Experimental use of food additives to accelerate the technological process of bakery production

M V Osipova
Yaroslav-the-Wise Novgorod State University, 41, ul. B.Sankt-Peterburgskaya, Veliky Novgorod, Russian Federation
E-mail: sampaz@list.ru

Abstract. In our country the production of bakery products is the most popular food industry. In the diet of citizens, the consumption of bakery products is a priority. In this regard, increasing the variety of products, and expanding the choice of bakery products for the population are important tasks for the food processing industry. These tasks can be solved with greater efficiency by applying the latest modern technologies at enterprises, which allow them to produce products of excellent quality with reduced financial costs. In the production of bakery products, it is possible to use production intensification technologies using new methods that allow optimizing the stages of the technological process and the entire production process. The use of new methods for optimizing technological processes allows reducing costs of production by reducing the time component in the bakery production process.

1. Introduction
For many hundreds of centuries people have been cooking bread since ancient times. They try to improve its quality, seek new tastes, and invent forms. In each state there were its own traditional ways of bread and bakery production. A priority was the production of tasty, flavored products which preserve quality for a long time. As a result, mankind obtained a great variety of bread and bakery products.

In ancient times bakers used long-term fermentation technologies. As a result, they obtained bread with original taste and flavor. Fermentative processes caused changes in carbohydrate-containing ingredients of bread dough. This resulted in an improvement of taste properties of bread products [1].

Today, bread and bakery production has changed cardinally. Increasingly, manufacturers try to use accelerated technologies for dough maturation which allow them to shorten the duration of production process by several times.

There are some techniques which modern bakers use actively. These are intensive kneading, additions of an increased amount of baking yeast, improvers, taste and aroma enhancers, and other additives in the bread recipe [2].

Every year, competition between manufacturers in the bread and bakery goods market increases. Enterprises are trying to widen an assortment of products yielded, and attract customers with new goods. New technologies and trends develop, manufactures are modernized, new kinds of equipment appear. In recent years, technological schemes of speeding up processes of preparing dough and baking bread have been actively introduced. This can be achieved by using baking mixes and various improvers.

Accelerated technologies allow manufacturers, while reducing the duration of technological operations, to increase manufacturing capacities without purchase and installment of new additional
equipment, to avoid the implementation of new additional technological workshops and plots, to save material and labor costs. In the addition, shelf life of products increases, as well as assortment.

However, besides undisputable positive aspects of using accelerated technologies, there are some negative ones: a raw material self-cost increase due to introduction of new ingredients in the recipe; mandatory labeling of E-additives which can be understood negatively by the consumer; possible worsening of taste characteristics of bakery products.

While making products using yeast technologies, one of the longest stages is fermentation during dough preparation. So, the shortening of this particular technological stage is a key element in optimizing technological processes and bakery production in general.

For Russian people, bread and bakery are traditionally one of the main food products. Daily need of a person amounts to 250-300 g of bakery products, including bread, pasta, various cereals [3]. In the Russian Federation there are a large number of enterprises producing bread and bakery products to provide the population with a daily norm of consumption of carbohydrate-containing products.

Bread is defined as a product obtained by the method of baking dough, which, in turn, is made using bread-baking yeast Saccharomyces cerevisiae and/or lactic acid bacteria. Dough is made from various raw materials (rye flour, wheat flour, rye-wheat flour, etc.), using various technologies, observing time and temperature modes, and adding salt, water, microorganisms, as well as other kinds of raw materials required by the recipe [4].

The recipe for “Darnitsky” bread includes 60% of rye flour, 40% of wheat flour. This bread is distinguished by its soft taste, pleasant flavor, good porosity and softness, firm crust, good sour tint in aftertaste.

2. Results
Bread manufacture is a multi-stage process. At each stage numerous physical and chemical interconnected processes occur. These processes are conditioned by chemical composition of dough components, microorganism activities, enzyme system effect, features of technological processes and equipment.

At the base of technological process of bread production there lie physical and chemical processes of the life activity of baker’s yeast Saccharomyces cerevisiae. The result of this effect is specific taste and aroma, as well as the appearance of the bread. In the technological process of making “Darnitsky” bread both dry and pressed baker’s yeast are used [5].

Taking into account all technological operations (proofing, baking), time spent on making “Darnitsky” bread is about 4 hours. The duration of the technological process of this type of bread may be changed provided that food additives are used to accelerate the dough maturation.

