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Sensory quality of traditional foods ☆

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Abstract

It is generally admitted that the expression 'traditional food' refers to a product with specific raw materials, and/or with a recipe known for a long time, and/or with a specific process.

Industrialization of food production, European laws on food safety and even the development of innovative products necessitate the characterization of the typical sensory characteristics of these traditional products.

Numerous are the sensory studies made on wine, cheese or cereal products. Different strategies can be used for such studies, depending on the aim of the study: olfactometry to determine key-aroma compounds in local wines, texture profiling for pressed cheeses, tracing aroma compounds brought by the various raw materials or generated by the different unit operations of a process.

More than that, the perception of the sensory characteristics of a product is related not only to its intrinsic characteristics. This short review evidences that the mastery of food products implies to integrate all the steps of their production and marketing, from the raw materials to the consumer.

Keywords: Traditional foods; Sensory; PGI; PDO; Bread; Cheese; Wine; Flavour

1. Introduction

When talking about food, tradition is a very large subject that can be described at different levels: within social groups as small as a family or as a function of time scale for example.

Traditional foods can be related to special events such as a wedding or a birthday as for example the traditional wedding cake in Great Britain. Religions also have a great importance when talking about traditional foods: prohibited foods that are numerous, special dishes corresponding to an event of the religious calendars.

Traditional foods are also often related to local foods and artisan foods referring to specific ingredients, location of the production and know-how. It could be the food made by your grand-mother or by the native people of your country (ethnic food).

Different questions are rising when reproducing these foods. Is it still possible to find the ingredients? Is it possible to reproduce the recipe and the process? Could it be as good as it was? Could it be better from a sensory point of view? Could it be healthier? It is possible to find what makes the specificity (or the typicality) of these products? And finally as many new products are proposed everyday to consumers: how much time does it take before an innovative product becomes a traditional one?

2. What is the context of the production of traditional foods? Why is it necessary to characterize traditional foods?

There are some important dates in the history of the food industry (Table 1). One can consider that the modern food industry was born in the 30's with the introduction of the household refrigerator (Anonymous, 2005). In fact, before this date the classical way to preserve food was fermentation and from the moment a convenient way to store

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Table 1
Some dates of importance in the food industry

Period of time	Percentage of a household income for food	Evolution of food technology	Structure of food companies	Evolution of consumer's demand
		Preservation by fermentation	Artisan	
30's	25	Household refrigerator		Mass production
60's–70's		Preservation technologies moving: Salting Drying Canning Freezing	Industry: Big groups together with SMEs	Ready to eat Individual portions
80's–90's	15–18			Quality – safety – health

food was for public use, the ways to preserve food could move, from salting to drying, from drying to canning, from canning to freezing (Laberge, 2005).

That is why, from the middle of the XXth century, great developments of processed products were observed as compared to the raw products that were formerly used for cooking. Ready to eat foods and individual portions appeared (Deneux, Bizet, & Dussaut, 1999).

This mini-revolution was followed during the 60's–70's by a great modification of the structure of the Food companies. For example in France, it was observed that food companies were merging in big groups. Many artisan products became manufactured products.

Nevertheless, almost half of the French food companies are small and middle enterprises (SMEs) (less than 50 employees). The general trend in Europe is that Food companies are bigger in the Northern countries and smaller in Southern countries and especially in Italy (Lienhardt, 2004). This characteristic could be an advantage for the preservation of traditional products and for the reactivity to the consumer demand.

Some requirements concerning food quality, food safety and for healthier food have been taken into account since the 80's–90's. In the 30's, food represented 25% of a household income, nowadays it is about 15–18%. The modern consumer is used to buy low cost food products but does not accept to be put at risk. Food safety became during the 90's a key factor for food manufacturing as shown by the creation of the European Food Safety Authority.

