Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 6 June 2022

Review Article

Using Water in the Modern Bakery Industry

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Received: April 18, 2022

Published: May 25, 2022

Abstract

In bakery water is used as a solvent for salt, sugar and other raw materials: for dough preparation, preparation of liquid yeast, starter cultures; goes for household needs cleaning of raw materials, equipment, premises, for heat engineering purposes - the production of steam necessary to humidify the air in proofing cabinets and ovens. Water plays an important role in the technology of delayed baking of bread products or in the technology of frozen semi-finished products: it is used during kneading to obtain an optimally developed gluten frame for better form and gas holding capacity; to obtain cold dough, which is the basis for slowing down the onset of the fermentation process, while fermentation should be minimized or completely absent; the amount of water affects the consistency of the dough for better dimensional stability during defrosting. A low-temperature process, deep freezing strongly affects the structural and mechanical properties of the dough and the quality of the finished product; secondly, under certain parameters of freezing, the structure of the intracellular water of yeast can lead to a decrease in their activity, and even to the death of microorganisms. Therefore, the issues of the quality and quantity of water at any technological operation in bakery production with delayed baking are issues of the quality of finished products and therefore are very relevant.

Keywords: Water Treatment; Industry; Bakery; Dough Kneading; Yeast; Freezing; Product Quality

Introduction

For kneading the dough, they often use regular drinking water or purified water with reverse osmosis systems, which is completely devoid of salts. In both cases, this has a bad effect on the final result, which is a dough that can be used for delayed baking. Delayed baking technology uses low temperatures to slow down the fermentation process or stop it altogether. The technology of "shock" quick freezing of the dough before the final baking for a limited period of time allows not only postpone baking, but also allows you to take the baked goods outside the enterprise. The main principle of the delayed baking technology is a very rapid cooling of the product to a temperature below minus 3° C, followed by a further decrease in temperature, at which the water contained in the bread freezes, as well as to limit and disappear enzymatic, oxidative, microbiological transformations. During normal freezing, all water molecules turn into crystals. The faster the freezing process, the smaller these crystals are. Only with micro crystallization of water, the product molecules are not destroyed. Blast freezers, thanks to the freezing system with air at minus 40° C, allow reaching minus 18°C in the middle of the food in less than 240 minutes: the maximum time during which it is necessary to carry out the blast freezing process to obtain micro-crystallization of water, thus preserving the unchanged organoleptic properties of the product. Due to the high rate of freezing and the transformation of water from a liquid state into a solid, the period of bacterial activity is shortened, since bacteria conduct their life only in the presence of liquid water. Bacteria of different types have different temperature limits of vital activity. When frozen slowly, traces of the vital activity of each of the types of bacteria appear in food, while during shock freezing, many of them simply do not have time to develop. The shelf life of quick-frozen food is longer than that of food frozen in conventional chambers. After defrosting, there will be no loss of liquid, the consistency and taste of the product will not change. Blast freezing provides a number of advantages over the conventional, traditional method of freezing food, namely: reduction of product weight loss; increase in shelf life; significant time savings. Due to the properties of water at low temperatures, it became possible to develop a technology for the production of baked goods with delayed baking. Water has a great influence on the quality of the finished product and the efficiency of the freezing process. It is imperative to prepare and control this component in terms of physicochemical (presence of hardness salts), micro-biological indicators, recipe quantity, water parameters before kneading the dough. Therefore, the issues of water treatment, recipes for bakery products, water parameters in the delayed baking technology play an important role and affect the quality of finished baked goods [1-3].

