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History and quality of bread

History and quality of bread

1. History of bread

The history of bread goes hand in hand with the history of man and his evolution. Although it is essentially a poor food itself, it has often been considered symbolically as the essence of well-being. Evidence of the strong bond that man has had and still has with this product remain the works of art of many artists who have depicted it as the core ingredient of banquets.

Initially bread was simply a mixture of water and flour that was placed in the sun for drying; the drying stage was refined in the Neolithic period using heated stones as dough support and hot ash as cover.

As you can see, there was one missing essential stage in bread making in terms of shape and taste: the leavening stage. A stage that was introduced only a few centuries later, precisely in 2500 BC, in ancient Egypt along the banks of the Nile. It is interesting to know that the leavening method has been the result of a casual discovery that marked forever the evolution of bread production. History tells us that during an overflowing of the Nile, the flour stored along its banks came into contact with water and that the temperature, humidity and natural microbial insemination caused the formation of microorganisms that, growing, contributed to the alteration of the appearance, swelling it. This natural process contributed to obtaining a product whose digestibility, taste and preservability were far better than the bread produced and consumed until then.

The leavening method was subsequently adopted and customised by the populations that used products available at various latitudes, such as grape juice for the Greeks or fermented barley (beer) for the Gauls.

But also bread, over the centuries, experienced dark times corresponding to the fall of the Roman Empire and to the consequent dominance of the northern populations that were not inclined toward agriculture.

Only during the Middle Ages and the Risorgimento breadmaking began to grow again, however alongside the first types of sophistication.

In the mid-Sixteenth century, with the advent of brewer's yeast, there was a fierce dispute between Italian bakers, headed by Maria De' Medici, who were strong assertors of the use of this kind of yeast, and French bakers who, on the contrary, used mother yeast. The dispute became so harsh that the king decided to summon doctors of his trust to determine if the brewer's yeast could actually be harmful. Their response was unique, they sentenced that brewer's yeast was dangerous. But the fact that the king, Maria De' Medici and noblemen consumed only bread prepared from brewer's yeast, actually ended the dispute in favour of Italian bakers.

The real revolution took place in the Eighteenth and Nineteenth centuries, when scientific discoveries and industrial evolution granted the basis for modern breadmaking.

The most important developmental steps in the bakery sector can be summarised in three stages:

- switch from millstones to cylinder ones that ensured a better refined flour;
- introduction of mechanical kneading machines and electric ovens that facilitated significantly the production stages;
- introduction of industrial yeast that allows the use of the direct mix and hence a greater practicality.

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In Italy, raw material for bread production, unlike what has happened in modern times, was not soft wheat, but the typical cereal of the Mediterranean area or durum wheat. Still today, in the Southern regions of Italy, Sardinia, Sicily, Apulia and Calabria, it is common practice to produce bread from durum wheat flour, commonly referred to as "rimacinata" (double milled).
Examples of typical breads of these areas are Altamura (Apulia), Matera (Basilicata), Cutro (Calabria) and Carasau (Sardinia).