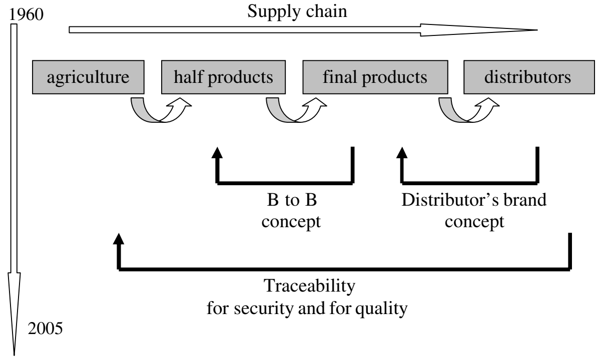

Fig. 1. Evolution of the relationships between agriculture and food companies during the past 35 years.

What should not be lost during these evolutions are the historical and specific relationships between agriculture and food companies (Fig. 1). Until recently, food industry had to transform raw materials from agriculture. Now, agriculture has to deliver to food industry raw materials fitting specific requirements. Half-products are more and more sophisticated and this increases the distance between raw materials and final food products. Traditional foods were supposed to be more directly connected to agriculture.

The same type of integration also occurred between the food companies and the suppliers with the distributor's brand concept and with traceability and quality along the whole supply chain. More recently, the B to B (business to business) concept that implies direct relationships between companies producing half-products and their clients could be an advantage for the marketing of traditional foods.

3. Why is it necessary to characterize the sensory properties of traditional foods?

Beside the demand for safe food, there is always the need to eat foods that taste good. For 'SMEs' which have a good control of their production costs and do not have the means to support marketing costs, a way of development is to make distributor's brand products but there are still some opportunities for 'SMEs' to develop innovative products corresponding to up to date demands of consumers.

For both these approaches, the consumer behaviour and the perception of food quality are major parameters to be taken into account.

Food quality is a multivariate notion ('it tastes good – it looks traditional, safe, healthy, etc.'). Traditional foods are sometimes used to carry an image of foods tasting good but in the same time could be perceived either good for health (as related to natural products, no chemical modification, no additives) or bad for health (as related to high fat content, microbial contaminants).

These aspects, taste and health, are to be improved in parallel and clarified for the consumers.

Industrialization of food production, European laws on food safety and even the development of innovative products necessitate the characterization of the typical sensory characteristics of these traditional products.

For example, it is necessary to specify the characteristics of the traditional products:

- When Protected Geographical Indication (PGI) or Protected Designation of Origin (PDO) labels are required.

In this case, it could be important to prove a difference of quality between non-certified and certified products. The ingredients, the process, the location of the production must be studied in relation with this specific quality (de Sainte-Marie, Monin, & Casabianca, 1997).

- When a modification of process is needed to improve food safety (e.g. cheese from raw milk).

This is an important demand in Europe considering that, for example, 13% (of the total weight produced) of the French cheeses are made with raw milk. Traditional cheeses using raw milk are made in many other countries but forbidden for export

- When one have to move from small-scale production to industrial production.
- When one have to formulate a new product – low-fat products for example, or products with a reduced amount of sodium chloride – derived from a traditional one.

4. Different strategies to check sensory quality

From an historical point of view, the interest for sensory analysis appeared in the 40's and was developed mainly during the 60's–70's. This science including many knowledge fields such as anatomy, physiology, or psychology was developed mostly for food science but was successfully transferred to other manufactured products such as cosmetics, cars or textiles.

