, as their decongestant properties will increase the olfactory capacity of the taster and leave them with a pleasant freshness on the lips.

The balance of these flavours is fairly well documented in traditional cuisine, but the use of pure compounds allows total control and regularity. Sea water is never used to add salt to a dish, because pure salt is more convenient to handle and more effective than salt from sea water. For example, the main notes 2,3-dimethylpyrazine will give a slight hazelnut tone. Acetylthiazole and furfuryl-mercaptan will work on the roasted appearance, and 2,3 dimethylpyrazine will give a slight hazelnut smell suggestive of the Maillard reactions; finally a hint of fat is also present in cherries, and alone, it leaves the brain of the person who tastes. By working on the top chord, we can create a chicken fragrance, sulphur compounds can be used for the middle chord, for example a combination of trithioacetone and 2-methyl-3-furanthiol. This skeleton will be completed with cis-3-hexenol and cis-3-hexenyl acetate, which both provide green tones of leaf and cut grass to improve the overall profile.

For vegetables, among the most recognizable notes are trans-2-cis-6-nonadienal, with the characteristic smell of fresh cucumber, and 2-isobutyl-3-methoxy-pyrizine, also known as galbazine, which has the odour of green bell-peppers and nutty tones if concentrated. Once it is diluted, the pea and green bean tones of the galbazine will take over. This skeleton of flavour can be completed with cis-3-hexenol and cis-3-hexenyl acetate, which both provide green tones of leaf and cut grass to improve the overall profile.

To create a chicken fragrance, sulphur compounds can be used for the middle chord, for example a combination of trithioacetone and 2-methyl-3-furanthiol. This skeleton will be completed with different side notes to get the desired flavour profile. Acetylthiazole and furfuryl-mercaptan will work on the roasted appearance, and 2,3 dimethylpyrazine will give a slight hazelnut smell suggestive of the Maillard reactions; finally a hint of fat will be given by trans-2,trans-4-decadienal.

For dairy products and cheeses, the middle chord will be creamy. A good skeleton of Roquefort cheese will be obtained with 2-heptanone, with a small amount of methylthiobutyrate for the cheesy aspect. The secondary notes will consist of pentan-2,3-dione (butter) and lactones such as gamma-nonalactone and gamma-decalactone, which will bring creamy and fruity tones.

More generally, there are hundreds of other notes that can be used to form middle chords. Among these, guaiacol (2-methoxyphenol) has a woody fragrance, evoking this smoky note found in products that have been smoked. Different terpenes, such as limonene (1-methyl-4-prop-1-en-2-yl-cyclohexene), myrcene (7-methyl-3-methylideneocta-1,6-diene) or gamma-terpinene (4-methyl-1-(1-methylethyl)-1,4-cyclohexadien), make it possible to obtain citrus or hop notes. Of course, all this does not imply that one has to use traditional ingredients, and the mixture of pure compounds can otherwise lead to a wealth of new odorant structures.

### The Middle Chord

The creation of a middle chord is slightly more complex, because apart from some specialists, we have not been trained to develop our sense of smell, and this is the main sense at stake here. The middle chord will consist of two types of notes: the main notes that determine the “skeleton” of the flavour and the secondary notes that give nuances (cooked, raw, creamy, fruity, ripe, green, fresh, etc.). The tasting exercise of a wine goes in search of these secondary notes, the main notes constituting the skeleton of the wine being detected rather easily.

Take the example of the almond: benzaldehyde will mainly be used because in this case, it represents quite well the skeleton of the aromatic profile of almonds. However, benzaldehyde is also present in cherries, and alone, it leaves the brain of the taster the choice to evoke cherry or almond. To get closer to the aromatic profile of the almond, we can combine benzaldehyde with other compounds, the secondary notes, like pyrazines such as 2,3-dimethylpyrazine, which will give it a nutty tone, dihydrocoumarin, which can bring mellowness, and pentan-2,3-dione, which will give a creamy and buttery side. Adding these three notes in the right proportions can be a good start for the creation of an almond middle chord.

Some skeletons come from the combination of more unexpected compounds. Isoamyl acetate has a sweet smell and banana flavour, and adding to it a little bit of eugenol (a major component of clove oil) gives a perfume with much more depth and authenticity. However, it should not be overdosed, and therefore small consecutive additions of eugenol should be tested (Wright, 2004). Complementing with secondary notes such as ethyl propionate should give a very ripe fruit tone, while small doses of furaneol (4-hydroxy-2,5-dimethylfuran-3(2H)-one) and maltol can also be used for sweet tones.

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### The Top Chord

Often, one tastes first with the eyes, then with the nose. The cooks can hardly change the smell of the dishes that they make, and these dishes smell of what they contain. Yet, in the same way as with visual perception, the smell of the dish conditions the brain of the person who tastes. By working on the top chord, we can highlight certain characteristics of the dish by accentuating the odours of the food it contains (in the same way as we would seek

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to strengthen the green of vegetables or the red of a raspberry coulis). It is also possible to create a smell that is not present in the dish and to spray it on the spoon or on the side of the plate so that the brain mixes it into the flavour during the tasting.

The work on the top chord uses only odorous compounds. It’s about doing the work of a perfumer, creating a scent that will bring a new olfactory component to the dish. This perfume will be sprayed at the last moment on the dish, or on the container. We will then find notes that have a strong olfactory impact, because it is sprayed in small quantities on the surface of the dish without altering the initial flavour composition.

For some notes, the use in a top chord is interesting to enable them to express their potential to the fullest. If they have a slight scent and very little power in the mouth, spraying them on the dish will make the best use of their olfactory characteristics. Fresh notes such as cis-3-hexenol (freshly cut grass), L-carvone (spearmint) or eucalyptol (eucalyptus) are among these.

Other notes have a sweet scent but too much power in the mouth, which is undesirable in the final dish. This is the case for the rose, which has a very fresh and sweet fragrance, strongly characterized by the presence of phenethyl alcohol. Its smell is extremely interesting, but the presence in the mouth gives an unpleasant bitterness and makes it difficult to properly dose the phenethyl alcohol. The use of phenethyl alcohol as a perfume only, on the edge of the plate or on the handle of the fork, allows the taster to smell the scent of a fresh rose while eating without having the inconvenient taste of this compound.

**How to Work to Create Note by Note Flavours?**

The creation of a dish or of a 100% note by note flavour requires trials and failures. Speed and accuracy of creation can only be obtained with experience and good knowledge of the notes’ properties.

A first approach to experience note by note creation in a fun way is to start from an existing liquid product. This can be a fruit, a vegetable juice or an infusion, for example. The cook then faces a definite assemblage of compounds, as the base chord and the skeleton of the middle chord are already present. They can now work to improve them, thanks to note by note techniques. Consistency, volume and texture of this liquid will be later added to create a fluid foam, crunchy mousse, sorbet, gel or emulsion.

The second step is to train on recreating known flavours. By breaking down a flavour and reproducing it with pure compounds, a cook will gain an understanding of the power of these compounds and how they interact with each other. However, the true purpose of note by note cooking is revealed once the basics are mastered. From the moment one is able to work on existing flavours, why not try to create new ones? Nature has chosen a particular blend of compounds to create apple or salmon. Now that these compounds are at our disposal, we can consider inventing new tastes, new fruits or new meats. With more than 2,500 food-grade compounds authorized by the European Union, possibilities are endless (EU No 872/2012).

**REFERENCES**