2. Bread and bakers in ancient Rome

Among the various foods consumed in ancient Rome, bread is one of the most documented by literary sources, frescoes and bas-reliefs depicting the stages of preparation and sale, and even by the charred loaves found among the ruins of Pompeii.
From Pliny the Elder we know that bread was known relatively late by the Romans, accustomed to eating unleavened bread and *Polta*, a thick soup made of wild grains, legumes and, when available, meat. The most appreciated grain was spelt, while rye and oats were not much esteemed, and barley indeed was considered fit only for slaves and soldiers. The first type of wheat used for making bread was therefore spelt from whose seeds, lightly toasted and grounded to liberate them from the chaff, Romans obtained the *farrina* (hence the term "flour" went on to state the product of the milling of any grain). Around the late Fifth century BC appeared new hard and soft grains, probably originating from Sicily and Africa, of higher quality and more readily releasable from the chaff, which allowed a rapid improvement in terms of softness and acidity. The use of mills facilitated the grinding and the advances in sieving methods allowed the differentiation in flour and semolina quality. Generally the Roman bread was known for its hardness, due to poor quality flour (absorbing less water) and poor quantity and quality of the yeast used (prepared once a year at grape harvest time from grape juice and dough). There were, however, numerous types and sizes of bread, according to different end use, dough and baking methods. Superior quality flour (*siliga*) was used to produce the *panis siligineus*. Depending on the sieving methods, *panis cibarius*, *secundarius*, *plebeius* and *rusticus* were prepared. A sort of long lasting biscuits were the *panis militaris castrensis* (reserved for soldiers) and the *panis nauticus* (reserved for sailors); a quite hard bread was the *panis autopyrus* (wholemeal), not to mention the *panis furfureus*, reserved for..... dogs! A softer but less widespread type was the *panis parthicus*, also called *aquaticus* because it was spongy and able to absorb a greater quantity of water. Among the different types of dough, those in use in rural areas included legumes, acorns, chestnuts and other "poor" ingredients, while there were others more expensive and refined based on spices, milk, eggs, honey, oil; a luxury bread was the *artolaganus*, containing honey, wine, milk, oil, black pepper and candied fruit. The various baking methods gave rise to the *panis furnaceus* (oven baked), the *artopticus* (home baked under a lid), the *subcinerinus* or *fucacius* (baked under the ashes) and the *clibanicus*, a flat bread baked on the outer wall of a hot pot. There were loaves of elongated shape and round loaves, with scoring to facilitate the separation into four parts (*quadrae*, hence *panis quadratus*). As the grinding methods, flour sieving, preparation and baking of bread were becoming more

sophisticated, the production moved from a family to an "industrial" scale, thanks to the work of skilled artisans (according to Pliny, from 171 BC). The name *pistores*, originally reserved for slaves used for grinding spelt in the mortar, came to designate the actual bakers, who at first were mostly freedmen and lower class citizens. The bakers then obtained privileges and immunities from the public authorities and even a contribution by the state to start their business. They created their own corporation, the *collegium pistorum*, and concluded profitable contracts to supply bread to the authorities and for free distribution to the people. Hece, a baker could also make a fortune, as happened for example to the freedman Marcus Vergilius Eurysaces, whose tomb in Larger Gate (Rome) shows in the reliefs of the frieze the different stages of breadmaking, from grinding and flour sieving, to dough mixing and baking of bread. A special monument to celebrate one of the oldest and most popular jobs.

3. How to make bread

The baking methods currently used are numerous and differentiated from each other according to the type of final product to be obtained.

The result of the product is strongly influenced by two essential factors:
- ingredients;
- technologies used.

As far as the ingredients are concerned, the quality and type of flour, the characteristics of water and salt are of great importance.
From a technological point of view, the mixing, resting, leavening and baking stages are the most important operations in the baking process.

MIXING

Technological innovations have allowed the machines to replace the human hands, in particular the kneading machines, that can be of three different types:
1) twin arms with different speeds, 28 or 50 rpm. The first one requires about 25-30 minutes to knead the dough, while the second one takes about 15-20 minutes;
2) single arm, running at 60-120 rpm, allowing to prepare the dough in about 15 minutes;
3) high speed kneaders that allow to get the dough in about 40-70 seconds.

The ingredients used to make the dough are: flour, water, salt, yeast and other optional ingredients.
During processing, the protein fractions gliadin and glutenin, coming into contact with water, form gluten. Factors that determine the formation of gluten are the dough mixing time and the subsequent proofing. At the same time carbon dioxide is formed as a result of the fermentation process. The development of gluten and carbon dioxide must occur at the same time for the making of a good dough.

