

# Chapter 1

## History and Social Aspects of Sourdough

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### 1.1 Sourdough: The Ferment of Life

The history of sourdough and related baked goods follows the entire arc of the development of human civilization, from the beginning of agriculture to the present. Sourdough bread and other sourdough baked goods made from cereals are examples of foods that summarize different types of knowledge, from agricultural practices and technological processes through to cultural heritage. Bread is closely linked to human subsistence and intimately connected to tradition, the practices of civil society and religion. Christian prayer says “Give us this day our daily bread” and the Gospels report that Jesus, breaking bread at the Last Supper, gave it to the Apostles to eat, saying, “This is my body given as a sacrifice for you”. Language also retains expressions that recall the close bond between life and bread: “to earn his bread” and “remove bread from his mouth” are just some of the most common idioms, not to mention the etymology of words in current use: “companion” is derived from *cum panis*, which means someone with whom you share your bread; “lord”, is derived from the Old English vocabulary *hlaford*, which translates as guardian of the bread [1]. The symbolic assimilation between bread and life is not just a template that has its heritage in the collective unconscious, but it is probably a precipitate of the history of culture and traditions. Throughout development of the human civilization, (sourdough) bread was preferred over unleavened cereal products, supporting

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the hypothesis of a precise symbolism between the idea of elaborate and stylish, and that of sourdough. Fermentation and leavening makes bread something different from the raw cereals, i.e. an artifact, in the sense of “made art”. Besides symbolism, sourdough bread has acquired a central social position over time. Bread, and especially sourdough bread, has become central in the diet of peasant societies. This suggests that the rural population empirically perceived sensory and nutritional transformations, which are also implemented through sourdough fermentation. In other words, the eating of bread, and especially of sourdough bread, was often a choice of civilization.

The oldest leavened and acidified bread is over 5,000 years old and was discovered in an excavation in Switzerland [2]. The first documented production and consumption of sourdough bread can be traced back to the second millennium B.C. [3]. Egyptians discovered that a mixture of flour and water, left for a bit of time to ferment, increased in volume and, after baking along with other fresh dough, it produced soft and light breads. Much later, microscopic observations of yeast as well as measurements of the acidity of bread from early Egypt demonstrate that the fermentation of bread dough involved yeasts and lactic acid bacteria – the leavening of dough with sourdough had been discovered [4]. Eventually, the environmental contamination of dough was deliberately carried out by starting the fermentation with material from the previous fermentation process. Egyptians also made use of the foam of beer for bread making. At the same time, Egyptians also selected the best variety of wheat flour, adopted innovative tools for making bread, and used high-temperature ovens. The Jewish people learned the art of baking in Egypt. As the Bible says, the Jews fleeing Egypt took with them unleavened dough.

In Greece, bread was a food solely for consumption in wealthy homes. Its preparation was reserved for women. Only in a later period, does the literature mention evidence of bakers, perhaps meeting in corporations, which prepared the bread for retail sale. The use of sourdough was adopted from Egypt about 800 B.C. [4]. Greek gastronomy had over 70 varieties of breads, including sweet and savoury types, those made with grains, and different preparation processes. The Greeks used to make votive offerings with flour, cereal grains or toasted breads and cakes mixed with oil and wine. For instance, during the rites dedicated to Dionysus, the god of fertility, but also of euphoria and unbridled passion, the priestesses offered large loaves of bread. The step from the use of sacrificial bread to the use of curative bread was quick. Patients, who visited temples dedicated to Asclepius (the god of medicine and healing), left breads, and, upon leaving the holy place, received a part of the breads back imbued with the healing power attributed to the god [5, 6].

The use of sourdough is also part of the history of North America. The use of sourdough as a leavening agent was essential whenever pioneers or gold prospectors left behind the infrastructure that would provide alternative means of dough leavening. Examples include the Oregon Trail of 1848, the California gold rush of 1849, and the Klondike gold rush in the Yukon Territories, Canada, in 1898. During the 1849 gold rush, San Francisco was invaded by tens of thousands of men and women in the grip of gold fever. Following the gold rush, sourdough bread remained an element that distinguishes the local tradition until today. Some bakeries in San Francisco claim to use sourdough that has been propagated for over 150 years. The predominant

yeast in San Francisco sourdoughs is not brewer's yeast but *Kazachstania exigua* (formerly *Saccharomyces exiguus*), which is tolerant to more acidic environments. *Lactobacillus sanfranciscensis* (formerly *Lactobacillus brevis* subsp. *lindneri* and *sanfrancisco*) was first described as a new species in San Francisco sourdough [7]. The use of sourdough during the Klondike gold rush in 1898 resulted in the use of "sourdough" to designate inhabitants of Alaska and the Yukon Territories and is even in use today. The Yukon definition of sourdough is "someone who has seen the Yukon River freeze and thaw", i.e. a long-term resident of the area.