Many different basic procedures, as for example the duo-trio test, were frequently used to compare products and determine if one was different from another. Nevertheless, the definition of food characteristics by sensory analysis is important to establish the specificity or typicality of the products. Then profiling tests appeared allowing to characterize the differences perceived between samples. Traditional evaluation of sensory characteristics of food products consists of establishing sensory profiles. The complexity of the tasks asked to the panel increased and longer training periods together with more complex statistical analyses were required. Moreover, training does not always improve a panel's ability to discriminate between products (Chollet & Valentin, 2001). Free-choice profiling might be an alternative because it is more rapid (assessors use their own descriptors) but direct comparisons of products are sometimes difficult. Piombino, Nicklaus, Lefur, Moio, and Le Quéré (2004) proposed a two-step strategy for the rapid selection of food samples with given flavour characteristics. They wanted to select wines with berry flavours. Firstly the authors performed a sorting test on a large number of wines. This test was conducted with inexperienced jury and was followed by a free description of the criteria used to sort the products. A subset of the studied products was selected, on the basis of their fruity notes, and a qualitative descriptive analysis was then performed with a trained jury. This approach can be used successfully as an exploratory and qualitative tool to be followed by a more traditional descriptive analysis.

More generally, for each method, simplified or faster procedures were often developed as it was the case for profile test. For example, Sieffermann (2002) suggested combining free choice profiling and a comparative evaluation of the product. Judges simply rank the products attribute by attribute. Such methodologies are named flash profiling.

Actual developments of sensory methodologies also include dynamic measurements such as time–intensity (*T–I*) measurements. Most of the classic *T–I* procedures involve the continuous assessment of temporal changes in the perception of a single attribute but some adapted procedures were used to monitor several attributes at several times over the same mastication. Such a procedure was used by Pionnier et al. (2004) to explore inter-individual variations.

If the sensory approach is often considered as the ultimate validation, many studies aimed to propose alternative instrumental methods, less time consuming.

In fact, the use of the results obtained by sensory analysis could be limited by the variability of perception among individuals. This variability could be linked with differences in anatomy, in physiology, but also in the culture of the panellists as it was reported by Thomas-Danguin et al. (2003) concerning the modulation of olfactory capacity with age, gender, smoking habits or disease.

On the other hand, the use of the results obtained by instrumental analysis is limited by the fact that such analyses are often based on a single dimension of multi-dimensional parameters. For example, rheological methods allow the characterization of the mechanical properties of a food product but the perception of texture refers to many other characteristics as described by Kramer (1972). Nevertheless, techniques concerning aroma and odour are more developed and are found quite sensitive.

Following this statement, mixed methods were proposed to progress either in the description of stimuli or in the understanding of perception. Techniques such as olfactometry or measurement of flavour release by APCI-MS (Atmospheric Pressure Chemical Ionization Ion Trap Mass Spectrometry) are both based on the coupling between an analytical instrument and a human assessor (Table 2).

As written by van Ruth and Roozen (2000), an instrumental approach to characterize aroma can be regarded as a two-phase arrangement. The first phase involves representative isolation of volatile compounds, because the volatile composition and proportions of the volatile compounds determined afterwards are largely influenced by isolation procedures. The second phase involves the selec-

Table 2
'Mixed methods' combining instruments and human being for the evaluation of food odours

Representative isolation of volatile compounds	Characterization of relevant aroma compounds
Sampling of headspace	Physico-chemical analysis of compounds
• Static	• GC–MS
• Dynamic	• APCI-MS
Simulation of oral processing	Olfactometry
• Dilution	• Dilution methods, e.g.: AEDA
• Dilution + temperature + mastication	
• Mastication simulator able to handle various textures	• Detection frequency method
• Artificial throat	
In vivo extraction	Others
• Nose space	• Intranasal trigeminal stimulation (brain imaging)
• Mouth space	• Similitude testing

tion of the relevant aroma compounds from the whole range of volatile present in a particular food product.