PROOFING

The resting stage, differently from what it might sound, requires the working of the dough for short or long intervals according to the type of flour used; for weak flours, the intervals are longer compared to strong flours. The purpose of the operation is to eliminate excess carbon dioxide from the dough,

secondly to enrich the dough with air to favour fermentation and to strengthen the gluten, hence allowing for a better consistency of the dough.

LEAVENING METHODS

Three types of yeast are used in baking:
- natural yeast;
- compressed yeast;
- biga or leftover dough.

Leavening is the most important step in the baking process to get a quality product. In fact, as a result of the expansion of gas produced by the biochemical action (fermentation) of certain species of microorganisms, during the proofing of the dough several changes take place that, after baking, give bread its characteristic smell, taste, softness and tenderness.

Natural yeast or mother yeast was the first leavening system adopted since ancient times when bread was homemade. It consisted in the preparation of a dough to which, according to traditions, fermented milk, honey, beer and dried fruits such as grapes, plums and figs were added, in order to start a process of microbial growth representing the "mother", a sort of mixed culture medium of microorganisms, wild yeasts, and lactic (*L. sanfranciscensis*, *L. pontis*, *L. panis*, *L. plantarum*, *L. brevis*, *L. reuteri*) and propionic bacteria.

Mother yeast requires special care for its storage in vats covered with a well-cleaned cotton cloth and for frequent flour replenishment to develop microorganisms.

In the past, mother yeast was kept at home and the preparation was handed down from mother to daughter; part of the mother yeast was used daily for the production of bread and the rest was kept in the vats.

In case of "illness" of the mother yeast, it was necessary to eliminate it and seek help from neighbours who still had a "healthy" mother yeast.

This type of yeast is still used nowadays by those bakeries who want to offer a traditional bread in terms of smell and taste to their customers.

In Italy, differently from other countries, there is no legislation protecting the tradition of this technique through a definition of mother yeast. On the basis of French law, we have tried to make a definition of natural yeast, adapting it to the traditional practice existing in Italy, in other words "a dough consisting of soft or durum wheat flour, water, and possibly salt which is subjected to a spontaneous acidifying fermentation, free from a voluntary addition of microorganisms, and obtained thanks to a subsequent series of additions to ensure an adequate leavening capacity".

Like the pure leavening (compressed yeast), also the natural leavening produces: carbon dioxide, alcohol and water vapour, substances that allow the development of the dough and the formation, especially in baking, of the characteristic porous structure; this action is largely due to yeast.

Specifically, with natural leavening, it is possible to denature certain compounds present in the flour, such as starch and proteins, with the formation of simpler substances (amino acids, organic acids, aromatic substances and enzymes) that impart a higher acidity, an amber colour, a characteristic smell and taste to the finished product.

Due to the presence of an extremely heterogeneous microflora, linked to the microflora of the environment where bread is produced and the considerably longer

production times, compared to brewer's yeast, mother yeast offers several advantages that can be summarised as follows:

- richer aroma;
- better flavour;
- slower hardening process;
- nutritional quality (higher digestibility and assimilability).

Other bakers prefer to use compressed yeast, once called brewer's yeast due to the raw material from which it was produced, for a greater ease of use and a quicker preparation though affecting quality.

Compressed yeast, unlike mother yeast characterised by the presence of a mixture of yeasts and microorganisms, is made up of a virtually pure culture of *Saccharomyces cerevisiae*.

Compressed yeast is used with a direct kneading system in which flour, yeast and water are added at the same time: in this case, the production process is extremely rapid as the leavening time depends on the greater or lesser amount of yeast.

As an intermediate system, between the traditional mother yeast and the compressed yeast, the baker nowadays often resorts to a mixed system preparing, the evening before, a dough, called "biga", that represents a kind of mother yeast, and adding it the following morning to flour and compressed yeast to make bread (indirect leavening).