Main part

Pretreatment of water

Water used in the production of bakery products must meet all the requirements for drinking water in accordance with the current regulatory and technical documentation. According to these requirements, the water should be transparent, colorless, have no extraneous smell and taste, should be safe in epidemiological and radiation terms, harmless in chemical composition and have favorable organoleptic indicators. For each type of safety and purity of water, standards of maximum permissible concentrations have been approved. The safety of water in epidemiological terms is determined by the relevant standards for microbiological and parasite logical indicators. According to the requirements of microbiological purity of water, the total number of microorganisms in 1 ml of water should not exceed 100, and the number of bacteria of the E. coli group in 1 liter of water should not exceed 3. The number of bacteria forming colonies in 1 ml (when determining the total microbial number) is not must exceed 50 [4]. Of significant importance in the production of bread products of deferred baking is such a physical and chemical indicator as the hardness of water. Water for kneading must be taken clean, meaning not very saturated with mineral salts or coagulants. It is possible to use plain tap water, unless it is unnecessarily fluoridated and chlorinated. The hardness of water is characterized by the content of soluble salts of calcium and magnesium in it. The water hardness value of 1 mol/m3 corresponds to the mass concentration of calcium ion equivalents of 20.04g/m3 and magnesium ions of 12.153g/m^3. There are the following types of water hardness: general, carbonate, non-carbonate and removable. For example, the total hardness of water is expressed by the sum of the molar concentrations of the equivalents of calcium ions ($1/2C^{2+}$) and magnesium ($1/2Mg^{2+}$) in water. The total hardness of drinking water should not exceed 7 mol/m3. The hardness of water for bakery production is not a disadvantage, since moderately hard water favorably affects the rheological properties of the dough, improving its consistency. Excessively hard water slows down the process of alcohol fermentation, when using soft water, the dough acquires the properties of an unfermented semi-finished product. At the same time, soft water has a relaxing effect on the properties of the dough and, accordingly, gluten, and also reduces the intensity of fermentation. Hard water improves the rheological properties of gluten and low flour dough. In the case of chlorinated water, it is important to know the content of residual chlorine in the water, which has an oxidative effect and therefore also strengthens weak gluten. A typical water treatment technology may consist of the following stages: pre-filtration using mechanical equipment, deironing to which demanganation can be added, removal of salt impurities that increase hardness, ultraviolet treatment. The structural scheme of the water purification system depends on its source (underground or surface, central water supply), as well as on the results of its study. After studying these characteristics, a set of technologies that will be used in a particular case is determined.

The main tasks to be solved in the preparation of water for baking confectionery and bakery products, as well as measures to bring this raw material should consist of

- Optimization of organoleptic indicators: clarification, elimination of turbidity and odor, reduction of color intensity; regulation of mineral composition: mineralization of water, partial or complete.
- Reduction of rigidity and alkalinity; reducing the concentration of manganese and iron in water.
- Destruction of bacteria and microbes.

- Purification from organic additives and correction of oxidization with permanganate.
- Excretion of salt compounds of heavy metals.
- Removal of radon and other chemical elements with radiation activity.
- Bringing the level of acid-base balance back to normal.

The following technologies should be used for water treatment

- Effect on water with calcium and sodium hypochlorite.
- Demanganation and deironing by the method of using catalytic fillers.
- Sorption.
- Clarification.
- Mitigation with cat ionized sodium.
- Ozonation.
- Use of ultrafiltration.
- Demineralization, mitigation by reverse osmosis.
- Enrichment of water with oxygen (pressure and non-pressure).
- Ultraviolet treatment for the purpose of its disinfection [4].