Concerning the isolation of volatile compounds, many instrumental analyses of volatile flavours in food have been carried out without considering changes that may occur during eating as temperature increase, salivation and mastication. The development by Lee (1986) of a model system able to monitor the headspace continuously by using a mass spectrometer coupled with a dynamic headspace system was followed by many other attempts to reproduce the oral processing of food. Roberts and Acree (1996) presented a model in which food was macerated and hydrated under defined conditions and the volatiles released into the gas phase were analysed. van Ruth, Roozen, and Cozijnsen (1994) developed a model system in which mouth conditions are simulated taking into account the volume of the mouth, temperature, salivation and mastication. The performance of this model regarding the extraction of volatile compounds was compared to a dynamic headspace system, a purge and trap system and a direct sampling in the mouth of assessors owing to a Tenax trap (van Ruth & Roozen, 2000). The performance of extraction was checked on the release of aroma compounds of rehydrated French beans. It was demonstrated that aroma release in the artificial mouth system did not differ significantly from release in the mouth of the 12 assessors used for direct sampling. Both the release in the artificial mouth and the release in the mouths of assessors differed significantly from the ones obtained with the other methods.

Different laboratories are developing 'artificial mouth' systems more and more complex, able to handle with food products of different textures. Such a device is being designed by Salles et al. (2005) with the objective to reproduce as close as possible the destructuration of food as done by teeth and by the compression between tongue and palate. The initial specification list for this system is extensive: full gas and liquid tightness, chemical inertness, on-line measurements for aroma release (gas) and taste (liquid), high speed and torque, motions as tongue, rapid dismantling for cleaning between runs.

To go further in the simulation of oral processing, Boelrijk et al. (2005) proposed an artificial throat aiming to simulate swallowing and in vivo release in the throat.

Other authors prefer to use directly a human being for the extraction step of the aroma as it is the case for the API-MS 'in nose' method or 'in mouth' method as developed by Taylor and Linforth (1994). The measurement is still in vivo but the panellist is only asked to masticate the sample. This nosespace or mouthspace extraction (breath by breath analysis) could allow temporal flavour release monitoring.

Concerning the selection of relevant aroma compounds, olfactometry (GC-O) is reported to be an efficient tool because it permits the analysis of key odorants in food (Machiels, Istasse, & Van Ruth, 2004). Several olfactometry techniques are available.

Dilution analysis methods (CHARM and Aroma Extraction Dilution Analysis) were extensively used and applied to various foodstuffs. In these methods, the extract obtained from the food is first concentrated to a small volume and then diluted. An aliquot of each dilution is analysed by GC-O. The result is expressed as flavour dilution factor which is the ratio of the concentration of the odorant in the initial extract to its concentration in the most diluted extract in which the odour can be detected by GC-O. It can be considered as a relative measure of the odour potency of the compound in the extract (van Ruth & O'Connor, 2001).

Detection frequency method also was often used. It records detected odours over a group of assessors. The number of assessors detecting an odour is related to the intensity of the odour (van Ruth & O'Connor, 2001).

Both artificial mouth and olfactometry methods can be combined. For example, the volatile compounds of cooked meats from differently fed bulls were isolated in a model mouth apparatus by Machiels et al. (2004). Once the volatile compounds have been isolated, their odour activity was assessed by GC-O using 12 assessors. This specific technique of extraction was particularly useful in the present case where mastication and saliva are factors of importance when considering the aroma release from solid and textured products such as meat. Significant influences of breed and diet on the odour-active profile of cooked beef meat was demonstrated thanks to this technique.

Such techniques combining human being and instruments may also be used to understand the mechanisms of perception. For this last point, some experiments were conducted thanks to medico-analytical tools to follow the image induced in the brain of human beings by odours delivered directly in the nasal cavity via nasal canulae. This approach, using intranasal trigeminal stimuli, was used for example to reveal interindividual differences in trigeminal sensitivity (Lundström, Frasnelli, Larsson, & Hummel, 2005).

For complex products such as real food products different strategies could be used to check their sensory quality. The most important is to define precisely the objectives of the study. Different examples concerning the characterization of the sensory properties of some traditional products are presented in the following lines.