BAKING

The final stage is the baking of the dough. Most types of bread are steam cooked; this method allows the film developed during the rising stage to remain intact and to prevent the premature cooking of the crust. It also allows the dough to increase its volume as much as possible and to obtain a beautiful shape. The ovens used can be of two categories: fixed stand and mobile stand ovens. Cooking takes place indirectly, since the direct heating ovens, used a long time ago, are considered dangerous because of the presence of fuels in the cooking chamber, directly in contact with the bread. The only exceptions are wood-fired ovens.

The baking operation is carried out using peels or mechanical systems, by means of trays. The internal oven temperature can range between 200°C and 275°C.

The high temperature of the oven result in physical, chemical and biological changes to the dough, making it possible to obtain a product with excellent nutritional and organoleptic properties.

4. Bread shapes

The typicality of bread depends on its shape, volume and flavours traditional of the areas of origin that contribute to making it unique. Bread types can be distinguished by:

- main ingredients;
- additional ingredients characterising its taste and enriching its content;
- leavening method;
- shape.

Undoubtedly, apart obviously from its taste, shape characterises bread and makes it unique. In fact, bread has inherited the feature of being symbolically considered as a basic element for the existence of mankind and vital elements were also deity and sex. Therefore bread, or better the dough, ductile, yielding, elastic, has allowed the producers to model it in shapes recalling symbolic or natural elements, such as

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flowers or animals, but also to reproduce other shapes. The shaping of bread implied a knowledge of the kneading methods, since a good product is affected by a proper crust/crumb ratio.
Originally, also the size, like the raw materials and the type of leavening, was a feature of social distinction. In fact, the larger loaves were destined for the lower class, since it had a longer durability, required a shorter time and a lower effort in the preparation. On the other hand, in noble families, the possibility of having dedicated staff ensured to have fresh bread every day, allowing the bakers to produce small sized and funny shaped loaves.

5. Bread quality

Flour quality, yeast consisting of different types of microorganisms (yeasts and lactic bacteria) and prolonged leavening times confer to bread obtained with mother yeast characteristics completely different from those of bread obtained with the use of compressed yeast that, in organoleptic and nutritional terms, can be summarised in:

- a longer shelf life of the product, due to the higher acidity of the dough that allows a sort of inhibition in mould development;
- finer and more regular bubbles, due to a slower and more gradual carbon dioxide production caused by a longer duration of the leavening stage;
- characteristic taste and smell of bread exalted by the formation of aromatic compounds during baking between amino acids and sugars, occurring in long and diversified leavening;
- increased digestibility and assimilability since the enzymatic action of prolonged biological leavening causes a sort of technological predigestion of bread, hence facilitating the overall digestion.

6. Special bread, traditional products

The National Institute of Rural Sociology (Insor), in 1995, has published the *Atlas of traditional products*: *Bread,* describing about 200 types of bread "... originating from ancient, proven experiments based on acid fermentation: an example of the artisan loyalty of our bakers".
The 200 different types of bread described are however a small sample of what is produced in Italy. In fact, considering the various names and/or synonyms, the estimate grows to about 1,500 types of bread.
The typicality of Italian bread can be safeguarded and valorised through a product certification provided for by Regulation (EC) No. 510/2006 on the protection of designations of origin and geographical indications of foodstuffs, more commonly known under PDO and PGI.
To date, this recognition has only been requested and granted by the European Union to a few types of bead: Altamura Bread PDO, Dittaino Loaf PDO, Tuscan Bread PDO, Genzano Homemade Bread PGI, Couple Ferrarese PGI and Matera Bread PGI.