The use of water in the technology of bakery products

The role and properties of water are important at all stages of the technological process, determining the properties of semi-finished products, the degree of intensity of the complex of processes of their maturation. The formation of dough from flour and water is the process of plasticization of dry, solid hydrophilic chemical compounds of grain, in which water acts as a substance that weakens and destroys the internal bonds between molecules and aggregates with their subsequent replacement by hydrogen bonds. The moisture of colloidal capillary-porous bodies, which include flour, dough and bread, depending on the value of the binding energy, can be divided into four types: chemically bound, adsorption-bound, capillary-bound and osmotic ally retained. The process of swelling of flour takes place under the influence of osmotic moisture absorption, in the presence of water-soluble substances inside the colloidal particle. The difference in concentrations at the boundary of dispersed phases creates a difference in osmotic pressure, under the influence of which moisture penetrates into the colloidal particle. The absorption of moisture in this way is called sorption or swelling. The absorption of swelling moisture occurs without the release of heat and concentration but causes an increase in volume and changes the swelling pressure. In addition to adsorption and osmotic absorbed moisture in colloidal capillary-porous materials can be capillary moisture retained by the forces of macro- and micro capillaries. The water held by these forces has a negligible binding energy to the material, conditioned by surface tension forces. This type of water is called free moisture. In the hydrolytic processes occurring in the dough and bread, water is involved, capable of entering into chemical reactions, that is, free. Wheat dough of normal consistency contains about 0.19 grams of bound water per 1 gram of flour, which corresponds to 35% of the mass of water in the dough. Free water appears at a humidity of water-flour mixture of 24%, an increase in humidity to 59.5% does not lead to an increase in the content of water bound in it. In wheat flour dough, about 65% of the water is in a free state and participates in biochemical reactions [5,6]. Water is one of the main ingredients of the dough. The ratio of water and flour has a significant impact on the basic properties of the dough (viscosity, plasticity, extensibility, elasticity, etc.) and, ultimately, on the quality of bread. The water absorption capacity of flour is the most important indicator, on which the properties of the dough, the course of the technological process, the quality of bread, the output of finished products, technical and economic indicators of production depend. The water absorption capacity of flour is determined by the ratio of the amount of water absorbed by the flour, taking into account its calculated humidity, provided that the dough of the required consistency (500 units of the pharynograph) is obtained and this indicator depends on the amount of water absorbed by the individual components. The drier the flour, the more water it can absorb when kneaded. Therefore, the norms of bread yield are set for flour with a certain "basic" humidity (14.5%) and are adjusted accordingly when producing bread from flour with less or more humidity. The amount of water in wheat dough depends on a number of conditions

The type of products largely determines the amount of water in the dough.

For each type of bread products, the standard establishes the maximum permissible humidity of the crumb or the whole product. The norm of the maximum permissible humidity of this product determines the maximum humidity of the dough, and in this regard (taking into account the recipe of the dough and the humidity of the flour) and the amount of water added to 100 kg of flour. The lowest humidity has a dough for lamb products, the greatest - for molded bread from wallpaper flour; the yield of flour also affects the amount of water in the dough. The higher the flour yield, the more water can be contained in the dough. This is due to the fact that the particles of grain shells contained in flour of high yields have the ability to bind water in greater quantities than endosperm particles [7,8].