5. Sensory quality of traditional products: some examples

5.1. Bread

5.1.1. Effect of process on the aroma quality

For centuries baked cereal products have been present in our diets. Bread and wheat flour derivates are consumed throughout the world in many different forms, varying throughout the continents and civilizations representing one of the most consumed foodstuffs and can then be considered as traditional products. The aroma composition of baked cereal products has been widely studied, and as the methods for isolation and identification have been developed, more volatile compounds have been described (Folkes & Gramshaw, 1977; Mulders, Maarse, & Weurman, 1972; Mulders, Ten Noever De Brauw, & Van Straten, 1973; Schieberle & Grosch, 1983, 1984, 1985, 1987). Quantitatively the most important chemical groups are the aldehydes, alcohols, ketones, esters, acids, pyrazines and pyrrolines, as well as other compounds such as hydrocarbures, furans, and lactones. There are several steps in which these compounds can be produced; through dough fermentation by yeast and lactic bacteria, enzymatic activity during the elaboration process (kneading), lipid oxidation reactions and thermal reactions taking place during baking mainly through Maillard and caramelization reactions (Feillet, 2000; Richard-Molard, 1994).

Among the great quantity of volatile compounds that have been detected in baked cereal products, they do not all have the same importance for the final aroma. The aroma contribution of a determined compound depends on its concentration, but also of its odorant power that is determined by its odour threshold, the minimum quantity of a compound that must be present to be detected by olfaction. This value is usually known as odour activity value (OAV) (Acree, Barnard, & Cunningham, 1984). The AEDA technique allows the screening of the most relevant aromatic compounds for the final aroma of a product on the basis of the FD (flavour dilution factor) calculation. FD is proportional to the OAV of the compound in the air. Only the compounds with important FD factors will be quantified to obtain the OAV and to approximate their odour threshold value. With this procedure, it has been possible to make a characterization of the most potent odorants in baked cereal products, mainly in bread.

With the tendency to reduce delays of processing in bakery, there was a need to determine the impact of the different steps in the elaboration process of baked cereal products in the modification of flavour.

Kneading (intensity and duration) is one of the most important steps in making bread and other related products for the generation of aroma precursors by enzymatic action (Richard-Molard, 1994). It has been shown that; for example, the concentration of some aldehydes such as hexenal, in the breadcrumb is proportional to the intensity of kneading. The opposite effect has been shown for the Strecker aldehydes (methylpropanal, 2-methylbutanal, 3-methylbutanal, methanal) in the crust. Zehentbauer and Grosch (1998a) have shown that a second kneading step from 60 to 150 s was associated to a 32–38% decrease of these types of aldehydes in the crust. These authors have indicated that the more intense the kneading the more likely the change in the metabolic state of the yeast, leading to an inhibition of the formation of these aldehydes or to a faster consumption.

One of the main differences in the process of elaborating fermented baked cereal products are the *fermentation conditions*. Prolonged dough fermentation increases the concentration of 3-methyl-butanol and 2-phenyl-ethanol (Hansen & Hansen, 1996). These compounds are directly linked to the fermentative activity of the yeast in the dough fermentation step. Also acetic acid concentration is higher in bread made with a prolonged dough fermentation process. Longer fermentation times can produce intense proteolysis and higher amounts of free amino acids that can act as precursors of Strecker aldehydes mainly responsible for 'malty' notes (Zehentbauer & Grosch, 1998b).

In bread making, the controlled growth method is characterized by a refrigeration step of the dough (Feillet, 2000) that produces a slow fermentation velocity which results in two main effects: firstly, the production of fewer volatile compounds from fermentation (2-methyl-1-propanol, 2-methyl-1-butanol, 3-methyl-1-butanol) and an increase in production of compounds from Maillard reactions (Galey et al., 1994). Secondly, a delay in the oxidative degradation of linoleic acid and a reduction in the formation of aroma compounds from lipid oxidation (1-octen-3-one, *E*-2-none-nal, pentanol, hexanal, etc.) (Ullrich & Grosch, 1987) that is also due to the larger quantities of ascorbic acid that are usually employed in this method (Drapron & Richard-Molard, 1979). The sensorial consequences will be a less intense spicy note and a reduced "stale off-odor" (Zehentbauer & Grosch, 1998a).

