

The technology of flavours

Flavour and taste, together with touch and smell, materially approach us to the pleasure of senses. The sense of touch can inform us about material objects, based on physical contact, on sensations related to pressure and temperature, but taste and smell are chemical. With these senses we really detect molecules.

We count with ten receptors in the tongue, the palate, and the pharynx to perceive flavours. We have about ten thousand receptors in total located in the so called taste buds, although there are people who have a larger number (until 30000), and that is why they have the ability to appreciate flavours better. The receptor cells are connected to nerve fibres, so the impulses generated get to the brain through one of the four cranial nerves, and there, signals are transformed into what we call flavour. The number of receptors diminishes with age, that is to say, that a young person can appreciate sweet flavour in water if it contains only 1 gram of sugar per litre, whereas at the age of 70, one might need ten times more to be able to appreciate it. Young people are able to notice salty flavour in water that contains only 1 gram of salt every 5 litres.

Sweet and salty are considered the basic sensations of flavour. Then we should add bitter and sour. We could also talk about umami that is related to proteins. It is linked to monosodium glutamate, and it is not identified as a different flavour itself, but it does enhance other flavours.

The distribution of flavours in the taste buds is irregular in the tongue: sweet is mainly on the tip of the tongue, bitter at the back, and salty and sour on both sides.

To start with, the range of smells and flavours could be as broad as chemical substances, or even more, the number of all mixtures –in several proportions- that we could prepare with the enormous amount of chemical molecules capable of interacting with our smell and taste sensors. It is believed that it is possible to perceive up to 100000 different smells with the 1000 different receptors we have in our nose.

To olfactorily detect a substance we need two conditions:

1. That it is volatile (molecules individually penetrating in the nostrils)
2. It has to be a molecule that due to its structural characteristics (shape, polarity...) is capable of acting over smell receptors, that is to say, that constitutes what we call an aromatic substance.

Smell is essential for the sense of taste. In fact, smell is the strongest sense when we are born, (that is how a baby recognizes his mother). It is estimated that between 70 and 80% of the sensations we perceive, like taste, depend, actually, on the aroma of food. This can arrive to the sense of smell through our nostrils by a connection with the buccal cavity when we chew and swallow. That is why, when we have a cold, we cannot appreciate the flavour of food. It is difficult to distinguish between two marmalades if we pinch our nose. Also, if we do not perceive the aroma of coffee, chocolate or wine we lose most of their essence. Apart from smell and taste, food provides us other sensations, for example, spicy sensations (pepper), freshness (mint), the tickling of bubbles and other several tactile messages that come from the texture, the consistency or the temperature of food.

Everyone has different tastes. Each of us has our favourite food, and the fact that we like some dishes more than others, is a consequence of many other factors, from genetic to cultural ones, as well as others like age, education, experience or memory, and children's diet above all, and the environment where we have been happy in front of a good meal. What it is really interesting, is to have our own tastes after having tried a little bit of everything.

Human beings are omnivorous; we search for food guided by pleasure and/or health. Taste and smell allow us to remember in an evolutionary way, harmful and poisonous food, but also, to choose the nicer one.



PERFUMES, FLAVOURS. TASTE MEMORY.

Ancient flavours and new flavours

Grandeur and squalor of the two myths

The use of aromatic substances is not something new. For example, aromatherapy (use of natural fragrances of plant essential oils to improve the physical, mental and emotional well-being) has been used since ancient times. Civilisations from all the world have appreciated aromatic plants, flowers, woods and resins because of their curative, relaxing and pleasing (for the brain) power. For example, in India jasmine and rose aromas, woods like sandalwood and plants like patchouli are used for different aims.

According to experts, there are more than 30.000 aromatic components. Aroma specialists, for instance, work with a palette of about 300 natural aromas and about 4000 synthetic ones. Other examples would be whisky or coffee, which have about 250 or 400 components, respectively.

Therefore, we could have access to an enormous variety of flavours, according to the technique we use for that purpose. Obviously, depending on how the flavour is obtained, we will get different organoleptic characteristics.

We should take into account that a technique makes sense if the flavour is interesting. That means that the technology that we use will allow us to keep the same flavour quality of a product during the whole year. Each technology will provide us with a new and different characteristic of the flavour.

