Transilvania University of Brasov
FACULTY OF MECHANICAL ENGINEERING

ICMS 2019 & COMEC 2019
Brasov, ROMANIA, 21-22 November 2019

TECHNOLOGICAL FUNCTIONS OF ADDED SALT IN BREADMAKING

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Abstract: *Natrium chloride of commonly known 'salt' is one of the basic ingredients in most of the food products, being considered for its properties concerning the physico-chemical and sensory attributes of the final products. Taking into account its complete function, salt could influence also the activity of added water in products matrix, concluding to a much more restrictive control of the technological process, with the aim of preventing the negative effects that could occur.*
The purpose of the current paper is to analyze the technological functions of salt as ingredient in the process bread making, the levels of salt added in bread products, propose a series of strategies for reduction of amount of salt added and to highlight a sort of future trends that could be considered for future research.
Keywords: *salt, bread, technological process, effects, trends.*

1. INTRODUCTION

Salt is a mineral composed primarily of sodium chloride (NaCl), a chemical compound belonging to the larger class of salts. Taking into account the chemical aspects that refer to salt, it is known that commonly 'salt' is sodium chloride NaCl. Judging by its unique attributes, it is frequently used in cooking practices, in industrial production or in food preserving. According to Desrosier, 1970, the custom of salting foods is an ancient practice, dating approximately when agriculture was discovered, being considered one of the oldest ways of preserving foods.
In a pure state, salt is a colourless, transparent and crystalline fine solid particle, water soluble. Its hygroscopic property is related to the ability of absorb moisture from atmosphere.
In the manner of taste, it confers saltiness in the perception of the consumer, when interfering with the gustatory papillae and combinig with other chemical compounds.
The problem of the level of added salt in our contemporary diet concerning the effects that can occure on human health is an actual task that requires a more deeply analysis. It is well known that in the last decades, the Western population is tended to consume a higher level of sodium than the recommened level for nutritional purpose, leading to an increasing incidence of a series of illness such as – kidney disease, cardiovascular disease – with all the aspects – hypertension, blood pressure, stomach cancer, asthma, osteoporosis and can cause obesity or stroke.
Also, salt is considered an ingredient with a large usage, even if it is used as an ingredient, as a flavor substance or as a preserving agent. Taking into account the functions that salt accomplishes in different food products it is difficult to find an alternative product that has the same functions.
The main problem that is drawing attention against the people working in food industry or related to this industry is to define the main steps that can be applied in order to diminish the amount of added salt, but also to maintain the essential abilities of salt in food products.
Despite its basic role mentioned above, salt is appreciated for its important properties of handling and processing such as strengthening the gluten structure in case of bread or increasing water holding in meat products, help reducing the metabolic activity of the starter-culture bacteria and modify enzyme activity, playing an important part in the maturation of some cheeses.
Although the main usage of the salt is for manufacturing, the major quantity of salt we ingest every day is coming from processed food, approximately 75%, judging by the lifestyle and eating habits. The last 25% of sodium intake comes from cereals and cereal products that by their nature contain sodium.
Taking into account the eating habits of European people, it was found out that bread and bread products consumption is about 78-80 kg/ year, due to the fact that bread is one of the basic food products. Because of the higher rate of consumption, there was necessary to expand the production and to adopt new production strategies and maximize the rate of ingredients, especially salt in order to improve the properties and conservation status.
In this context, salt has become one of the most important ingredients in the production of bread, especially taking into discussion the fact that approximately 80% of the consumed bread derives from frozen dough.

According to the incidence of diseases caused by high salt content products consumption, the national and international associations such as FAO and WHO has made specific recommendations regarding the reduction of added salt – 6g/ day.