5.1.2. Effect of ageing on the aroma quality

The principal reasons for the deterioration of the aroma quality of baked goods are because of the loss of some of the most important odorant compounds during ageing and the formation of "off-flavours" originated from lipid oxidation. These two events are the reasons for the dramatic decrease in the flavour quality of baked cereal products that will make the product unacceptable for consumption. Soon after baking, a process of gradual but unstoppable deterioration in quality begins. This process of changes is referred as "staling" and manifests itself principally by a loss of flavour and an increase in crumb firmness (Van Dam & Hille, 1992). After baking, some of the most important odorant compounds such as pyrazines disappear very rapidly via evaporation of the volatile compounds of the crust. After 3 h at room temperature there is a loss of 47% and after 24 h the loss is of 74% of acetyl-pyrazine (Grosch & Shieberle, 1997). The other important process that takes place during ageing of baked cereal goods is the generation of volatile compounds from lipid oxidation, such as hexanal and (E)-2-nonenal. The elaboration method may also have an influence on the concentration of stale aldehydes. Zehentbauer and Grosch (1997) have shown that 1 and 4 h after baking the Strecker aldehydes (methylpropanal, 2 and 3-methylbutanal) that also disappeared via evaporation decreased about 45 and 50% for the baguettes produced by the industrial method and about 24% and 27% in the baguettes produced by the traditional method. The formation of the stale aldehydes and the loss of compounds with pleasant roasty notes such as pyrazines increase the stale off-flavour perceivable after storage of wheat bread (Schieberle & Grosch, 1992).

5.2. Cheese

5.2.1. How to improve safety without decreasing flavour diversity?

As reported by Battenfeld and Sorensen (2001), the proteolytic digestion of proteins during cheese ripening is considered to be a multi-step reaction involving the formation of rather large peptides, and their subsequent digestion into smaller peptides and free amino acids before final transformation into various volatile aroma compounds Visser (1993). The final steps in the proteolytic process are believed to result mainly from the action of proteinases and peptidases from lactic acid bacteria used as starter organisms whereas the initial proteolysis results from the action of two enzymes:

- Residual rennet of which (approximately 6-10% retained in traditional cheese).
- Indigenous milk protease, plasmin, which has been shown to be important for ripening.

Although plasmin is quite stable at elevated temperatures, the activity of the enzyme is decreased by high temperature treatments such as pasteurisation. Thus the proteolytic maturation of cheese including denatured whey proteins differs from that of traditional cheese made with raw milk.

The volatile fraction of Camembert cheese has been analysed by several authors and more than 100 compounds were identified (Kubickova & Grosch, 1997). Pérès, Begnaud, and Berdagué (2002) used a technique – coupling static headspace and mass spectrometry – to characterize five commercial Camembert-type cheeses among which three were made from raw milk. After statistical analysis by the cross-validation procedure, it appeared that the characterization of the cheeses according to the manufacturing type (raw or heat-treated milk) was 93% correct and the classification according to ripening stage was 100% correct. The authors indicated that a pre-concentration step of the volatile compounds in the headspace is compulsory to characterize rapidly this type of products.

5.2.2. Assessment of typicality with the help of texture and aroma lexicons

Some years ago, a collaborative study was developed under the COST action 901 and the programme FLAIR. This study concerned a group of sensory analysis of cheese. The objective was to harmonize the training of the tasting panel and to develop a common method for characterizing hard and semi-hard cheese. This study also led to a common lexicon. The characteristics of surface, mechanical, geometrical and other kinaesthetic and oral sensations were studied for different cheeses with PDO labels such as Appenzeller for Switzerland, Parmigiano-Regiano and Fontina for Italy, Mahon for Spain and Comté for France (Lavanchy et al., 1993).