It is important to highlight that the modern technology is not necessarily better, but the one that will offer a better flavour. Texturizers are fine if when use them in a dish they give a good flavour.

ANCIENT FLAVOURS

They are those from ancient times, which are nowadays used actively in our gastronomic culture.

The need to preserve food is as old as human beings, who until recent times could not assure their permanent availability. There were periods of scarcity and abundance that could not be controlled.

By observing and experiencing people learned, since prehistoric times, that cold preserve food better. In the Neolithic times people already chose the freshest part of the cave to store their food. With fire they learned the smoking process and when proving the effect of heat, they used the sun combined with air to dry their food.

The following step was the fermentation, probably involuntary, of some products. It is believed that it was in Egypt where bread was first fermented, and where the process was applied for the making of other products like beer and wine, although it was very different from the current processes, and fermented syrups from dates and honey. The salting and smoking process were also normally used.



The smoking process is a technique to preserve food that consists of a kind of slow cooking at a low temperature. But it is also a chemical treatment. Smoke is a complex material that has more than 200 components including alcohols, acids, phenols and several toxics. Toxic substances are precisely those that inhibit the growth of microbes. Phenols delay the oxidation of fats and the process as a whole gives the meat this characteristic flavour of wood when is burned. The salting process is generally combined with the smoking processes to minimise the oxidation of the fats that provoke the salting.

The salting process is based on the use of normal salt and generally on the use of nitric acid salt as well. Many times we use them together with other substances like sugar and spices to obtain a meat easier to preserve, which will differ from other products because of its texture, nice aroma and flavour, and colour similar to the natural colour of meat.

For thousands of years, salt has been used to inhibit the growth of bacteria. The meat was soaked in brine and covered by cooking salt. By carrying out this process, the water that is inside the cells tends to come out by osmosis. Therefore, the meat is dehydrated and the interior water of the microbes tends to be released by osmosis. Then an inhibition of the bacteria growth takes place. On the other hand, the salting process provokes the destruction of many proteins, and the meat undergoing this process has thus more fat. It also has an effect on the colour: ham (that is why many times it is vacuum-packed).



In the early nineteenth century, in 1809, the Frenchman Nicolas Appert disclosed the method for tinned food of long duration. In 1862 Louis Pasteur scientifically defined the process of food sterilization. Pasteur noted the presence in food of microorganisms which cause degradation (putrefaction) and how they could be removed at high temperatures. From that moment the canning industry has been continually developing and progressing.

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Fermentation

It is a chemical process through which alcohols and organic acids are formed from fermented glucose (organic matter involved in biochemical processes which act as inorganic catalysts)



Fermentation, therefore, is life, organic chemistry. For example, there are more than 300 ferments to make bread. The most commonly used today is the modified brewer's yeast, since it is the fastest, yet the least tasteful. Well-fermented bread should need one night of fermentation.

There are many kinds of ferments, depending on their origin: from wine, milk ferments... Some ferments are very acidic such as apple ferments, or less acidic like excrement ferments.

For example, the authentic panettone (which requires three days of fermentation) is derived from cow excrement. Once the cow excrements are dry, Italian chefs hydrate it with water and then mix it with flour to produce the ferments. Another example is glycerine, which is an emulsifier product of fermentation, with powerful anti-freeze. Parmesan, yogurt, tea and rum, to name but a few, are other examples.



Spoilage

This refers to the spoilage of food due to the presence of microorganisms which cause degradation. As time goes by, the taste of food changes. In fact, foods such as meat must go through a ripening process (spoilage), in order for it to taste better in its final consumption. A notable example is the face in days, with the snipe. Its taste is no good without this process.

Confit without sulphur

Cook the fruit with syrup (sugar and water mixture), for it to go through osmosis. The fruit pieces should be more or less complete. The sugar content usually varies between 65 and 100% of the fruit weight. When the fruit is cooked, the evaporation of the water they contain can be seen. Many confits, unfortunately, are worthless. It is not due to technology but to visual appearance. The fruit is exposed to a process of brine, sulphide and subsequent addition of aromas and artificial colouring in order for it to have an acceptable and attractive visual appearance.