ORGANIC BREAD

Organic bread is made from flours obtained from cereals organically grown, i.e. without the use of fertilisers and synthetic pesticides, and in accordance with the provisions of Regulation (EC) No. 834/2007. The different fertilisation techniques applied in the organic cultivation system affects the protein content

of wheat and, in turn, of bread. Proteins are present to a lesser extent and this may be reflected on the baking process, resulting in a product with a lower development. However, the organic method seems to affect the quality of cereals both in terms of protein and secondary metabolites (antioxidants). Studies carried out by some researchers have shown that there is a higher amount of antioxidants and mineral compounds than in conventionally grown wheat. If confirmed by further research, bread obtained from organic flour could be considered as a possible source of such compounds. Also from the organoleptic point of view, there seems to be a positive appreciation of organic bread by consumers. Some studies on Swedish consumers, that were asked to evaluate conventional and organic bread, have shown that tasters found the organic product more appreciable. Organic bread was characterised by an aroma of "cereals", a more pronounced flavour and acidity, while the conventional one had a sweeter taste, more elasticity and a crispier crust.

7. Ancient wheat varieties

Modern agriculture, characterised by intensive systems, favours the use of wheat varieties with high crop yields and technology. This trend has resulted in a progressive depletion of cultivated germplasm, with the consequent loss of local varieties in favour of few modern varieties. The high production of these varieties requires high crop inputs in terms of fertilisers, fungicides and herbicides, and, consequently, consistently high production costs and environmental pollution risks (Austin et al., 1980). With the development of more environmentally-friendly cultivation systems, such as the organic one, there has been a progressive rediscovery and protection of ancient varieties. Many of these (Gentil Rosso, Rieti, Risciola) are descendant of local varieties already mentioned in the Nineteenth century and in ancient times in many Italian regions; others (Mentana and Senatore Cappelli) are derived from a selection work made from the 1920s by some researchers including Nazareno Strampelli. Ancient varieties, thanks to the greater rusticity and adaptation to the growing environment, although often have lower productivity in terms of granular yield, are generally able to guarantee their stability over the years. Thanks to a higher size, making them more susceptible to bending, they are able, precisely for this reason, to compete better with weeds.

The recovery work of these varieties must include their identification and characterisation, as well as keeping them in purity. In Italy, there are already some examples of valorisation of ancient wheat varieties. In Emilia Romagna, the *Pan di Montagna* is produced from ancient varieties, often cultivated without fertilisers. The results are encouraging both from the point of view of productivity and organoleptic quality, assessed through a panel test. In the province of Benevento, local growing groups have been established for the production of Senatore Cappelli and Gentil Rosso wheat; the province of Siena has activated the *Grain-to-Bread* project using some ancient varieties. Other examples of short chain production with these varieties are also found in Veneto (Canove and Piave) and Basilicata. The research carried out by the Universities of Bologna and Florence (Di Silvestro et al. 2011) compared different modern and ancient varieties; some of the latter ones, with a productivity comparable to modern ones,

show a higher fibre and antioxidant content (polyphenols and flavonoids). Other studies have shown the greater amount of bioavailable folic acid in ancient varieties (Fenech et al., 1999; Piironen et al., 2008). The amount of folic acid contained in the grain would appear to be significantly higher than that present in fruit and vegetables, contributing for about 50% of the recommended daily allowance of this vitamin as a primary prevention of cardiovascular disease.
Therefore, it seems to be of great importance to identify the most naturally rich chains of these beneficial for health substances. The goal is to achieve, in a healthy way and only through the diet, the minimum amount of some essential food components for the prevention of chronic diseases, particularly those affecting the cardiovascular system (Slavin, 2004). A recent study at the University of Florence (Sofi et al., 2010) showed a significant improvement in cardiovascular risk parameters (total cholesterol, LDL cholesterol and intra-erythrocyte folic acid) after a period of dietary intervention with bread and pasta derived from Verna wheat.
Other studies carried out at the University of Wageningen in the Netherlands (van den Broeck, 2010) have compared modern varieties to local ones in terms of the presence of certain substances considered responsible for triggering the allergic reaction in celiac disease. The results show how the selection process of modern varieties has led to a higher frequency of these compounds causing an increase in consumer exposure towards them. These are some of the varieties of soft wheat intensely cultivated in Italy until the postwar period: Abbondanza, Autonomia, Bianco Nostrale, Frassineto, Gentil Bianco, Gentil Rosso, Marzuolo, Mentana.