This precise analysis of the texture was followed by the publication of a guide to the sensory evaluation of smell, aroma and taste of hard and semi-hard cheeses (Bérodier et al., 1997a). A complete methodology was then available for the sensory characterization of these types of cheese. An additional study concerning flavour was done for Comté cheese, leading to a list of 91 attributes. This was used during three years to describe 99 Comté cheese samples. These samples were provided by 20 different cheese plants and were of different seasons. From the 91 attributes proposed at the beginning of the study, it was possible to extract 28 key attributes that were the most often quoted or characteristic of a given cheese (Bérodier, Stèvenot, & Schlich, 1997b). This contributed for example to the studies concerning the sensory properties of Comté along with the location of the cows and to confirm the necessity of AOC label (French label equivalent to 'PDO' label) to preserve the sensory quality of such products.

Such an approach (descriptive analysis) was also proposed by Rétiveau, Chambers, and Esteve (2005) as the best way to completely characterize the sensory properties of cheese. These authors developed a general lexicon aimed to be useful for French cheeses. For that purpose, 43 samples of French cheeses were evaluated by a five-assessor panel. The five highly trained assessors completed 120 h of training in all aspects of sensory techniques and a minimum of 1000 h of general sensory testing. They had experience testing a wide variety of dairy products. Additionally to their training they received 6 h of orientation to the reported project. Thirty-one attributes were established, classified in seven categories.

5.2.3. Electronic nose as on-line sensors for cheese-making

It is obvious that such an approach is very time-consuming and does not match necessarily the expectations of cheese makers. In fact, the aroma is of extreme importance as an indicator of quality and product conformity but there is a practical impossibility of employing sensory panels to the continuous monitoring of aroma. Ampuero and Bosset (2003) reported that electronic noses have the potential to fulfil this task. Once they have been calibrated, electronic noses can perform odour assessment on a continuous basis at a low cost. The electronic nose concept is based on the mammalian olfactory system. Once the volatile compounds reach the olfactory epithelium, the interactions of odorants with the appropriate chemosensory receptors, olfactory neurons, produce electrical stimuli transmitted to the brain. It was evidenced that a single olfactory neuron responded to several odorants and each odorant was sensed by multiple olfactory neurons. In the same way, electronic nose base the analysis on the cross-reactivity of an array of semi-selective sensors. The signals are processed via a pattern recognition program. It must be precise that a sampling step remains needed and the training of electronic noses based on sensory panel classifications is required in order to obtain odour-meaningful classifications. Moreover, the biological sensitivity can go down to ppt levels with a response time of milliseconds, whereas instruments barely go under ppb levels with a response time of seconds. Reported applications to dairy products are quite numerous and the authors indicated that classification by the cheese variety was possible. This was done by Jou and Harper (1998) using four different Swiss cheese samples (0% fat, 33% fat, sharp and bland). Five grams of grated cheese were placed in glass vials and incubated at 40 °C. The headspace was purge with compressed air at 250 mL/min and data were recorded during 1 min. Discriminatory analysis produced a correct classification; it was based on the intensity of various acids (acetic, propionic, butyric, isovaleric and hexanoic) which are known as key compounds of Swiss type cheese flavour. When increasing the number of volatiles used for the discrimination it failed. Adequate sampling techniques could improve the signal to noise ratio (use of SPME, a given pH, a given temperature, etc.).

5.3. Wine: typicality due to vine?

Sensory analysis is particularly prevalent in the case of wine. In fact, wine tasting is regularly used to check the quality of wines but surprisingly it is often surrounded by a cloud of mystery. The vocabulary developed by experts for wine tasting is extensive but sometimes more poetic rather than precise. For example, Castillo-Sanchez, Mejuto, Garrido, and Garcia-Falcon (2006) followed the variations of the sensory properties induced by various wine-making protocols. Beside spectrophotometry that was used to measure colour density, the wines were tasted by a sensory panel. The eight experts of this panel were asked to score the colour, the foam, the aroma and the taste of wines obtained with different wine-making processes. The attributes given for aroma were limpidity, intensity and quality. Those for taste were limpidity, body and mouth feel, harmony, length and intensity of aftertaste. This rather simple sensory method was sufficient to check the overall quality of the wines and to select or eliminate some of the wine-making protocols for further studies.