We are losing variety

The problem lies in the dominance of sight over taste. It is important to recover the ancient flavours.

The immediate taste

Studies on the cellular structure of plants demonstrate how this structure changes as time goes by. Clearly, a freshly picked piece of fruit will taste better than one left in the fridge for days, as it starts to lose vitamins, minerals, and therefore lacks in taste.

TRADITIONAL TREATMENT TECHNIQUES OF TASTE AND INDUSTRIAL TECHNIQUES

This supports the whole “natural” concept in the ingredients.

Here are some examples of traditional techniques of flavour extraction, easy to elaborate:

Food toasting

Food is toasted by putting it on the heat for it to acquire more colour, without letting it burn, and to enhance its flavour. For example, raw almonds have very little flavour, but when roasted their flavour is enhanced significantly. Another example of toasted food would be that of the wine grape from the harvest, which is oxidized by the sun and wind, completely changing its original flavour. Another case is the herbs we use in cooking.



Traditional confit. Cooking with syrup

Milling

Grinding grains or fruits enhances the perception of flavour (coffee, nuts ...). For example, no one can eat 100 grams of pure hazelnut paste but instead, we can eat 100 grams of whole hazelnuts. The difference in taste is remarkable.

Cold and hot infusions

Certain organic substances are introduced in water to extract from them the soluble parts. It is obtained from various fruits or aromatic herbs. They can be made cold (acquiring little flavour) or hot (altering the taste).



Simple distillation: simple extraction of flavours

Enfleurage

This is a procedure by which fats are introduced into other fats. For example, if we put tons of flower petals in oil, the oil will absorb the entire flavour. If you melt butter and add rosemary, it will acquire the pure flavour of this aromatic herb when it solidifies. This occurs with any plant which has essential oil in its structure. ■

New flavour technologies

Firstly, we have to give perspective and historical context to the new ingredients coming from new flavour technologies. In whichever discipline, there are always those who believe that “any time in the past was better”, and those who undoubtedly hold on to the most modern and innovative. In my humble opinion, in haute cuisine and modern pastry, it is all about recognizing and choosing the best ingredients regardless them coming from ancient or very modern technological elaborations.

Classic confits are wonderful, as well as semi-confits per cycle of pressure and de-pressure. As the fruit is not heated, it becomes a fantastic product. Haute cuisine does not have to follow the new or the old. We simply must choose the best products with all the potential and existing techniques. The use of modern techniques for drying, extracting, milling and confit in pastry and cuisine has existed for centuries and we now have some new techniques which do not replace the traditional ones, but complement them. Haute cuisine should gather the best products from each technology despite it being new or not. The product must be of an excellent quality.

First of all, we must note that technology itself does not always guarantee organoleptic quality. Just because a lyophilised product is modern does not mean that it is always good. For it to be good it is necessary to lyophilise a raw material of excellent quality through the correct procedure. Among these technologies, drying techniques and modern extraction stand out. They allow us to draw water out from the food without heating it, retaining most of its intrinsic qualities. The techniques used in haute cuisine must be at the flavour’s service and not otherwise.

In the following chapters we shall analyse the use of modern techniques applied to obtain new ingredients and we shall review some of the old ones.

MODERN FLAVOUR TREATMENT TECHNIQUES

How many times have we come across with a dish on a restaurant menu, and after tasting that dish, we were surprised to not have found the flavour described in the menu?

New flavour treatment techniques try to avoid such disappointments, as well as open a wide range of creative possibilities.

We call modern techniques or flavour treatment techniques to those that are not normally within the grasp of restaurants or bakers except for very few restaurants. These techniques have generated a series of auxiliary products with the following functions:

- To provide different textures of flavour from those of the original product (lyophilised, dried and preserved products).
- To enhance, improve a taste. (All)
- To provide a flavour without the texture and/or colour of it (aromatic extracts of high concentration).
- To solve technological problems in the application (disappearance or reduction of the flavour during cooking, or problems due to excess of water in the application).
- Extend the life of foods without heat.

The different flavour treatment techniques have been divided in the following sections.