2. THE TECHNOLOGICAL FUNCTIONS OF SALT IN PROCESSED FOOD PRODUCTS

2.1. Gluten structure

Due to the sensory and technological functions in baked products, salt has become in the actual context one of the basic and most important ingredients. Taste primes in consumer's choice, fact that leads to the consideration of salt as a flavor agent, but despite this aspect, the technological function of salt is the most important due to a series of factors summarized in figure 1.

Figure 1: The technological functions of salt in baked products

The basic attribute of the process of bread making is the development of the gluten structure in the matrix of the dough, creating an extensible gluten network. According to Cauvain, 2000, the gluten network is a proper atmosphere for retaining the air bubbles that result in the dough mass and is a crucial factor for retaining them during the other stages of production such as fermentation and baking. In the first stages of gluten formation, the gluten gets hydrated with the added water and the glutenous fractions – gliadin and glutenin get developed, being boosted by the energy of the mixing act. The rheological properties of the mixture of the flour with water change during the mixing process, the flour increases its moisture, resulting an important change. In the first moments of the mixing, the mixture becomes hard and mighty and the firmness is low. After proceeding with the mixing process, the dough increases its resistance, resulting a homogenous mixture – the dough reaches its maximum resistance. As the process continues, the resistance decreases and the flour-water mass loses its resistance and developing a bound shape with smooth elasticity. By continuing the mixing process, the resistance reduces and the extensibility tends to increase, until the dough becomes sticky and gelatinous. This step is called 'break down' and leads to a less consistency of dough. [2], [3]

By proceeding with the mixing, there is obtained a mass of dough with proper characteristics for baking, but taking into account the requirements of the quality control, increasing the mixing time results in increasing the bread loaf volume, without taking into consideration taste and other factors.

A reduced number of bakers use the mixture flour-water for making bread. In current practice, it is added salt, yeast and a series of ingredients that meet consumer's preferences. In this context, the gluten network formation takes place in an acid and salty atmosphere created by the addition of yeast and salt. Cauvain and Young, 2000, mentioned in their study the dipolar type of the water molecule ability to combine with salt due to its ionic nature, resulting in a restriction of available water for creating a gluten structure.

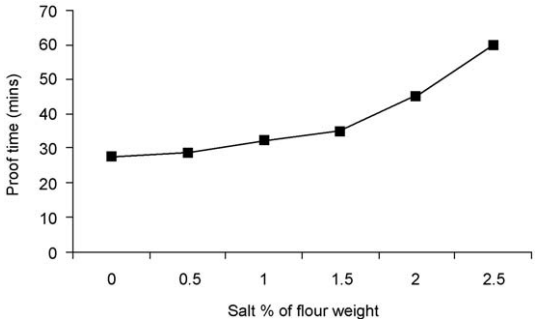

Figure 2: The effect of salt level on yeast activity [2]

During mechanical mixing, the ability of salt to affect dough rheology is hard to notice, comparing to the hand mixing. The gluten formation is affected by the addition of salt, being much more obvious in case of flours with weak gluten formation capacity, where it is better that salt is added in the final stage of dough obtaining, in this manner allowing the gluten protein to develop at maximum potential. A reason for this fact is that the affinity of salt for water is high, but because the gluten structure was already created, it could not affect the final structure.

In the last period, many bakers have been studying the effect of the salt added in the mixture of dough, trying to establish a proper proof time according to the amount of salt added, judging by the role of salt in controlling the yeast and water activity. This lead to the statements in figure 2, where is observed that with the increase of the salt added, the proof time also increases. Salt controls the multiplication rate of the yeast cells, diminishing the quantity of available water, resulting in extension of the proof time.