From antiquity to most recent times, the mystery of leavening has also been unveiled from a scientific point of view. The definitive explanation of microbial leavening was given in 1857 by Louis Pasteur. The scientific research also verified an assumption that the Greeks had already advanced: sourdough bread has greater nutritional value. Pliny the elder wrote that it gave strength to the body. The history and social significance of the use of sourdough is further described below for countries such as France, Italy and Germany where this traditional biotechnology is widely used, and where its use is well documented.

## 1.2 History and Social Aspects of Sourdough in France

The history of sourdough usage in France was linked to socio-cultural and socio-economic factors. There is little information about sourdough usage and bakery industries (it seems to be more appropriated than baking), in general, in France before the eighteenth century. It seems as if sourdough bread was introduced in Gaul by the Greeks living in Marseille in the fourth century B.C. In 200 B.C., the Gauls removed water from the bread recipe and replaced it with *cervoise*, a drink based on fermented cereal comparable to beer. They noticed that the cloudier the *cervoise*, the more the dough leavened. Thus, they started to use the foam of *cervoise* to leaven the bread dough. The bread obtained was particularly light.

During the Middle Ages (400–1400 A.D.), bread making did not progress much and remained a family activity. In the cities, the profession of the baker appeared. The history of bread making in France was mainly linked to Parisian bakers because of the geographic localization of Paris. The regions with the biggest wheat production were near Paris, and Paris had major importance in terms of inhabitants. In that period, the production of bread was exclusively carried out using sourdough fermentation, the only method known at that time. Furthermore, the use of sourdough, thanks to its acidity, permitted baking without salt, an expensive and taxed (*Gabelle*) raw material, and allowed one to produce breads appropriate for eating habits in the Middle Ages [8].

The seventeenth century marked a turning point in the history of French bakery. Until then, sourdough was used alone to ensure fermentation of the dough even if in some French regions wine, vinegar or rennet was added. Toward 1600 A.D., French bakers rediscovered the use of brewer's yeast for bread making. The yeast came from Picardie and Flanders in winter and from Paris breweries in summer. The breads

obtained with this technique were named *pain mollet* because of the texture of the dough, which was softer than the bread produced up to that point (*pain brie*). Two French queens, Catherine de Medicis (Henri II's wife) and Marie de Medicis (Henri IV's wife) contributed to the success and development of these yeast-fermented breads. In 1666, the use of brewer's yeast was authorized for bread making but, after a great deal of debate, in 1668, the use of brewers' yeast was prohibited. Following the request of Louis XIV, the Faculty of Medicine of the Paris University studied the consequences of yeast usage on public health. According to the doctors, yeast was harmful to human health, because of its bitterness, coming from barley and rotting water. Despite this negative conclusion by the Faculty, Parliament, in its decision of 21st March 1670, authorized the use of brewer's yeast for bread making in combination with sourdough. Besides the apparition of yeast in bread making, during that period, eating habits evolved towards less acidic foods. Thus, back-slopping techniques were adapted in order to reduce bread acidity [9].

The seventeenth century was also a period of development of the French philosophic and encyclopaedic mind and, fortunately, bread making did not escape this movement. Two books detail the art of bread making and provide information on bread-making techniques and knowledge of that period: "L'Art de la Boulangerie" [10] and "Le Parfait Boulanger" [11]. We have already learned that sourdough was obtained from a part of the leavened dough prepared on the day in question. The volume of this dough piece is progressively increased through addition of flour and water (back slopping) to prepare a sourdough that is ready to be used to ferment the dough. The original piece of dough, called *levain-chef*, must not be too old or too sour. The weight of the *levain-chef* is doubled or tripled by addition of water and flour leading to the *levain de première*. After 6 or 7 hours of fermentation, water and flour are added to give the *levain de seconde*, which is fermented for 4 or 5 hours. Again, water and flour are added. The dough obtained is called *levain tout point* and after 1 or 2 hours of fermentation is added to the bread dough. This technique called *travail sur 3 levains* was recommended by Parmentier [11], who imputed the bad quality of Anjou bread to bread making based only on one sourdough. Bread making based on two or three sourdoughs was predominantly used in that period. In addition, it was understood that outside Paris, bread was mainly produced at home by women. It is interesting to note that Malouin had already made the distinction between sourdough and artificial sourdough in 1779 [10]. Artificial sourdough refers to sourdough obtained from a dough that may contain yeast. This distinction between sourdough and artificial sourdoughs remained in the nineteenth century.