Food additives are manufactured in many countries. The main production is centered in Europe, the United States, and China.

Today, the problem of healthy diet is very popular. This fact influences the food supplement industry. The increasing tendency is observed to consume low-calorie products, and fewer fats, this results in the growing consumption of products with vitamins, minerals, sugar substitutes, etc. So, the production of food additives will expand further.

The main direction in baking industry is development and implementation of intensification technology. This process can be implemented through the use of food supplements, including bread improvers influencing technological and functional properties.

Very often, the concept of a food additive includes natural substances, whose function is to provide products of special purposes, for example, medicinal and prophylactic products, etc. At the same time, nutritional supplements give new necessary properties to products, improve their organoleptic properties, help to intensify the stages of technological production.

When labeling, food additives are designated with a letter “E” in compliance with the international system of numerical codification of food additives.

In bread baking technology the various groups of food additives are often added in flour/dough. The action principle of them is different. The use of these additives is conditioned by the following aims:
• need to use flour with low-quality parameters;
• need to intensify the stages of technological processes without significant material costs, including the need to implement the accelerated technology of bread and bakery production;
• possibility to give the dough certain properties: increased gas-holding capacity, elasticity, viscosity, plasticity, etc.;
• possibility to improve baking qualities of products and widen the assortment;
• ensure stable production of high quality products on continuous lines of bakery production;
• prevent damage of products, avoid the shortening of shelf life;

Functionality of food additives is different, their list is quite wide. For example, improvers with oxidizing and reducing effects play a role in regulating dough condition during kneading, and dough behavior throughout the entire technological process. They allow intensifying biochemical and colloidal processes in dough. Modified starches help to improve the structure and mechanical properties of dough, porosity, and color of bread crumb. Enzyme preparations differ from each other in effect. However, when added to the dough, they allow performing the technological process with the set action algorithm, and processing raw materials of various degrees of technological complexity. They improve crust color of bakery products, intensify the processes of spirit fermentation and dough maturation. Surfactants contribute to longer freshness of products. In baking, citric, lactic, acetic acids are regulators of dough acidity, including the rye flour dough. Calcium, magnesium, phosphorus salts and other mineral salts contribute to fermentative activity of baking yeast Sacharomyces cerevisiae.

In most cases, complex food additives consisting of many components with various functional purposes are used. They can contain both two and more than six components. They are manufactured in the form of powder, paste, tablets, liquid. Doses of food additives are insignificant: from 0.1 % to 1% of the total mass of dough flour ingredients. The leading manufacturers of food additives are companies in Western Europe: Schaller and Diamant (Austria), Puratos (Belgium), Ireks (Germany), and others.

A number of food additives for bakery products have useful properties which increase the volume of finished products, improve their appearance, taste and flavor, due to the fact that they contain soybean flour with a high content of lipoxygenase. They are able to retain gas in the dough with a low content of gluten, improve such general bread properties as appearance and crumb texture, slow down the process of bread staling, increase the yield of finished products by 1-2%.

There are a number of food additives used as a remedy for potato disease. They can be used in the manufacture of all sorts of bakery products, except for pastry. They act to inhibit the growth of microorganisms Bacillus mesentericus (potato bacillus), which are pathogenic for humans and animals.

A number of food additives strengthen the structure and structural mechanical properties of bread dough. These additives belong to the group of food emulsifiers and surfactants. They improve fermentation, molding, and proofing processes. Products obtained by this way are distinguished by a large volume, good crumb with a finely porous structure, and a thin crust. The best result can be obtained by adding emulsifiers into the dough in the form of solutions of fat emulsion in water.

Multi-functional food additives with complex action and content are often used. These additives include acid-containing components. Such additives are used to make bread from a mixture of rye and wheat flour, as well as from flour of the second grade. Bread obtained by this way is distinguished by a shorter period of fermentation, elastic crumb, porosity, slower staling. These complex multi-functional additives allow performing two functions simultaneously: they improve bread quality and technological processes, and they act as a sourdough.

The food additive named Classic (IREKS, Germany) acts as an improver. This additive helps to solve technological problems when the flour of unstable quality must be used, possesses the effect of whitening, contribute to bread desired volume and shape, taste and flavor, ensures even golden coloration of the product surface, contribute to slower staling of bread. This food additive can be used to manufacture all types of bread and bakery products from wheat flour high in sugar and fat. Experimental use of this additive makes it possible to manufacture bread by different ways, with
leaven and without leaven, contributes to shorter fermentation, and, consequently, allows accelerating the technological process of bakery production.