The amount of sugar and fat that is added to the dough according to the recipe significantly affects the amount of water that should be added when kneading the dough. The more sugar and fat in the dough, the less water is required. When sugar is added to the dough that contains only tenths of a percent of moisture, and therefore «drier» than flour, the dough still seems to be diluted and as a result of this, the amount of water that would need to be added to obtain a dough of normal consistency decreases. The dehydrate effect of sucrose leads to liquefaction of the dough due to the fact that the amount of water osmotic ally bound by proteins in the dough decreases with the addition of sugars, so the content of the liquid phase of the dough increases and the dough becomes more "liquid". Adding fat to the dough also dilutes it somewhat. Therefore, when introducing significant amounts of sugar and fats into the dough, it is necessary to reduce the amount of water added during kneading accordingly. If the dough formulation includes milk containing about 88% water, or eggs, the amount of water in the dough also has to be reduced accordingly. The strength of the flour determines the rheological properties of the dough from it. Therefore, the stronger the wheat flour, the relatively higher the amount of water that should be applied to the dough to obtain bread with the greatest volume and better porosity. When processing weak flour, the properties of the dough during the fermentation period deteriorate greatly. The dough is thinned and sticky, making it difficult or even almost impossible for pieces of dough to pass through rounding and seaming machines. When stretching, test blanks are very quickly and strongly blurred. In this regard, the amount of water introduced into the dough from weak flour has to be reduced, and the dough is prepared with humidity, often even less than is permissible from the point of view of the norms of humidity of the bread of this variety of products. This, of course, entails a decrease in the yield of products and a deterioration in the economic indicators of their production [9]. The amount of water in the dough is also affected by the methods of preparing the dough, technological modes, the use of improvers and other factors. The use of intensive kneading or enhanced machining of the dough increases the water absorption capacity of the flour due to, probably, the redistribution of water between protein substances and starch. When using brews, the water absorption capacity of the dough increases due to an increase in the binding of water with pasteurized starch. Food additives (improvers) affect the rheological properties of the test. With the intensification of oxidative processes in the dough as a result of the action of certain improvers, the water absorption capacity of the test increases [10,11]. The introduction of water into the dough is essential for the processes that occur at all stages of the preparation of bread. With the participation of water, a complex of biochemical reactions is carried out. The amount of water depends on the processes of vital activity of yeast and other microorganisms, the rate of their reproduction, the intensity of alcohol and lactic acid fermentation. Water with a pH above 8 due to the greater content of alkaline salts in it neutralizes the acids formed during fermentation and negatively affects the vital activity of yeast [12]. Given the important technological role of humidity of semi-finished products, water is included in the complex of controlled indicators of their quality, because the humidity of the dough actually predetermines the humidity of the bread pulp, regulated by the standard. In the furnace, their volume increases to a constant on the surface formed a strong crust. Its color and thickness during baking are constantly changing. There is a hardening of the crumb and the formation of a structure characteristic of the finished bakery product. The spread of heat goes from the crust to the inner layers of the dough. The baking process can be divided into three stages: I - moisturizing, II - basic baking, III - baking. They are characterized by the temperature and relative humidity of the baking chamber environment, respectively: t = 100-120°C, w = 60-70%, t = 200-260°C, w = 0%, t = 160-180°C, w = 0%. Dough blanks, entering the baking chamber, fall into the humidified zone, moisture exchange in this zone occurs due to the fact that the temperature of the dough blanks is 29-30° C (below the dew point), so the moisture condenses on the surface and is partially absorbed by the test blanks, the mass of which increases by about 1%. This process is of great technological importance. If there is little moisture in the first zone of the baking chamber, then a crust is intensively formed, and the volume of dough blanks continues to grow. At the same time, explosions are formed on the surface. Sometimes uncontrollably increase the volume of steam supplied to the first zone of the furnace. In this case, the crust is thin and wrinkles and breaks during storage. Moistening of dough blanks should occur for a maximum of 5 minutes, and each type of product corresponds to its own degree of moisture. Sorption of moisture by test blanks depends on the temperature and degree of moistening of the baking chamber, the properties of the dough blanks, etc. After warming up the dough blanks to 100° C, moisture gradually evaporates from the surface until the moisture content of the crust is equal to 0. The crust has low moisture and thermal conductivity therefore, it is necessary to raise the temperature when the dough blanks enter the II baking zone. In the II baking zone, the temperature of the baking chamber rises from 100° C to 200-260° C, the crust stabilizes, warming up goes from the surface to the center. When the moisture content of the crust becomes equal to 0, the balance between the outer and inner layers is disturbed. Due to diffusion, moisture begins to migrate from the center to the peripheral layers. But the low moisture and thermal conductivity of the crust resists this movement. At this time, from the periphery to the center, moisture will move under the pressure of the temperature gradient (the phenomenon of thermal moisture conductivity). Since the temperature difference is significant, the movement of moisture to the center is more intense. Therefore, in the central part of the bread, the humidity is 2-3% higher than the initial one. In the II zone, the transfer of moisture mass by thermal moisture conductivity is greater than due to diffusion. After the formation of the crust, evaporation is asked into the subcortical space and slowly deepens to the center. Unlike Zone II, Zone III is characterized by a lower temperature. The movement of moisture due to diffusion and thermal moisture conductivity is leveled, the subcortical layer has a temperature of up to 100° C, and the center of the bread is 98-99° C. The hydrolysis of part of the starch and proteins under the action of amyl lytic and proteolysis enzymes increases. Dextrin's formed during the hydrolysis of starch on the surface of dough blanks dissolve in condensation, contributing to the formation of a glossy crust. When the crust temperature reaches 100° C, redox reactions between sugars, acids and proteins begin to develop. As a result, the reaction of melanoidin formation intensively proceeds, giving the crust color, aroma and taste. When preparing the dough, proteins intensively absorb moisture, about 2 times its own mass. After planting the dough blanks in the furnace at 45-50° C, the proteins begin to denature, while moisture is released. Denaturation of proteins stops at 60-65° C. Starch absorbs the moisture lost by proteins, due to which it swells and at 68-72° C is pasteurized. But for complete pasteurization there is not enough water, which needs 2-3 times more than is in the dough. Such limited pasteurization of starch proceeds until the end of baking. Denaturation of proteins and pasteurization of starch leads to the formation of bread pulp. After planting test blanks in the oven, their volume quickly increases by about 10-30%, which is facilitated by the elasticity of the crust. The role of the crust is that it serves as an obstacle to the removal of CO_2 and the penetration of microorganisms during [13-15].