- 1/ Drying
- 2/ Grinding
- 3/ Concentration
- 4/ Confit
- 5/ Extractions and aromatic compositions of high concentration

In either of these cases, the function of these technologies is NOT TO REPLACE. That is, they are not used to remove raw materials but to provide more applications and possibilities of primary products.

Each and every way we treat a flavour gives us a decline or variation thereof, and each decline is another opportunity to express the nature of this ingredient in a different way. The relationship of the decline with the original is not as simple as it may seem: nature itself, in its own variability, is a steady decline and of great richness in each scent. This problem is almost platonic. Technologies allow us to decline this essence, approach it from a different perspective, and in some cases, like in pure abstractions, they may allow us to actually be closer to them. The different technologies with which we can treat flavours are part of a huge range of taste and culture that is added to the ingredient or raw material. The goal of any good chef is to know nature and its declines as best as possible to create or recreate subtle and complex dishes, which would contribute to have new taste perceptions of nature.

In haute cuisine, technology must be at the service of flavour and not otherwise. We must escape from the myth that everything was better in the past and also, that everything new is better.

1/ DRYING

Partial drying at low pressure by steam and lyophilisation

Drying is an ancestral method of preserving food by applying heat and aeration. Nowadays, drying is used in gastronomy not as a preserving system, but, as a way of obtaining food with special flavour characteristics or to facilitate the use of products where water causes problems in the making. A dried apricot allows us a better use in all type of makings where water would cause us trouble: mousse, crystallization in ice-cream, ganache, crème pâtissière, etc. It is also very important that these products do not release water in doughs that contain flour and where you would like to incorporate fruit. Panettones, brioche, croissants, bread, etc. use dried fruit to avoid the release of water during the making process.

Several technologies have been incorporated to the traditional drying method that allows evaporation of water without thermal treatment, preserving the organoleptic properties of the products. There are two drying systems without temperature: lyophilisation and low-pressure or vacuum drying.

Partial drying at low-pressure by steam

<http://en.wikipedia.org/wiki/drying>

Partial drying at low-pressure is a method through which water is evaporated at a very low temperature by the use of steam. The result is soft products, with a soft texture that maintain the flavour, but their aspect reminds us of traditional products dried by air. See pictures of soft dried fruit.

<http://www.sosa.cat/familias.php?idfamilia=frutas-secas&idgrup=frutas&idgama=ingredientes-gastronomicas>

Lyophilisation

This is a dehydration method that is done by freezing the material and then reducing the surrounding pressure and adding enough heat to allow the frozen water in the material to sublime directly from the solid phase to the gas phase. In other words, it is a process by which 100% of the water is extracted by freezing and pressure. The fruit, for example, is deep-frozen and, by means of the pressure, pure water crystals come out. Thus, it is completely dried, maintaining all the flavour of the fruit.

It should not be hydrated for its use; on the contrary, its basic application is to incorporate it in products where the release of water would bother us.

<http://es.wikipedia.org/wiki/Liofilizacion>

Lyophilisation has been incorporated to modern gastronomy in a non-stop process. For example, for lactics, fruits, vegetables, spices, meat and fish, mushrooms, herbs, aromatic plants, among others. Why has lyophilisation been introduced in this way? Firstly, it is due to its respect towards raw materials and flavours. Secondly, because it plays an important role within the structure or equilibrium of a dish or dessert: the equilibrium between dry and humid, between soft and crispy.

Lyophilised products broaden the possibilities to count with dry and crispy options in a context where, in general, most of the foods have a "water" or humid base. Thus, lyophilised products compensate the excess of "humidity" and softness that is very typical in modern cuisine, and that has unfairly abandoned a lot of dry textures that come from flours (bread, puff pastry, brioche, etc.)

Lyophilised products have a version that comes in powder that allows us to incorporate flavours in makings where the water of the fruits would impede a distinguished and excellent flavour (ganache, mousse, crème pâtissière, sauces, reductions, meringue, macaroni, fresh pasta, among others).



2/GRINDING (CONCHING)

Conching of nuts and seeds

Grinding is also an ancient technique of food processing. Conching can refine fat based products up to 25 microns (nuts, seeds, coffee, and cacao, of course).