2.2. Control of yeast activity

Concerning the yeast activity, salt, by its affinity for water molecules, tends to approach to the yeast cell walls. Cell walls become thinner and weaker, dispossessing the ability to produce gas. The addition of salt limits the ability to produce gas molecules of the yeast cells, contributing to the monitoring of the gas formation of dough during proofing. The activity of the yeast is limited, the cell wall gets impermeable, getting unable to absorb oxygen and nutrients in order to support enzymes and other substances activity. In the presence of salt, the yeast releases some of its water to the salt by osmosis, and this in turn slows the yeast's fermentation or reproductive activities. (M.I.Luchian, C.M.Canja, 2010) [2]

2.3. Control of water activity

Bread and bread products have a moisture content of about 18-42% depending on the type of product. In this case, for ensuring the quality and safety requirements of the products, it is better to control the water activity. The most important aspect that is due to be taken into account is the Equilibrium Relative Humidity – ERH. For bread products it is recommended to be lower, decreasing the formation of the molds and bacteria.
In case of a high moisture content the microbial rate of multiplication is high and in some cases it is possible to develop a series of bacteria and mold. Due to its hygroscopic capacity, salt has the ability to control the moisture content of the product, prolonging the shelf-life. Comparing to the sucrose that is added usually in products for lowering the ERH, salt has a better capacity of contributing to the reducing of moisture.
Bakery products have a ERH reduced on the crust compared to the moisture of the core; when the product gets out of the oven, the crust is a sterile surface. As the time since it was taken out of the oven passes, the moisture of the core migrates through the crust, resulting in a moist area that can be a proper condition for developing bacteria such as Bacillus subtilis and Bacillus licheniformis, or different types of mould, decreasing the quality of the product.

3. AMMOUNT OF ADDED SALT IN BREAD

Over the last decades, a true phenomenon regarding the rate of salt consumption has started, related to the values found in comparison with the physiological needs. The context has been related to the link between sodium and hypertension, considered a disease of the contemporary century, which is exacerbated with the impact of technological progress and the widening of the assortment of products made available to the consumer.
The amount of sodium ingested varies at European level, the biggest contributor to the consumption rate of sodium is salt, but sodium can also have extra provenance, deriving from other foods and foods whose composition is introduced. There was an 11g consumption rate for men, while women tend to consume about 8.1 g of sodium per day.
While salt is predominantly used in culinary processes, being added during cooking or serving, it is considered to represent a considerably small part of the total amount of sodium ingested daily. The processed products are considered to represent 80% of the total salt intake daily.
Salt contains about 39% sodium. In the baking process, considering that the cereals from which the flour is obtained contain 23-25% sodium, it was found that the sodium level exceeded the values considered normal and balanced, which led to the impetuous need to reduce the sodium content of products.
As it could be observed in figure 3, the sodium content is about 38% in bread, the figure showing an average of the values of sodium content of different types of bread. Table 1 shows the approximate levels of sodium

chloride in certain products, classified from raw material – flour, intermediate product – dough and final product – the baked product.

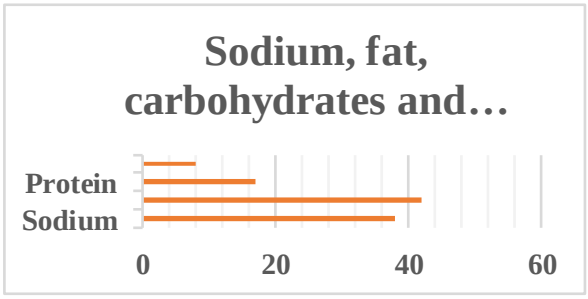

Figure 3: The amount of sodium, fat, carbohydrates and protein content in bread

Table 1: Level of sodium chloride in certain bread products [1], [5]

Type of product	Approximate level of sodium chloride/ 100 g product	Typical level of sodium chloride/ 100 g dough	Typical level of sodium chloride/ 100 g flour
Pan bread	1.15-1.25	1.08-1.19	1.8-2.0
Crusty breads	1.15-1.34	1.08-1.27	1.8-2.1
French baguette	1.23	1.17	2.0

The values shown in table 1 are representative for the type of breads analysed. It could be observed that the highest level of sodium chloride resides in the raw material – flour, decreasing with the processing of flour into dough, and then increasing in the final product due to the addition of natrium chloride in the final product.