One of the main indicators by which the consumer evaluates the quality of bread is the degree of its freshness or callousness, the compressibility of the pulp. The staleness of bread is determined by changes in the structural and mechanical properties of the pulp and crust, which loses its hardness and shine, taking moisture from the pulp and surrounding air. As you can see, water also plays a big role here. Starch pasteurized in the baking process over time releases the moisture absorbed by it and passes into the previous state characteristic of flour starch. Starch grains are compacted and significantly reduced in volume, air layers are formed between them. Free moisture released by starch, when the product is stale absorbed by proteins and partially evaporated, and also remains in formed air layers. Gluten in the process of stale bread is not inert: it is stronger than starch, binds moisture, and therefore more difficult to release it. The process of stale bread is accompanied by changes in the protein part of the pulp, leading to a compaction of its structure and a decrease in hydration ability. However, these changes occur 4-6 times slower compared to the rate of aging of starch, which is 5-7 times more than protein. Therefore, we can assume that in the process of stale bread, the main role is played by changes in the starch of the pulp. Bakery products belong to the traditional and most important products of human nutrition. Modern society imposes certain requirements on the assortment and quality of bakery products. Food products with a preventive orientation are in special demand. These include bakery products using various herbal additives, fruit and vegetable fillings containing a wide range of carbohydrates, nitrogenous substances, glycosides, vitamins, mineral salts, organic acids, tannins and aromatic substances. The method of processing and storage of the resulting semi-finished products is also important. One of the promising technologies in the bakery industry is the technology of preparing bakery products from frozen semi-finished products. Frozen bakery products are products pre-frozen to a temperature of 18°