Conching is a technological process that largely enhances the flavour of nuts. The more hours of conching, the more nuances and aromatic notes will appear. Chocolate could be between 24 and 48 hours conching. It is the means by which one can extract the maximum flavour of nuts, seeds and beans in a fat base.

The more fat there is, the more we can feel the taste. A non-fat beer ice-cream gives the feeling of little flavour. If it has a little bit of fat, the dinner guests are much less "beer", holding the flavour for a longer time in their palate.

During conching, fat molecules homogeneously incorporate into the solids of the fruit, being completely free. That is why they pass from a solid state into a liquid or doughy state. It is calculated that the power/strength of the flavour of conched nuts increases 20-30%, basically because as they contain free fats, it is retained longer in the taste buds, thus increasing the "flavour sensation". The more free fat there is, the greater the sensation of flavour. Pralines are also made by this technique (by conching sugar with nuts) or gianduias (conching of nuts with chocolate and lactic in powder).

By the conching of coffee beans with a little bit of sunflower oil (because coffee does not contain enough fat for conching) one can achieve one of the most intense and pure flavours of coffee.

Pure paste allows us to do sauces, cream soups, and all kind of makings where you can perfectly distinguish all the flavours.

3/ CONCENTRATION

Cold concentrate

The most technologically advanced concentration procedure, such as lyophilisation, is based on evaporating at a low temperature using very low pressure. In this case, the temperature of the evaporation is set at 20 degrees. This evaporation can produce concentrations of fruit, wine, beer, vegetables etc. without heating the product and therefore losing very little of its flavour. Once we obtain the concentrate, it can be applied to all hydrophobic makings already mentioned without altering the flavour. Cold concentrations enhance the potential of the taste and, above all, avoid modifying or ruining the quality of the flavour.

Pulp concentrate allows us to have the highest quality of flavour with a minimum amount of water. This same technology can concentrate wine, beer, etc. In fact, this technology allows us to make cold reductions which would initially have to be hot.



Examples of gastronomic applications:

- Meat with wine or bear (there is no need to concentrate them)
- Balsamic vinegar concentrate
- Raw coulis

4/ CONFIT

Cold confits

Confit is a cooking process with an osmotic exchange of sugars and other components. Heat has been added to the classical procedure—introducing sugar per cycles of pressure/de-pressure without heating. This same technique is used for all types of impregnations. With this technique it is possible to preserve all the vitamins, colours, properties, etc.

Once the sugar has been put in, other products can be added into ice cream products and they will not crystallize.

Marmalade and jams can be made with this same technique conserving the flavour of the fruit.

5/ EXTRACTION

Historical perspective and complexity

The use of aromatic substances is not a novelty in cuisine. The first extractions (oleoresins) date from ancient Egypt (3500 BC.), followed by the Greeks and later by the Romans. These extractions were mixed with beer and honey in ancient Egypt or with wine and honey in the classical era. The first true facts about distillation date from the first century BC in Alexandria, but the Arabs developed the necessary tools for distillation. In the tenth century, Avicenna introduced it in Europe. The Catalan scientist Arnau de Vilanova spread his knowledge among European alchemists. From then onwards, these culinary techniques have been commonly used, especially in the cultures of the Middle and Far East. During the twentieth century new extraction systems have been introduced which, along with the “aromatic reconstruction” method from aromatic molecules, has brought aromatic art to its highest level. The art of aromas, which combines extraction with recreation from aromatic molecules, is of an enormous complexity. According to experts, there are over 30,000 aromatic components. Aroma specialists, for example, work with a palette of 500 natural extracts (increasing each day) and about 4000 synthetic extracts (identical to natural or synthetic). As an example of the complexity of the issue, we should note that whisky has about 250 aromatic components and coffee has around 400 components.

Types of aromatic substances

There are three types of aromatic substances:

- **Natural aromatic substances:** aromatic substances obtained from animal or vegetable raw materials via physical, microbiological or enzymatic processes. Among them, essential oils, oleoresins, CO₂ extracts, FTNF extracts and distillates from alcoholic macerations. They cannot have substances identical to natural nor synthetic substances.
- **Natural-identical aromatic substances:** Aromatic substances obtained by synthesis or isolation via chemical processes but are completely identical to natural substances for human consumption. They cannot contain artificial substances.
- **Artificial aromatic substances:** Aromatic substances which have not been found in any natural product for human consumption, processed or not. Normally, they are produced through fractional distillation and chemical manipulation of natural chemicals derived from petroleum.