Until 1840, the yeast was always used in association with sourdough to initiate fermentation. On this date, an Austrian baker introduced a bread-making process in France based on yeast fermentation alone. This technique was called *poolish*. The bread obtained, called *pain viennois*, had much success but use of this method remained limited. In the middle of the nineteenth century, bread making based on three sourdoughs progressively disappeared and was replaced by bread making based on two sourdoughs. Indeed, the back slopping, necessary to maintain the fermentative activity of sourdoughs, imposed a hard working rhythm on the bakers. In 1872, the opening of the first factory for the production of yeast from grain fermentation in France by

Fould-Springer facilitated the development of bread making based on yeast to the detriment of sourdough bread making. This yeast was more active, more constant, with a nice flavour and most of all had a longer shelf life than brewer's yeast. As a consequence, from 1885, bread making based on polish fermentation was becoming more wide spread. Sourdough bread was, from that time on, called French bread.

In 1910, a bill that prohibited night work and, in 1920, the reduction of working hours, necessitated modification within fermentation processes. Sourdough bread making regressed to a greater and greater extent in the cities when bread making based on three sourdoughs totally disappeared even though, in 1914, the first *fermentôlevain* appeared. After the First World War, the use of yeast was extended from Paris to the provinces. Indeed, yeast that was produced on molasses from 1922 had a better shelf life and was thus easier to distribute over long distances. However, homemade loaves were still produced, even though they no longer existed in the cities, in the country until 1930 in the form of the *levain chef*, kept in stone jugs, and passed on from one family to another. The return of war in 1939 led to a further reduction in the use of homemade sourdough bread. In 1964, Raymond Calvel [12] wrote that "sourdough bread making does not exist anymore". Indeed, baker's yeast was systematically added to promote dough leavening, which permitted one to obtain lighter breads. In addition, the use of baker's yeast permitted one to better manage bread quality and to reduce quality variations. Two sourdough bread-making methods remained in this period. The first was a method based on two sourdoughs, which was mainly used in West and South Loire, and the second, more commonly used, method was based on one sourdough with a high level of baker's yeast. Between 1957 and 1960, the sensory qualities of bread decreased as a consequence of cost reduction. Fermentation time was reduced to a minimum. Sourdough bread was no longer produced. It was only during the 1980s that sourdough bread making gained popularity again thanks to consumer requests for authentic and tasty breads. Since 1990, the availability of starter cultures facilitated the re-introduction of sourdough in bread-making processes. Indeed, these starters permit one to obtain a *levain tout-point* with a single step and simplify the bread-making process. A regulation issued on 13th September 1993 [13] defined sourdough and sourdough bread. According to Article 4, sourdough is "dough made from wheat or rye, or just one of these, with water added and salt (optional), and which undergoes a naturally acidifying fermentation, whose purpose is to ensure that the dough will rise. The sourdough contains acidifying microbiota made up primarily of lactic bacteria and yeasts. Adding baker's yeast (*Saccharomyces cerevisiae*) is allowed when the dough reaches its last phase of kneading, to a maximum amount of 0.2% relative to the weight of flour used up to this point". This definition allowed one to dehydrate sourdough with the flora remaining active (amounts of bacteria and yeast are indicated). Sourdough can also be obtained by addition of starter to flour and water. Article 3 of the same regulation declares that "Breads sold under the category of *pain au levain* must be made from a starter as defined by Article 4, just have a potential maximum pH of 4.3 and an acetic acid content of at least 900 ppm". The *syndicat national des fabricants de produits intermédiaires pour boulangerie, pâtisserie et biscuiterie* is working on a new definition of sourdough in order to be closer to the reality of sourdough bread.