C. They can be raw, or they can be partially cooked. An intensive dough mixture is important, the temperature of which should be 16-20° C. For this, ice water and dry ice are used. Fermentation of the dough after kneading should be minimized. Yeast is used fresh. They are introduced 3-5 minutes before the end of the kneading and very actively mixed for uniform distribution. The amount of yeast is increased, compared to the traditional kneading. For bakeries it is 5-7%, for butter 7-10%. The rate of laying yeast depends on the duration of storage of frozen dough semi-finished products. The amount of salt also increases to 2% by weight of flour. Salt slows down oxidation at the beginning of kneading, slows down fermentation, retains water and promotes a thin crust [16]. Deep freezing is the main stage in the technology of manufacturing frozen dough semi-finished products. For the freezing process, "shock" freezing chambers of various types are used, depending on the volume of production: dead-end, tunnel or spiral. It is important that all the necessary parameters are met to ensure the quality of the final product. The presence of air circulation in the shock chamber in conjunction with the optimally low temperature provide an indispensable kinetics of freezing of the test work piece. The duration of freezing of test semi-finished products should provide a temperature in the center of minus 12-18° C. Also, the process will depend on the semi-finished product itself (shape and size). The larger the specific surface of the work piece, the more uniform is the freezing (it is recommended to make flat blanks weighing no more than 300 grams). The rate of freezing depends on the recipe of the product. The presence of sugar reduces the crystallization temperature of water, that is, its transition from a liquid state to a solid state will occur much later compared to a test blank from a simple dough. During normal freezing, all water molecules turn into crystals. The faster the freezing process, the smaller these crystals are. Only with the micro-crystallization of water, the product molecules are not destroyed. Shock freezers, thanks to a powerful freezing system with air at a temperature of minus 40° C, allow you to reach a temperature of minus 18° C in the center of the products in less than 240 minutes: the maximum time during which it is necessary to carry out the shock freezing process to obtain micro-crystallization, thus preserving the unchanged organoleptic properties of the product. Due to the high rate of freezing, the period of activity of bacteria is also reduced. Bacteria of different types have different temperature limits of vital activity. With slow freezing of products, traces of the vital activity of each of the types of bacteria appear, while with shock freezing, many of them simply do not have time to develop. Thus, the shelf life of quick-frozen products is higher than that of products frozen in conventional chambers. After defrosting, there will be no loss of liquid, the consistency and taste of the product will not change. Shock freezing gives a number of advantages compared to the usual, traditional method of freezing products, namely: reducing the loss of product weight; increase in shelf life; significant time savings. For bakery products (rye bread, wheat, small-piece bakeries and butter, doughnuts, yeast and yeast-free puff pastries, pizzas, etc.) the following options for deferred and shock technologies can be used: test blanks of delayed resistance; dough blanks frozen after division; dough blanks frozen after molding; partially distributed dough blanks; quipped frozen dough semi-finished products; partially baked dough semi-finished products; baked products.

For flour confectionery (pies, mousses, biscuits, cakes, etc.): baked semi-finished products for cakes, pastries, muffins; baked and decorated products (creams, fruits, etc.).

The easiest and most affordable way is the delayed proofing technology. For the technology of production of bakery products from frozen semi-finished products, the issues of the state of water in frozen products occupy an important place, since the freezing method is the main one for long-term storage of food worldwide [17-19]. In the technology of bakery production, freezing is widely used in order to slow down or interrupt the fermentation of the dough and to preserve the finished product. Currently, the use of freezing is practiced at various stages of the technological process: after kneading, at various stages of stretching and baking semi-finished products. The main problem in cryogenic technologies of bakery is the deterioration of the quality of finished products, in particular, a decrease in specific volume and shape resistance, as well as the separation of the crust from the crumb, its fragility and fragility. Freezing of semi-finished products of bakery production is a complex process that leads to a change in their microbiological, rheological (structural-mechanical) and thermo physical properties. To optimize the process of production of bakery products based on frozen semi-finished products, it is necessary to study the complex of processes occurring at the stages of freezing, storage, defrosting, stretching and baking. Gluten proteins, flour enzymes, yeast cells and lactic acid bacteria are especially susceptible to profound changes. Starch is resistant to low-temperature processing, but its destruction occurs when the water in the starch freezes.