In the European legislation, the last two (identical to natural and synthetic substances) are classified as aromas and the first one as a natural aroma.

Types of natural extractions

Important note: what is usually called natural aromas is really a mixture of different natural extraction technologies.

Essential oils

These are mixtures of various chemical substances biosynthesized by plants, which give a characteristic scent to certain flowers, seeds and animal-based extracts. Their aroma is intense, non-fat (so they do not become rancid), volatile (they evaporate quickly) and lighter (less dense). They are insoluble in water, slightly soluble in vinegar, and soluble in alcohol, fats, waxes and vegetable oils. They oxidize due to air exposure. They are present in various parts of plants: in flowers (lavender, jasmine and rose), in trees (eucalyptus), in leaves (lemon leaves), wood (sandalwood) in roots (vetiver), in exuded resin (incense, myrrh), and in fruit peel (lemon, orange, bergamot).



They are very concentrated; therefore only small quantities are needed to achieve the desired effect.

It is obtained in various ways; either by distillation in a steam current or by cold extraction (such as the lemon aroma extracted from the small bubbles in the lemon peel).

<http://en.wikipedia.org/wiki/Distillation#History>

Oleoresins

Oleoresins are the oldest method of extraction, also known as “enfleurage”. The technique is based on crushing the product and mixing it with fat. As heat is applied to it, the resins or essential oils disperse from the fat and then the oil is removed using a centrifugation or decanting system. Oils and resins are incorporated into the fat and are ready to be used in perfumes and beverages. In general, oleoresins give greener hints.

CO₂ Extracts

They are also known as supercritical extractions. CO₂ is normally a gas or solid of negative temperature. Under certain pressures and temperatures, CO₂ reaches its peak and its state of matter lies between a gas and a liquid. More specifically, it behaves as a supercritical fluid to 31.1° and 7.39 Mpa. It expands like a gas but with the density of a liquid. When in this supercritical state, it is used as a non-toxic extraction solvent and is environmentally neutral. The low temperature extraction also allows maximum respect for the organoleptic properties of the extracted product. http://en.wikipedia.org/wiki/Supercritical_fluid_extraction

Absolutes

These are extracts where the extraction uses a solvent to extract the hydrophobic aromas. It is actually a kind of oleoresin extraction but after filtering, a distillation occurs, intended to generate “wax” or “solid material”. The fragrances of low molecular weight are extracted from the concrete with ethanol. When it evaporates - the absolute- the oil appears. Absolutes are more concentrated than essential oils and, in general, more complex but we must be aware of the remains and types of solvents when applying them to gastronomy. [http://en.wikipedia.org/wiki/Absolute_\(fragrance\)](http://en.wikipedia.org/wiki/Absolute_(fragrance))

Aromas in haute cuisine

Haute cuisine uses aromas not to replace raw materials like industries do, since haute cuisine has to be able to buy the best raw materials, but for different purposes:

- To enhance a flavour that has faded after the process of cooking or elaborating (eg. adding a hint of fresh rosemary to a sauce or stew, after cooking).
- To give a hint of a certain flavour without its actual texture (eg. black pepper flavour without the actual pepper grains, or giving a hint of lemon without having to put lemon juice or peel over the fish).
- To enhance a flavour that has not been well defined due to the instability of nature (insipid watermelon soup).
- To enrich a cooking process with subtle aromatic hints (chocolate ice cream with ginger).
- To create, with a flavouring, environmental scents in a room or dish.
- Aromas allow enhancing a chef’s capacity of sensorial analysis. The more the chef senses, the more the chef analyses. Aromas allow developing flavour pairings prior to the preparation of the dish in an abstract non-intuitive way. (www.foodpairing.be).

In general, haute cuisine must use the most natural aromas as possible, without undervaluing many aromas which are identical to the natural ones, which are authentic works of art. ■