4. STRATEGIES FOR REDUCING THE AMOUNT OF ADDED SALT

4.1. Decreasing salt amounts

In the current production practice, there is a discussion of replacing sodium chloride with potassium chloride. This fact is not affecting the products quality and neither creates and disadvantages. Potassium chloride role in yeast and water activity is not different of the sodium chloride and the rheological properties are not affected. In the manner of taste the potassium chloride highlight the metallic taste of the products, especially when the substitution is higher than 20%.
Trying to decrease the level of sodium chloride will reside in a negative perception of the taste for the consumer and finally leading to a less consumption of bread, fact that affect a healthy diet that is based on fiber, vitamins and calcium mainly from bread.

4.2. Using yeast

Salt flavor can be replaced with an acid flavor similar to that created during fermentation. The flavor of bread would be influenced since the flavor agent would be external and would depend on the control of the fermentation and the type of used microorganisms. Time and temperature should also be taken into account, a longer fermentation period leading to a more intense flavor. The pH of the dough should also be taken into account, a pH that is too low will stop and burden the development of the processes that happen in dough bioactivity – enzymes and yeast cells. Lowering the pH means also an inappropriate environment for bacteria and microorganisms to develop and multiply leading to a safer product.
Also, the temperature affects the activity of the dough contributors, a lower temperature system diminishing the structure of the agents and as a consequence affecting the whole process, sometimes in an irreversible manner.

4.3. Flavored agents

In the process of bread making, there are a large number of flavor agents that are introduces in products in order to make them much tasty and delicious. Often there are added a series of seeds and germs as a response to consumer's requirements not necessary as a replacement agent for salt. The supplement of the products with

different cereals could replace the need of additional salt in the taste of the product, due to the flavor and volatile agents that lead in the cereal bran.

5. FUTURE TRENDS

The challenge of the baking industry is to meet the demands of the consumer and to meet the nutritional requirements of the organizations implied in the control and maintaining the state of health of the population. By having a controlled diet and knowing the composition of the consumed products, it could be easy for people to compose a daily menu by controlling the amount of salt added.
Bread and bakery products has become an important factor of discussion concerning salt content debate, taking into account the fact that the main nutritional pyramids have as a base cereal and bread products and there has been a considerable focus on bread because of the central role that it plays in the diet of many consumers.
The bread making industries have to focus on lowering the level of salt added in products and to monitor the positive health effects that can be demonstrated towards consuming these products.
The changing lifestyles of consumers lead to decrease of bread consumption, being often replaced with similar products from the nutritional point of view, but with a level of salt according to the daily intake recommendations. The white breads were gradually replaced with breads obtained from different types of flour – such as: oat, corn, soybean or flour derived from vegetables or kernels. The proper matrix for adding fiber sources to products is bread, ensuring ease of ingestion and consumption for the consumer.
The industry is focused on creating products that meet the progressive and changing habits and demands of the customer to deliver a product that the consumer will enjoy and buy again and again.
Researchers tend to focus on finding different replacers of the natrium chloride with a less negative effect on human health, but with similar properties of preserving and acting in the process of breadmaking.
Also, an informative campaign for 'low sodium content' products may be obvious for consumer to reconsider its nutritional choices when creating a menu.

6. CONCLUSION

Natrium chloride, or commonly 'salt' has become an actual task of discussion, being considered one of the factors that lead to the rapid incidence of diseases that gradually affect population in some cases starting with delicate ages when the human body defines its functions. Considered an important ingredient in breadmaking together with flour, water and yeast, salt is still keeping its well defined role in the technological process.
Besides its roles in human physiology, nutrition and health, salt performs a multi-purpose role in many manufactured foods, the most frequently consumed product being bread and bread products. By controlling the fermentation rate, water activity and gluten structure, salt has become a trivalent ingredient that appears to be indispensable in bread production.

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