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The Technology of Preparing Cookies and Cakes from Sorghum Flour

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Abstract: In this article, the technology of making cookies and cakes from sorghum flour was studied. Its chemical composition and functional properties were analyzed, and its impact on product quality was assessed. Due to the absence of gluten, the need for additional components to improve the dough structure was substantiated. Studies have shown the importance of dough composition, aeration, and temperature regime. As a result, an improvement in the porosity, taste, and shelf life of the products was revealed, and corn flour proved to be a promising raw material for gluten-free products.

Keywords: Sorghum, gluten-free products, cookies, cakes, technology, starch, rheological properties, aeration, emulsifiers, stabilizers, confectionery products, food industry, functional foods.

Introduction: Currently, the production of functional and dietary products in the food industry is becoming an important global trend. This process is explained, on the one hand, by the increased demand for healthy nutrition, and on the other hand, by the widespread prevalence of gluten-related diseases - in particular, gluten intolerance. Therefore, the production of high-quality and biologically valuable confectionery products using gluten-free raw materials is one of the urgent scientific and practical tasks.

In recent years, sorghum has gained particular attention among grain crops. It is distinguished by its rich chemical composition - rich in proteins, complex carbohydrates, dietary fiber, vitamins, and minerals. Corn contains natural antioxidants, which are important for human health. Most importantly, corn grain is naturally gluten-free, which allows it to be used as a promising raw material in the production of dietary and functional products.

However, there are problems such as insufficient formation of rheological properties, structural strength, and organoleptic indicators of dough in products made from gluten-free flour. Therefore, when using corn flour, the improvement of technological processes, the selection of optimal recipes and additional components are of great importance. This research is aimed at solving these problems and scientifically illuminates the possibilities of improving the quality indicators of confectionery products made from corn flour.

Corn is distinguished by its high ecological adaptability, low water demand, and good yields even on saline soils. This shows it as an important component in sustainable food systems.

The chemical composition of corn grain consists of a complex biopolymer system, the main part of which is starch. Starch consists of amylose and amylopectin fractions, the ratio of which directly affects the technological properties of the product. Under the influence of heat and moisture, starch granules swell, and gelatinization of starch occurs. During this process, starch undergoes structural changes, transitions to a semi-liquid gel state, and forms the internal structure of the product.

Sorghum proteins are dominated by the prolamine fraction, which cannot form an elastic three-

dimensional network like gluten in wheat. As a result, the gas retention capacity of the dough decreases, and the volume, porosity, and elasticity of the product are reduced. Therefore, it is necessary to introduce additional components that strengthen the structure in the technological process.

The rheological properties of corn flour depend on its degree of dispersion, particle size, surface energy, and hydration capacity. The smaller the particles, the larger their surface area and the stronger their interaction with water. This increases the viscosity of the dough and influences its formation. At the same time, the addition of excess water disrupts the rheological balance of the dough, as a result of which it becomes sticky and uncontrollable. Therefore, determining the optimal amount of water is considered scientifically important. The optimal state of the dough is that it has neither a very dry nor a very liquid viscoelastic system.

The main scientific problem in cookie production technology is the formation of the structure. Due to the absence of gluten, the molecular bonds within the dough are weak. Therefore, fat and sugar components play an important role. Fat reduces friction between particles, making the dough plastic, while sugar binds with water, forming crystalline and amorphous structures. During the baking process, Maillard reaction and caramelization reactions occur, forming the organoleptic indicators of the product. Especially as a result of the Maillard reaction, complex aromatic compounds are formed, which enhance the smell and taste of the product.