8. How to choose quality bread

At the time of purchase, good bread made from quality flour and natural leavening shows a characteristic smell and taste, while bread obtained with the direct system has no distinctive properties, but it is rather odourless and tasteless. Moreover, bread made with compressed yeast and the direct system has a very limited shelf life, hardening or becoming chewy within a few hours in the event that improvements have been used (additives). On the other hand, bread made with mother yeast has a greater preservation of the typical characteristics, originating from freshly baked bread.

9. Bread: health benefits

In a balanced diet, about 60% of calories should come from carbohydrates, most of which should be in the form of complex carbohydrates. The importance of these compounds is due to the fact that they are absorbed more slowly than the simple ones (sugar), forming a long lasting energy reservoir for the body. It is precisely so that bread, a staple food, reveals all its nutritional importance. In the composition of bread, in fact, complex carbohydrates, mainly starch, account for about 50-60%. Then, there are fibres, especially in wholemeal bread, whose function is essentially that of regulating certain physiological functions of the body (good functioning of the gastrointestinal tract, regulation of the absorption of sugars and fats). Protein intake is rather modest (about 10%) and it is characterised by a low content in some essential amino acids (lysine). The vitamins present are essentially those of group B, the minerals are especially sodium,

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phosphorus, calcium and iron (higher in wholemeal bread). The fat content, except for bread rolls with milk and oil, is virtually nil. A 100 g portion of bread provides approximately 270 kcal, increasing to 300 kcal in the case of bread rolls with milk and oil.

LOW SALT BREAD

Several epidemiological studies have shown that excessive salt intake, due to the presence of sodium, causes an increase in blood pressure (hypertension) resulting in an increased risk of severe cardiovascular diseases, such as myocardial, cerebral and kidney stroke. High salt consumption is also associated with higher risk of stomach cancer, increased urinary calcium loss, and therefore a higher risk of osteoporosis.
Among daily foodstuffs, bread is certainly one of the main sources of salt because of its use as an ingredient (2% added to flour equaling to 0.8% in the finished product) and for its widespread consumption (66 g per capita per day).
This is why the Italian Ministry of Health promoted a special protocol with the bakery sector with the aim of reducing salt intake through a change in daily dietary habits. The "Guadagnare salute" program therefore provides for a gradual reduction in salt content in bread by 5% in three years until a total reduction of 15% is achieved.

NUTRITION FACTS LABEL

In recent years, food has become increasingly important for the consumer because of its positive repercussions in preventing the so-called "industrial civilisation" diseases such as cardiovascular disease, hypertension and cancer. Fundamental therefore becomes the role that individual foods, with their chemical composition, have on dietary choices that consumers have to take into account when defining a balanced and healthy diet.
In this context, nutrition facts, even though optional for common foods, is becoming increasingly important in the label of packaged foodstuffs. It is a manufacturer's spontaneous declaration of nutrient content and energy intake what appears on the label.
Nutrition facts become mandatory when advertising specific nutritional aspects such as "low fat" and dietary products.
In general, nutritions facts are given through a table listing the energy value and the fat, saturated fats, carbohydrate, sugars, dietary fibre, protein and salt content.

Values refer to 100 grams or 100 ml of product and per serving or per unit or per piece.
Nutrition facts can be supplemented by a percentage, per 100 grams or per serving, of each nutrient in terms of the recommended daily allowance.
Among the packaged foods, nutrition facts are widespread in breakfast cereals and bakery products.

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Hereunder, an example of nutrition facts for common bread type 0.