Changes in the structural and mechanical properties of the dough occur as a result of recrystallization of ice, which causes a weakening of the three-dimensional protein structure responsible for gas retention in the dough. The negative effect of freezing on the structural and mechanical properties of the dough and the quality of the finished products is mainly due to damage to the protein matrix by ice crystals, as well as other factors. The ice formed in the dough during freezing is a viscoelastic elastic medium with abrupt changes in physical and mechanical properties at the interfacial boundaries, has an inhomogeneous macrostructure: large ice crystals with inclusions of the product substance form separate grains, between which there are local zones of solutions of various salts, the same zones are inside the ice grains. It should be borne in mind that during freezing and subsequent storage, the dough under the influence of various processes undergoes changes. Therefore, the original properties of products are not fully restored during defrosting. The effect of the processes of freezing and defrosting on the quality of products in the thawed state, the researchers explain from the standpoint of the theory of crystallization of water. The freezing rate is a decisive factor affecting the number, size and uniformity of the distribution of ice crystals in the dough. The size of the crystals depends on the degree of preservation of the integrity of the natural structure of the dough. The degree of destruction of the structural elements of the dough also depends on the depth of autolytic processes at the time of freezing. In addition, during storage, there is an increase in ice crystals, further deepening of autolytic processes, the phenomenon of "aging" of protein colloidal systems and membranes of yeast cells, which negatively affects the final product. Changes in the colloidal structure of the dough caused by the redistribution of water and an increase in the concentration of the liquid phase during freezing are reflected in the value of the moisture-binding capacity after their defrosting. They are the greater the higher the speed and the lower the freezing temperature. The main reasons for the formation of water during the freezing-defrosting process are: denaturation of proteins as a result of the separation of water from the protein substance; the increase in the concentration of minerals in solutions contained inside and outside the fibers, etc. The degree of influence of these factors is determined by the rate of crystal formation and the depth of the phase transformation of water. In order to restore the moisture content in the dough, moisture must first undergo a phase transformation (ice-water), and then penetrate and recover in those protein substances and colloidal systems from which it diffused into the intercellular space during freezing and storage with the help of diffusion-osmotic forces. The ability of protein substances and colloidal systems to absorb and bind this moisture is determined by their biological activity, which depends on the modes of refrigeration of products, including defrosting [20-23]. Freezing to - 18° C and cooling at + 5° C allows you to work more efficiently, reducing product preparation time, reducing the amount of space required for storage of finished products and improving the quality and safety of products. Baking - the final stage of preparation of bread products, finally forms the quality of bread. In the process of baking, microbiological, biochemical, physical and colloidal processes take place inside the test piece. Test blanks are heated gradually, starting from the surface, so all the processes characteristic of baking bread do not occur simultaneously in its entire mass, but in layers, first in the outer and then in the inner layers. The speed of heating the dough, bread in general, and hence the duration of baking depends on a number of factors. When the temperature in the baking chamber (within certain limits) increases the heating of the workpieces and reduces the duration of baking. The moisture content of the hot bread crumb (in general) increases compared to the moisture content of the dough due to the moisture transferred from the top layer of the workpiece. Due to lack of moisture, the gelatinization of starch is slow and ends only when the central layer of bread dough is heated to a temperature of 96 - 98° C. Above this value, the temperature in the central layers of the crumb does not rise, as the crumb contains a lot of moisture the heat will be spent on its evaporation, not on heating the mass.