Table 1

Complex influence of technological parameters on product quality

Parameter	Low level result	Optimal level result	High level result
Humidity (%)	Dry, brittle, dense	Soft, elastic, stable	Sticky, shapeless
Temperature (°C)	Immature	Homogeneous, porous	Dry, burnt
Fat (%)	Hard structure	Softness & plasticity	Excessive fat
Sugar (%)	Tasteless, colorless	Balanced taste and color	Increased caramelization
Starch (%)	Weak structure	Durable gel system	Very dense

Table 1. The influence of technological parameters on product quality is a complex and interconnected process. The degree of moisture determines the consistency of the dough: at low moisture, the product becomes dry, brittle, and dense, and at the optimal level, a soft, elastic, and stable structure is formed. When moisture increases, the dough becomes sticky and the product may lose its shape.

The temperature regime is also an important factor; at low temperatures, the product does not fully ripen, and at optimal temperatures, a uniformly ripened and porous structure is formed. At high temperatures, the outer part of the product dries quickly, causing burns.

The amount of fat directly affects the texture of the product: less fat forms a hard and dense structure, while the optimal amount makes the product soft and soft. Excess oil makes the product extremely heavy and fatty.

The amount of sugar shapes the taste and color of the product. Its insufficiency leads to weak taste and color formation, and in optimal quantities, pleasant taste and color are provided. However, excess sugar causes severe caramelization, leading to excessive darkening of the product.

Starch serves as the main structural element of the product. A small amount of it weakens the structure, and at the optimal level, a strong and stable gel structure is formed. Excessive starch makes the product too dense and hard.

Process of making dough from corn flour

Confectionery made from corn flour

Sweet pastries

Porous structure

The process of making dough from corn flour has its own technological features, and this stage is one of the main factors determining the quality of the finished product. As a result of correct balancing of the dough composition, uniform mixing of components, and ensuring optimal conditions, it is possible to obtain high-quality confectionery products, in particular, sweet pastries. When such products are manufactured according to the correct technology, they are distinguished by a soft and porous structure.

The cake preparation process is even more complex, and aeration plays an important role in it. Egg proteins undergo denaturation as a result of mechanical processing, forming a stable foam. This foam, holding air bubbles, expands during the cooking process and serves to increase the volume of the product. However, the relatively dense and heavy structure of corn flour can reduce the stability of this aeration system.

Therefore, the use of emulsifiers and stabilizers in the technological process is of great importance. These substances combine the oil and water phases, stabilizing the dispersed system, as a result of which the porosity, volume, and overall quality of the product are improved.

Table 2

Prescription components and their technological role

Component	Technological function	Mechanism of action
Egg white	Aeration, foaming	Protein denaturation and foam stabilization
Oil	Plasticity	Reduces friction between particles
Sugar	Structural bonding	Creates a crystalline structure, forming a solution.
Starch	Strengthening the structure	Creates a gel system
Emulsifier	Phase integration	Increases emulsion stability

Table 2. The thermophysical properties of corn products are also very important. Due to low thermal conductivity, heat penetrates slowly into the product. This creates a heat gradient, meaning a temperature difference occurs between the outer and inner parts of the product. If the baking process is organized incorrectly, the outer layer may burn out, and the inner part may remain raw. Therefore, it is recommended to carry out cooking in two stages: first, the inner structure is formed at a low temperature, then the outer layer is brought to a crispy state at a high temperature. This process significantly improves product quality.

Table 3

Complex results of various recipes

Option	Sorghum (%)	Additions (%)	Porosity	Taste	Overall quality
A	100	0	Low	Average	Low
B	80	20	Average	Good	Good
C	70	30	High	Very good	Excellent

Table 3. The preservation properties of corn products also have scientific significance. High fiber content

increases the product's ability to retain moisture, which slows down its drying. However, the oxidation of fat components worsens the taste and quality of the product. Therefore, technologies for the use of antioxidants, vacuum packaging, and low-temperature storage are recommended. These measures extend the shelf life of the product and maintain stable quality.

In general, the technology of making cookies and cakes from corn flour is a complex multifactorial system, in which the composition of raw materials, rheological properties, heat exchange, chemical reactions, and structural formation are closely interconnected. Through in-depth scientific analysis of these factors and their optimal management, it is possible to produce gluten-free, high-quality, functional confectionery products that meet modern requirements.

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