### 1.3 History and Social Aspects of Sourdough in Italy

The people in early Italy mainly cultivated barley, millet, emmer and other grains, which were used for preparation of non-fermented *focacce* and polenta. Emmer was not only used for making foods, but also performed as a vehicle of transmission in sacred rituals. At first, the Romans mainly consumed roasted or boiled cereals, seasoned with olive oil and combined with vegetables. After contact with Greek civilization, the Romans learned the process of baking and the technique of building bread ovens. Numa Pompilius sanctioned this gastronomic revolution with the introduction of celebrations dedicated to Fornace, the ancient divinity who was the guardian for proper functioning of the bread oven. The Romans gave a great boost to improvements in the techniques of kneading and baking of leavened products, and regulated manufacture and distribution by bakers (*pistores*). Cato the Elder described many varieties of bread in *De agri coltura* (160 B.C.), which by then had already spread to Rome: the *libum* or votive bread, the *placenta*, a loaf of wheat flour, barley and honey, the *erneum*, a kind of pandoro, and the *mustaceus*, bread made with grape must. In the first century A.D., Pliny the Elder [14] refers to several alternative methods of dough leavening, including sourdough that was air-dried after 3 days of fermentation, the use of dried grapes as a starter culture, and particularly the use of back-slopping of dough as the most common method to achieve dough leavening. Pliny the Elder specifically refers to sourdough in his indication that “it is an acid substance carrying out the fermentation”. According to Pliny the Elder, it was generally acknowledged that “consumption of fermented bread improves health” [14].

After the triumph of classical baking, there were no novel developments in this field throughout the Middle Ages. Finding bread and flour in these centuries was difficult, because of involution of agriculture and the famine and epidemics raging at this time. The bread was divided into two categories: black bread, made from flours of different cereals, of little value and reserved for the most humble people, and white bread, made from refined flour, which was more expensive and present on the tables of the rich. A special bread, whose tradition has been preserved to this day in different national or regional varieties, is the *Brezel*, originating from the South of Germany. It has a characteristic shape of a knotted and dark red crust, which is generated by application of alkali prior to baking, and is sprinkled with coarse salt crystals. According to legend, it was invented by a German court baker in Urach in South West Germany, who, to avoid the loss of his job, was asked by the Duke of Württemberg to develop a bread that allows the sun to shine through three times. This special bread requires 2 days of working: the first to prepare the sourdough with wheat flour, and the second to mix it with water, flour, salt, lard and malt.

During the Renaissance, the practice of holding banquets in the courts of the nobles was a triumph for bread, which was presented in various forms in support of the different dishes. In Venice “*fugassa*” was prepared for the Easter holidays, a sweet bread made with sugar, eggs and butter. In Tuscany, they used to prepare “*pane impepato*”, while in Milan it appeared as “*panettone*”. Only towards the end

of the 1600s was the use of yeast re-introduced for the distribution of luxury bread, which was salty and had added milk. In 1700, a very important innovation in the art of bread making was disseminated: the millstones in mills were replaced with a series of steel rollers. This allowed cheaper refining of flour. Also, pioneering mixers were set up. With the advances brought by the industrial revolution, bread was increasingly emerging as a staple food for workers. Rather than making the bread at home, people preferred to buy it from bakers. This change was criticized as distorting traditional values. At the same time, a health movement that originated in America started a battle against leavened bread, stating it was deleterious to health. Baker's yeast was considered a toxic element, perhaps because it was derived from beer, while the sourdough gave a bad taste to the bread, which was remediated by the addition of potash, equally harmful. When Louis Pasteur discovered that microorganisms caused the fermentation, the concern over the toxicity of biological agents was amplified. Pasteur's discovery eventually benefitted the supporters of the bread, as they stated that the use of selected yeast and related techniques was helpful in the manufacture of bread with a longer shelf life. The education of taste in different food cultures explains, however, the different relationship that has existed between the perception of the quality of bread and its level of acidity.

During the First World War, the so-called "military bread" was used in Europe, which was a loaf of 700 g weight with a hard crust. It was initially distributed to soldiers and then also passed on to the civilian population. In the post-war period, thanks to the much-discussed Battle of Wheat, strongly supported by Mussolini, the production of wheat was plentiful and the bread was brought to the table of the general population. The Second World War again resulted in an insufficient supply of bread. With the arrival of the American allies, the bread of liberation – a square white bread – became disseminated. Today, bread is regaining some importance. With a turnaround in the culinary habits of Westerners, bread made with unrefined flour, so-called black bread, is more widely consumed.

A brief mention should be made, finally, of the various breads that are currently made with modern baking practices. Typical breads, with PDO (Denomination of Protected Origin) or PGI (Protected Geographical Indication) status, are the Altamura bread, the bread of Dittaino, the Coppia Ferrasese, the bread of Genzano and the Cornetto of Matera. The manufacture of these breads is based on new processes, but still at an artisanal level [15].