Nutrition facts for bread type 0

Average values	per 100 g	per slice (50 g)
Energy kcal	275	122
kJ	1151	575
Fat g	0,5	0,2
- of which saturates g	0,0	0,0
Carbohydrate g	63,5	31,7
- of which sugars g	2,0	1,0
Dietary fibre g	3,8	1,9
Protein g	8,1	4,0
Salt g	0,8	0,4

Sensory analysis of bread

Sensory analysis of bread

1. Principles of sensory evaluation

Sensory analysis is a method for determining the organoleptic characteristics of food products through the use of all five human senses (Figure 1).

Analytical tests are laboratory tests that are carried out using experienced and / or trained tasters; they are used to evaluate differences or similarities between two or more samples as well as for the identification and quantification of sensorial descriptors.

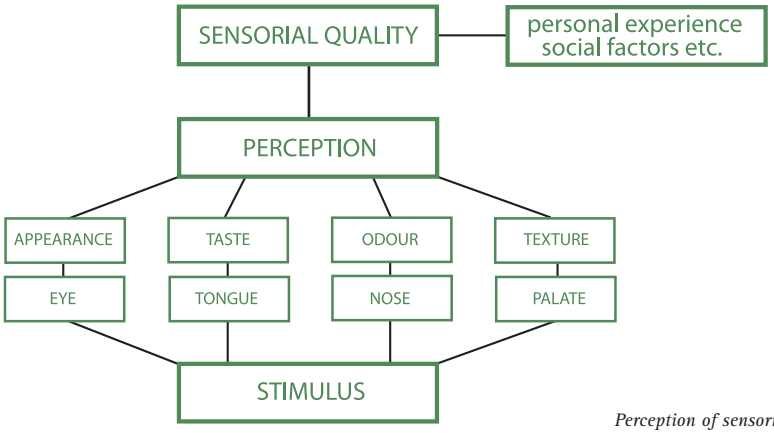

Figure 1
Perception of sensorial quality

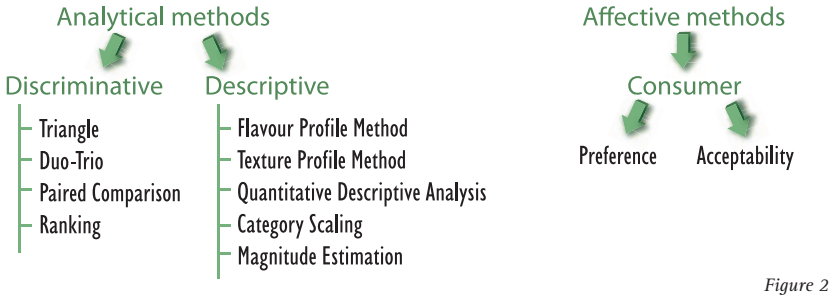

Figure 2
Classification of sensory evaluation methods

Sensory tests are classified into two main groups: “analytical” tests that, in turn, are divided into descriptive and discriminative, and “affective” tests, i.e. preference and acceptability (Figure 2).

Discriminatory analytical methods give an answer to the question “Is there a significant difference between products?” To get relevant results, this kind of test requires 25 to 50 evaluations.

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Descriptive analytical methods give an answer to the question "What is the difference and how wide is it?" These tests are conducted on a small number of participants, 6 to 12, depending on their degree of experience.
The affective tests, finally, allow you to determine whether the differences between the products are important for the consumer and affect their acceptability and therefore their purchase.
The classification of the sensory methods, according to the above mentioned three categories, each one with specific goals, requires a different degree of qualification of the participants, distinguished in panel and consumer, to distinguish between objectivity and subjectivity of the sensory evaluation (Figure 3).

PANEL

- selected or professional tasters
- trained
- work as analytical instruments
- answer to discriminative and descriptive tests
- group: 6-12 tasters

CONSUMER

- consumers selected at random
- untrained
- represent a target population
- express only preference or acceptability opinions
- group: 100-500 consumers

Figure 3

Analytical tests are performed by a panel of 6 to 12 qualified tasters, while affective tests are performed by consumers, in other words by a target group representing a certain population of 100 to 500 untrained people.

