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## РАСШИРЕНИЕ ВОЗМОЖНОСТЕЙ ИСПОЛЬЗОВАНИЯ ПРОДУКТОВ ПЕРЕРАБОТКИ ЗЕРНА В ХЛЕБОБУЛОЧНЫХ ИЗДЕЛИЯХ

## EXPANDING THE USE CASE GRAIN PROCESSING PRODUCTS IN BAKERY PRODUCTS

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Аннотация: Одной из актуальных проблем является использование в выпечных хлебобулочных изделиях различного рода модифицированных крахмалов. Такие крахмалы могут быть получены из зерна невысокого качества, обычно составляющего значительную часть потерь при его хранении. Особую актуальность переработка такого зерна в полезные ингредиенты для использования при получении продуктов питания представляет в условиях отсутствия рядом с хранилищами специализированных крахмально-паточных производств, например в районах Крайнего Севера, вахтовых поселков и других районов с компактным проживанием населения лишенных возможностей регулярного пополнения продуктами питания.

*Ключевые слова*: выпечные хлебобулочные изделия, модифицированные крахмалы, зерно невысокого качества, потери при хранении, полезные ингредиенты.

**Abstract:** One of the most pressing problems is the use of various types of modified starches in baked bakery products. Such starches can be obtained from low-quality grain, which usually accounts for a significant part of the losses during storage. The processing of such grain into useful ingredients for use in the production of food is of particular relevance in the absence of specialized starch-treacle production facilities near the storage facilities, for example, in the Far North, shift settlements and other areas with a compact population deprived of the possibility of regular replenishment of food.

Key words: baked bakery products, modified starches, low-quality grain, storage losses, useful ingredients.

**Introduction.** Modern requirements of critical technologies and priority directions of the development of science and technology associated with the rational use of natural resources and the development of biotechnology at the current level should be implemented in the food industries in the form of deep processing of such valuable food raw materials as grain. Experts believe that a promising direction in this area is the search and application of new technological methods for processing low-quality raw materials into useful ingredients for their use in the production of food products, in particular bakery products [1]. In this regard, additional research is required to identify the effective-ness of the use of different types of starch in baked small-piece bakery products.

**Research objectives and formulation.** Formulations and starch slurry manufacturing process chosen for the experiments traditional native starch and in accordance with the development of All-Russia Research Institute of starch products [2]. They included thorough mixing of the starting material in water at 50 of C, and maintaining the resulting slurry for one hour, and in 0.12% FeSO 4 and 0.20% H 2 O 2 wt. were taken as modifying reagents of dry substances.

For the prepared samples, the rate of gelation was determined in accordance with the developed technique.

A comparative qualitative analysis of the gelation rate was determined using high-speed photography on prepared samples of starch suspensions by the gelation rate determined by the ratio of the equivalent spreading diameter to the gelation time (Fig. 1)

$$V = D/\tau [m/s]$$
 or  $V = \frac{2\sqrt{\pi}}{\tau} [m/s]$ 

Comparison of the experimental results obtained over a period of 5 to 20 minutes indicates that modified starches have a higher gelation rate, as evidenced by a lower spreading rate of the paste (Fig. 2). In order to improve the technology for the production of modified starches for workshops of low productivity, we have carried out studies of the combined thermo-chemical treatment of grain starch of the first grade in accordance with GOST 31935-2012 Wheat starch. Technical conditions. The composition of the raw material source for it was selected in the form of wheat with lower quality requirements bordering on substandard grain according to GOST 9353-2016 Wheat. Technical conditions. The chemicals used were the same as in the preliminary experiment with the same dosages.



Figure 1. Dynamics of gelation of starch paste at 50  $^{\circ}$  C

(upper row - spreading of control samples along the measuring grid, lower row - spreading of modified samples)



время, мин

Figure 2. Comparative characteristics of the spreading rate of chemically modified (1) and native (2) and starch

Table 1

Characteristics	of grain	raw materia	ls selected	for the	experiment

Indicator name	Characteristic	
	top grade	first grade
Mass fraction of moisture,%, no more	14	14
Mass fraction of total ash in terms of dry matter,%, no more	0.20	0.30
Acidity, cm, no more	20	25
Mass fraction of protein in terms of dry matter,%, no more	0.3	0.5

The thermo-chemical treatment of such grain was carried out on a KESh-2 extruder equipped with the necessary measuring sensors, according to the modes recommended for extruding starch-containing food raw materials [3].

After receiving the extruded product (Fig. 3), it was ground on a laboratory hammer mill MD  $5 \times 2$  to the degree of powder.



Figure 3. Extruded starch

The obtained thermo-chemical modified starches were used for baking samples of small-piece bakery products to compare their organoleptic characteristics.

The quality of baked samples of bakery products was assessed organoleptically (Fig.4).



Figure 4. Samples baked using different starches for organoleptic evaluation: 1 - native; 2 - chemically modified; 3 - thermo-chemically modified

## **Results obtained and discussion**

The organoleptic assessment of the quality of baked bakery products was carried out by a group of experts including designers of heating equipment, technologists of bakery production and representatives of customers from chain supermarkets, such as "Lenta". Concordance of the expert group was assessed by the Kendall criterion

$$W = \frac{12S}{m^2(n^3 - n)}$$
(1)

where M is the number of experts in the group;

N is the number of factors;

S is the sum of the squares of the rank differences (deviations from the mean), calculated by the formula:

$$S = \sum_{j=1}^{n} \left( \sum_{i=1}^{m} A_{ij} - \frac{1}{2} m(n+1) \right)^{2}$$
<sup>(2)</sup>

The value of this criterion turned out to be 0.87, which indicates the consistency of the opinions of experts.