The complex food additive S-5000 of company Puratos made by Russian enterprise is a baking improver. Being a universal improver for wheat flour, it can be used in manufacturing a large assortment of bakery products. Having enzymes in its composition, it effects on main dough components. As a result, the period of fermentation becomes shorter, machine processing of dough is easier, dough during baking rises optimally. Finished products with a thin and golden crust, the desired volume and shape, a homogeneous crump structure are obtained. The presence of other ingredients in the composition of the food additive S-5000 ensures the whitening of the product, slow down the staling process. In addition to the improvement of organoleptic parameters of finished products even the small and economic dose of the food additive contributes to the improvement of technological and economical results, as the yield of finished products increases due to the improvement of flour quality.

Introduction of food additives allows transforming the components of flour and dough in such a way which is required by a technologist to perform a manufacturing task. At the same time biochemical, microbiological, and physical chemical processes change. In the vast majority of cases, this change is progressive and leads to the intensification of technological process of baking in general.

The studies have showed that, when using food additives, the technological process is accelerated by almost 2-3 times. First of all, this is due to the shortening of fermentation which is the longest process by itself. Also the use of food additives in the technological process makes it possible to exclude the most labor consuming and long process of sourdough making.

Experimental samples of bakery products were shown to correspond to organoleptic parameters required by the regulations for such products, completely identical to control samples without food additives. The humidity of crump of rye-wheat bread was 43-45%, acidity was 7.2-7.5°Т, porosity was 65%.

3. Conclusion
Summing up, we can note the following: in the industry there is a tendency to decrease the volume of consumer demand, and, consequently, decrease the output of bakery products. Most enterprises have reduced revenue, low profitability of production. The existing equipment is mainly out-of-date. Plants do not have enough means for technical re-equipment and replacement of worn-out equipment. Technical progress does not stand still, equipment manufacturers offer new products, however, modernization does not practically happen, due to difficult financial situation. As a result, we can only observe the backlog of the entire baking industry.

Bread and bakery products are the base of the human diet, and the baking industry itself belong to the industries producing essential products. For enterprises to “survive” in the conditions of fierce competition, they should constantly maintain and update the assortment, follow market news and new fashion trends.

In recent years, the assortment of manufactured products has changed. Much attention is paid to functional foods, healthy diet. Gluten-free products are becoming more common, and the demand for them is growing every year. In the gluten-free production there are some difficulties in raw materials processing and ensuring good external organoleptic parameters (shape, crust color, crumb texture). In this connection the need arises to use food additives-improvers in the recipe of these products.

Difficulties can also arise when traditional products are manufactured using “complex” raw materials. To prevent a decline in the quality parameters of finished products, improving additives are also used.

The use of food additives to accelerate the technological process of bakery products is one of the solutions in the present situation, and the production intensification in general. They allow manufacturers to increase existing capacities without significant costs.

References
[1] Demarigny Y and Gerber P 2014 Usefulness of natural starters in food industry: The example
of cheeses and bread *Food and Nutrition Sciences* 5 1679–91 DOI: https://doi.org/10.4236/fns.2014.517181

[2] Sofyan M, Selma A-H, Radwan A, Yousef T and Ola Al 2013 Utilization of different hydrocolloid combinations in gluten-free bread making *Food and Nutrition Sciences* 4 (5) 496–502 DOI: https://doi.org/10.4236/fns.2013.45063

[3] Ovsyanko D V and Chaika V A 2006 Features of organizing the process of continuous quality improvement in Russian companies and its relationship with the processes of strategic behavior *Scientific report* 6 (R) (SPbGU: Research Institute of management) https://gsom.spbu.ru/files/upload/niim/publishing/papers/Ovsianko_Chaika.pdf (date of request 08.03.2020)

[4] Danza A, Mastromatteo M, Lecce L, Spinelli S, Laverse J, Lampignano V, Contò F and Nobile M 2014 Effect of wholemeal durum wheat varieties on bread quality *Food and Nutrition Sciences* 5 977–88 DOI: https://doi.org/10.4236/fns.2014.511108

[5] Meledina T V, Davydenko S G, Golovinskaya O V, Shestopalova I A and Morozov A A 2018 Use of a new strain of yeast in bakery *Technique and technology of food production* 48 (4) 59–65 DOI: https://doi.org/10.21603/2074-9414-2018-4-59-65