Descriptive tests imply qualitative and quantitative description of the sensory characteristics of a product by a panel of qualified tasters. In addition to being able to express verbally their perceptions of taste, flavour and aroma, they have to evaluate the intensity and differences of each category of product assessed.

The evaluation stages are essentially three:
- selection of descriptors;
- panel calibration;
- estimate of the intensity of the descriptors.

In the first stage, a panel of experts selects the adjectives that best describe the products to be evaluated.
In the second stage, preliminary tests are performed on standard products allowing panel calibration

Finally, a quantitative evaluation of each qualitative descriptor, expressed with a common numeric scale that, most often, ranges from 0 to 10.

Sample analysis involves a visual examination (appearance), followed by the olfactory evaluation (aroma) and taste.

As far as taste is concerned, it has to be noted that sensations are perceived mainly by the tongue through taste buds that allow to recognise the four basic tastes: sweet, sour, salty and bitter (Figure 4).

Sensory analysis of bread

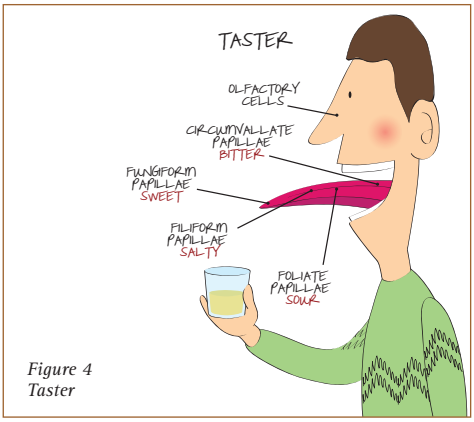

Figure 4
Taster

2. Bread evaluation

Initially, defects are defined because, if present, would lead to the exclusion of the product from the subsequent evaluation stages (Table 1). The selection of descriptors describing the product was carried out by a panel of experts, who developed the list according to the product characteristics (Table 2).

Table nº 1

BREAD DEFECTS

A. Visual evaluation
1. On the crust: dark-burned colour due to excessive baking;
2. On the crumb: stickiness due to microbial spoilage;
3. Under crust: separation of crust from crumb (apart for limited areas).

B. Olfactory evaluation
1. On the whole product: stale, mould or other off odours.

C. Gustatory evaluation
1. On the crumb: bitter or excessively sapid;
2. On the crumb: excessively acid.

D. Structural evaluation
1. On the crumb: excessively compact.

Table nº 2

POSITIVE BREAD ATTRIBUTES

A. Visual descriptors
1. Colour: characteristic golden colour of the crust;
2. Rising: indirect measure of the crumb porosity;
3. Holes: characteristic of crumb porosity;
4. Humidity: sensation of humid crumb perceived with hands or lips.

B. Olfactory descriptors
1. Overall odour: general term used to indicate the complete set of sensations perceived through the nose;
2. Fragrance: olfactory intensity of freshly baked bread (index of freshness);
3. Stale: odour of stale or old bread;
4. Roasted: odour associated with a well cooked bread, toasted;
5. Cereals: odour characteristic of the cereal or cereals used.

C. Gustatory descriptors
1. Sweet: basic taste characteristic of sugars that are formed during proofing, perceived mainly on the tip of the tongue;
2. Sour: basic taste characteristic of the organic acids that are formed during

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proofing, perceived mainly on the sides and under the tongue;
3. Bitter: basic taste characteristic of anomalous fermentations during proofing or product defects, perceived at the back of the tongue, unless included in product specifications;
4. Overall sensations: overall aromatic and trigeminal sensations perceived;
5. Cereals: typical sensations of the cereals used.

D. Structural descriptors

1. Hardness: resistance to chewing;
2. Crunchiness: crumbling of the crust evaluated by breaking the crust with the hands and biting it;
3. Cohesiveness: deformation/crumbling of the crust, evaluated by breaking the crust with the hands.

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