During the survey, an attempt was made to identify the influence of the main organoleptic indicators on the quality of bakery products baked with native starch, chemically modified, thermo-chemically modified.

The indicators set for organoleptic control by the National Standard of the Russian Federation [4] were chosen as descriptors for such an assessment.

The collected data was subjected to statistical processing, taking the overall quality of the product as an objective function, and individual indicators as descriptors.

Table 2

Descriptors according to the national standard				
Indicator name	Characteristic			
Smell	Characteristic of a product of this type, without foreign smell. When using aromatic additives - the smell			
	characteristic of the added additives			
Surface	Corresponds to the type of product			
Color	Light yellow to dark brown			
The form	Inherent to the product			
Baked	Baked, not wet to the touch, no traces of impurities			
Promes	No traces of impurities			
Porosity	Porous			
Taste	Characteristic of a product of this type without any foreign taste, When using food additives, characteristic			
	of the additives introduced			

Descriptors according to the national standard

Quality of baked goods

Table 3

		Starch type		
	Name of indicator	Native	Chemically modified	Thermo-chemically modified
1.	Smell	77	64	75
2.	Surface	22	41	31
3.	Color	21	37	38
4.	Form	22	34	41
5.	Baked	31	33	23
6.	Promes	16	15	17
7.	Porosity	5	14	8
8.	Taste	30	41	48

In order to more objectively assess the quality of baked products, you can determine the areas of the figures outlined by the corresponding curves. The results obtained are presented in Table 4 and Fig. 7. The calculation results showed that the filling factor for baking using thermo-chemically modified starch is 1303, and for chemically modified starch 812.242.

		Results of the survey of expert	S	
Expert	Starch type			
Ñ₂	Native	Chemically modified	Thermo-chemically modified	
1	77	64	75	
2	22	41	31	
3	21	37	38	
4	22	34	41	
5	31	33	23	
6	16	15	17	
7	5	14	8	
8	30	41	48	



Figure 5. Processing of survey results by types of starch: 1 - native; 2 - chemically modified; 3 - thermochemically modified

For the scientific substantiation of the technology and technological processes of food production, a mathematical model has been developed for predicting the accuracy and stability of processes [5]. The essence and main stages of modeling are shown in figure 6.



Figure 6. The main stages of the mathematical model for predicting the accuracy and stability of grain processing and production of baked goods

Table 4

#### Results

Modern requirements for resource conservation, the fulfillment of which is implemented in the food industries, require deep processing of such valuable food raw materials as grain. One of the promising directions in this area is the use of modern technological methods for the processing of low-quality raw materials into useful ingredients for their use in the production of food products, in particular bakery products. The above experiments have shown that the best quality is possessed by baked goods containing thermo-chemically modified starch obtained by extrusion of low quality grain subjected to preliminary chemical treatment.

## ЛИТЕРАТУРА

1. Романчиков, С.А. Изменение условий разработки новых продуктов питания для импортозамещения в условиях экономических санкций / С.А. Романчиков // Известия Санкт-Петербургского государственного аграрного университета. 2017. № 4 (49). С. 178-183.

2. Способ производства модифицированного крахмала, Патент РФ2159252Жушман А.И. и др. Опубликовано: 20.11.2000 Бюл. № 32.

3. Василенко, В.Н. Научное обеспечение производства полноценных коэкструдированных и экспандированных комбикормов/ докторская диссертация – Воронеж – 2010.

4. Приказ Федерального агентства по техническому регулированию от 29 декабря 2005 г. N 480-ст«Изделия хлебобулочные из пшеничной муки».

5. Ермошин, Н.А. Методологические аспекты научного обоснования технических решений модификации технических средств и технологического оборудования продовольственной службы /Н.А. Ермошин, С.А. Романчиков// Ползуновский вестник. 2020. № 2. С. 100-106.

#### REFERENCES

1. Romanchikov, S.A. Izmenenie uslovii razrabotki novykh produktov pitaniya dlya importozameshcheniya v usloviyakh ehkonomicheskikh sanktsii / S.A. Romanchikov // Izvestiya Sankt-Peterburgskogo gosudarstvennogo agrarnogo universiteta. 2017. № 4 (49). S. 178-183.

2. Sposob proizvodstva modifitsirovannogo krakhmala, Patent RF2159252Zhushman A.I. i dr. Opublikovano: 20.11.2000 Byul. № 32.

3. Vasilenko, V.N. Nauchnoe obespechenie proizvodstva polnotsennykh koehkstrudirovannykh i ehkspandirovannykh kombikormov/ doktorskaya dissertatsiya – Voronezh – 2010.

4. Prikaz Federal'nogo agentstva po tekhnicheskomu regulirovaniyu ot 29 dekabrya 2005 g. N 480-sT«Izdeliya khlebobulochnye iz pshenichnoi mukl».

5. Ermoshin, N.A. Metodologicheskie aspekty nauchnogo obosnovaniya tekhnicheskikh reshenii modifikatsii tekhnicheskikh sredstv i tekhnologicheskogo oborudovaniya prodovol'stvennoi sluzhby /N.A. Ermoshin, S.A. Romanchikov// Polzunovskii vestnik. 2020. № 2. S. 100-106.

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