The notion of typicality – as referred to the type of vine that was used or to the location of the vine – was often studied for wines. Unique sensory characteristics are balanced with a large variability due to differences in producers 'know-how' and to seasonal variations (vintages). To assess typicality, one of the recurrent questions is about the use of an expert panel or not. It was reported that experts do not exhibit more sensitivity but they know better to put words on sensations than customers (Bende & Nordin, 1997).

Sensory analysis could be performed for different purposes. For example, Ballester (2004) used it for different steps of his study concerning the typicality of white wines from Chardonnay. White wines from different grapes were presented to a panel of experts and all the Chardonnay wines were recognized as typical of Chardonnay but some wines from other grapes were put in the same category. Then the wines were tested by two different ways: orthonasal and global (orthonasal, retronasal and mouthfeel perceptions). Only the Chardonnay wines were always put in the same category indicating that the typicality of Chardonnay is mainly based on olfactory parameters.

Then olfactometry was used to determine if some specific aroma compounds were responsible of this typicality. The olfactometry technique was applied on dichloromethane extracts and allows determining 101 flavour compounds. PLS Regression was used to determine the correspondences between the typicality and the odorant zones and this allowed identifying different molecules responsible for the typicality of Chardonnay wines.

Two main groups of studies concerning wines will probably be developing in the future:

- Concerning the production of wines with a reduced alcoholic proof without corrupting the sensory quality (colour, bouquet)? As the relationship between alcohol intake and some diseases is well known and as the intake of alcoholic beverages with high proof is decreasing, wines with lower proof will be marketed. There will be a need to determine the best way to produce wines with a reduced alcoholic proof and to assess their sensory quality.

Most conventional methods for producing low and reduced-alcohol wine involve the removal of alcohol from fully fermented wines with membrane or distillation techniques or partial fermentation. As reported by Pickering, Heatherbell, and Barnes (2001), many authors reported that the sensory quality of such products was not satisfactory. An alternative process was proposed (Pickering et al., 2001). This process involves the enzymatic removal of the glucose component of grape juice. These authors quantified the volatile compounds of such reduced-alcohol wines immediately after fermentation by GC–MS. They detected four compounds unique to the reduced-alcohol wine among which 2(5H)-furanone and 4-ethyl-cyclohexa-none. Surprisingly, these wines also appeared to have a higher concentration in esters. Some caution should be applied to interpret these results as analyses were done immediately after fermentation and wine esters are known to hydrolyse in the months after fermentation. As underlined by the authors, further sensory work is needed to elucidate the relationship between the chemical composition and the perceived quality of such products:

- Concerning the improvement of the sensory quality of wines when changing the process or the location of vines. Many countries will prefer to produce locally these high values products rather than import them. The effect of new techniques such as the addition of oak chips instead of aging in oak barrels has also to be checked (del Alamo Sanza, Nevares Dominguez, & Garcia Merino, 2004).

Sensory analysis remains a reference method for such studies.

6. Conclusion

It is known that the perception of the sensory characteristics of a product is related not only to its intrinsic characteristics but also:

- to other parameters such as brand, origin, nutritional facts and price,
- to factors connected with the consumer such as perceptive abilities, memory for foods and other psychological and social aspects.

The mechanisms of sensory perception are not fully elucidated and instrumental analysis cannot replace sensory for every purpose. Nevertheless, some interesting tools are continuously developing that could be at least useful for food control and assessment of the specificity of food products.

It is now put at evidence that mastering a food product implies to integrate all the steps of its production and marketing, from the raw materials to the consumer. The traceability imposed to ensure food safety is also of great importance to improve sensory quality, for traditional foods but also to develop innovative products.

What should not be forgotten is that eating with pleasure leads more rapidly to satiety and consequently may be of some importance for well-being and public health.

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