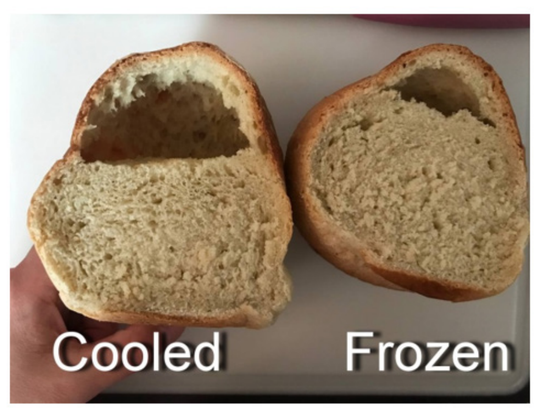

Figure 1

Defects of crumb - poorly kneaded dough, lag of crust from crumb, hardening, crumbliness, uneven porosity and unbaked crumb. Defects of the crumb occur when using flour obtained from sprouted grain, or when adding excess water, resulting in unbaked and sticky crumb. In technologies with deferred baking for bakery products, various fruit and vegetable semi-finished products can be used as a filling in the form of concentrated puree, a mixture of pieces of fruits and vegetables with puree. Such fillings can be stored separately from the dough blanks and together with them. In the case of separate storage of the filling - semi-finished products are preserved in an aseptic way. With aseptic canning, the product is briefly sterilized in a thin layer "in the stream" at elevated temperature, quickly cooled and packed under sterile conditions in a pre-sterilized container with capping under aseptic conditions [24-26].

Sterilization "in the stream" with aseptic packaging can significantly simplify the heating process and quickly cool the product, which is especially important for puree with high viscosity and thick consistency. The main parameters characterizing the sterilization process are the temperature to which the sterilized product must be heated and the holding time during which the product is heated. The sterilization temperature depends on the pH value and the acidity of the sterilized product. The higher the acidity of the product, the lower the value of the active acidity (pH) and the lower the sterilization temperature may be, since microorganisms are very sensitive to the value of the active acidity of the medium. In acidic products, many pathogens cannot develop [27-30]. Low-acid liquid foods are more exposed to microorganisms and pathogenic bacteria than high-acid foods (e.g., fruit juices). Aseptic technology allows at least six months to keep food safe and fresh without cooling or adding preservatives. Foods better retain color, texture, taste and nutritional value. Along with the preservation of the original properties of the product and a significant reduction in the duration of processing, aseptic canning has a number of advantages: - ensuring the same quality of the canned product with a constant sterilization mode, regardless of the size and shape of the container, since the transfer of heat through a layer of product of different thickness is excluded

- Increase without prejudice to the quality of shelf life of canned products, since as a result of short-term sterilization, their complete sterility and more accurate control of sterilization are achieved, since the adjustable value is the temperature of the sterilized product, and not the coolant (as in autoclaves).
- Significant cost savings due to the continuity and short duration of sterilization, cooling, automation of the production process, a significant reduction in the consumption of steam, water, electricity and production areas per unit of production and a higher safety factor for servicing the equipment of technological lines [31-33]. Fruit and vegetable semi-finished products contain up to 90% water, in this regard, when freezing them in a fresh state, the same questions arise as when freezing the dough [34-37]. When using fruit and vegetable semi-finished products in a fresh state without heat treatment, as in the case of aseptic canning, it becomes possible to fill the products prepared for baking with filling and freeze the dough semi-finished products already in a ready-to-bake form. This method of production, on the one hand, allows you to significantly save energy costs, since it does not require heat treatment of the filling as in the case of using the aseptic method, and on the other hand requires additional energy consumption for cooling the increased, due to the filling, the amount of products prepared for delayed baking.

Figure 2

It can be said that the quality of such a product, like bread, is easy to make in a given hour, to vary, to improve, for the help of all kinds of additives, which is one of the main food products. Based on the research, the prescription composition of bakery products and frozen semi-finished products has been improved. The results of research of physico-chemical and structural-mechanical parameters of bread allow us to conclude about the possibility of producing bread from frozen semi-finished products of high quality through the combined use of different types of flour and adjustment of technological parameters.

Conclusion

Thus, water and its quality indicators in the technology of production of bakery products with deferred baking has a great impact on the quality of the finished product - these are issues of the state of water in frozen products; organoleptic, physic - chemical, microbiological parameters, water hardness, its technological parameters and prescription quantity. Shock freezing technology ensures the safety of the quality of the fresh product and does it better than other methods of harvesting and storage. Due to the long shelf life of products, it becomes possible to better plan production and prepare in advance a large number of finished products and semi-finished products, avoiding the need to repeat the preparation every day. Depending on the type of bakery products and the characteristics of the production of finished products of deferred baking, fruit and vegetable filling of aseptic storage or fresh, subjected to the process of deep freezing can be used.

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