## 1.4 History and Social Aspects of Sourdough in Germany

Acidified and leavened bread has been consistently produced in Central Europe (contemporary Austria, Germany, and Switzerland) for over 5,000 years. Leavened and acidified bread dating from 3,600 B.C. was excavated near Bern, Switzerland [2]; comparable findings of bread or acidified flat bread were made in Austria (dating from 1800 B.C.) and Quedlinburg, Germany (dating from 800 B.C.) [16]. It remains unknown whether these breads represent temporary and local traditions or a permanent

and widespread production of leavened and acidified bread; however, these archaeological findings indicate that the use of sourdough for production of leavened breads developed independently in Central Europe and the Mediterranean.

Paralleling the use of leavening agents in France, sourdough was used as the sole leavening agent in Germany until the use of brewer's yeast became common in the fifteenth and sixteenth centuries [4, 16]. In many medieval monasteries, brewing and baking were carried out in the same facility to employ the heat of the baking ovens to dry the malt, and to use the spent brewer's yeast to leaven the dough. The close connection between brewing and baking is also documented in the medieval guilds. In Germany, bakers and brewers were often organized in the same guild. In many cities, bakers also enjoyed the right to brew beer [17].

Baker's yeast has been produced for use as a leavening agent in baking since the second half of the nineteenth century [4, 16, 18]. Baker's yeast was initially produced with cereal substrates, but the shortage of grains in Germany in the First World War forced the use of molasses as a substrate for baker's yeast production [4]. Although artisanal bread production relied on the use of sourdough as the main leavening agent until the twentieth century, the use of baker's yeast widely replaced sourdough as the leavening agent. Maurizio indicates in 1917 that baker's yeast was the predominant leavening agent for white wheat bread, whereas whole grain and rye products continued to be leavened with sourdough [19]. In 1954, Neuman and Pelshenke referred to baker's yeast as the main or sole leavening agent for wheat bread and as an alternative leavening agent in rye bread [20]. The industrial production of baker's yeast to achieve leavening in straight dough processes was followed by the commercial production of sourdough starter cultures in Germany from 1910.

The continued use of sourdough in Germany throughout the twentieth century particularly relates to the use of rye flour in bread production. Rye flour requires acidification to achieve optimal bread quality. Acidification inhibits amylase activity and prevents starch degradation during baking. Moreover, the solubilisation of pentosans during sourdough fermentation improves water binding and gas retention in the dough stage. Following the introduction of baker's yeast as a leavening agent, the aim of sourdough fermentation in rye baking shifted from its use as a leavening agent to its use as an acidifying agent [18]. This use of sourdough for acidification of rye dough in Germany is paralleled in other countries where rye bread has a major share of the bread market, including Sweden, Finland, the Baltic countries, and Russia. For example, the industrialization of bread production in the Soviet Union in the 1920s led to the development of fermentation equipment for the large scale and partially automated production of rye sourdough bread [21].

Chemical acidulants for the purpose of dough acidification became commercially available in the twentieth century as alternatives to sourdough fermentation. However, artisanal as well as industrial bakeries continued to use sourdough fermentation owing to the substantial difference in product quality. To differentiate between chemical and the more labour-intensive and expensive biological acidification, German food law provided a definition of sourdough as dough containing viable and metabolically active lactic acid bacteria, and defines sourdough



bread as bread where acidity is exclusively derived from biological acidification. Sourdough is thus one of very few intermediates of food production that is regulated by legislation, and recognized by many consumers [4]. The consumer perception as well as the regulatory protection of the term “sourdough” in Germany and other European countries facilitated the recent renaissance of sourdough use in baking. In comparison, the term “sourdough” is not protected in the United States and the widespread labelling of chemically acidified bread as “sourdough bread” resulted in a widespread consumer perception of sourdough bread as highly acidic bread, and the use of alternative terminology to label bread produced with biological acidification.

The commercialization of dried sourdough with high titratable acidity constituted a compromise between economic bread production based on convenient use of baking improvers, and the use of sourdough fermentation for improved bread quality. These products were introduced in the 1970s [18]. Their economic importance rapidly surpassed the importance of sourdough starter cultures. Dried or stabilized sourdoughs produced for acidification provided the conceptual template for the increased use of sourdough products as baking improvers over the last 20 years. Sourdough fermentation was thus no longer confined to small-scale, artisanal fermentation to achieve dough leavening and/or acidification. Sourdough fermentation is also carried out in industrial bakeries at a large scale matching large-scale bread production, and in specialized ingredient companies for production of baking improvers specifically aimed at influencing the storage life as well as the sensory and nutritional quality of bread.

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