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PROSPECTS OF USING RICE CEREALS AND FLOUR IN THE PRODUCTION OF CANNED PRODUCTS OF LONG STORAGE

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ABSTRACT

The article is devoted to the study of prospects and the possibility of introducing into the production of rice cereals and flour for canned products of long-term storage. It has been established that in food production it is simpler, cheaper, faster to use starch-containing raw materials instead of pure starch. The nutritional and biological value of the feedstock was studied and it was noted that rice and rice flour do not contain fat, gluten (a protein containing gliadin) - an irritant of the gastrointestinal tract and do not have allergic properties, have a neutral taste and a clean aroma. Based on a complex of studies, it was found that in canning it is advisable to use: rice flour as a thickener, structure-forming agent and partially filler in the production of various sauces, jelly, desserts, creams, marmalades, jams, etc .; Rice groats as a filler in the production of a variety of cereals, pastes, pastes, second and first courses.

Disciplinary: Food and Nutrition Sciences.

1. INTRODUCTION

In view of the insufficiently favorable environmental situation in the country, the search for means that increase the human body's resistance to harmful environmental influences is of particular relevance. On the other hand, in conditions of the economic instability of the nutrition structure, the population is undergoing significant changes in the direction of exacerbating the imbalance of the main components of the diet. One of the reasons for this is the high cost and low incomes of the population, therefore, the issue of finding conditions, selecting, developing formulations of food products, especially long-term storage, when they are prepared using natural, equivalent in nutritional value, but cheaper types of raw materials, is also more relevant. sparing technological parameters of

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the technology for preparing finished food products, ensuring the safety of their natural biological value in the manufacture [1-5].

Among the violations of the nutritional status of the population of Russia (2000–2020), there is a factor of excessive sugar intake, which affects body weight and is one of the causes of excess weight (an important problem for many). Therefore, in the production of canned sugar-containing concentrated products (jams, jams), a decrease in the formulations of expensive high-calorie sugar is relevant, because this increases the usefulness of the product and will affect the reduction of its cost.

However, sugar refers to carbohydrates, which are an essential energy component of food, providing up to 60% of the calorie intake, confirming the need for carbohydrates in food [6-8]. Therefore, the search for cheaper carbohydrate equivalent raw materials (materials) instead of granulated sugar is important. Such raw material is starch. In recent decades, experts in the field of chemistry of starch production have studied, evaluated its innumerable possibilities, developed various methods for its modification processes and ways to adapt the properties of starches to the ever-increasing needs of consumers around the world, starch is an almost universal raw material, it is used in the world for the production of a number of food products (sauces, jelly, mayonnaise, etc.) as a thickener, structurant, filler [9-10]. In a practical world, the most common raw materials for starch use are potatoes, corn, tapioca, wheat. The technology for producing starch is relatively labor-intensive, energy-intensive, and material-intensive, so the price of starch is quite high. The use of starch incomparably upsets the cost of the finished product, the diet of which includes pure starch. Starch, depending on the amount added, makes the product structure creamy, emulsified, thick, pouring, loose, etc [11-14].

Based on the foregoing, the conclusion is that it is advisable to add not starch to the formulation of starch-containing products, but starch-containing raw materials from which starch is obtained, it is simpler, cheaper, faster. In addition, raw materials, as a rule, are biologically valuable, which is lost in the process of making starch [15-19].

When choosing starch-containing raw materials, it is necessary to take into account that these raw materials are neutral in taste, clean in aroma (odorless).

In this case, in parallel with the quality, the cost issues of the finished products produced will be positively resolved.

In Russia, starch is traditionally obtained from potatoes, corn, and sometimes from wheat. It is known that only potato starch has a pure aroma, but it is expensive, almost at the level of sugar, and starch from wheat, waxy corn has a mild aroma characteristic of raw materials, which is not desirable for canned products. Rice products are supposed to meet our requirements.

The canning industry in the production of canned products of long storage is guided by the following postulates:

- use only high-quality natural raw materials of guaranteed useful quality;
- use gentle technologies to maximize the nutritional and biological value of the raw materials used;
- finished products should have good gustatory and taste properties and provide the body with the required complex of biologically active substances, be as useful as possible to the health of the consumer.

Currently, canned products produced according to traditional technology and recipes have good food and taste properties, a fairly high biological value, but relatively expensive, which reduces its purchasing value against the background of the cost of imported products, significantly inferior in all quality characteristics of domestic products, as It contains many cheap additives - enhancers of taste, aroma, consistency, preservatives, stabilizers of artificial origin, even often having an expired shelf life. In the production of many canned domestic products, such as sauces, meat-and-vegetable, canned meat, modified materials (soy and soy products: flour, starch, etc.) are used as thickeners and flavor enhancers, which, according to medical studies, are not safe for human health, especially to children.

2. METHOD

The studies were carried out in the laboratory and bench conditions of the Research Institute "Biotechpererabotka" and in the production conditions of canning enterprises in the Krasnodar Territory.

The object of the study was: corn and potato starch, rice flour, finely ground, processed by IR radiation or extrusion, rice (cereal), white polished or brown peeled.

Standard physical and chemical (dry substances, pH, titraTable acids, mineral impurities) and organoleptic (taste, color, smell, consistency, appearance), as well as indicators characterizing food, are selected as the main indicators characterizing the quality and value of objects of research. and biological value: vitamins: (C, β-carotene, P (polyphenols)), minerals K, Na, Ca, Mg and trace elements, free acids, and microbiological indicators, in accordance with regulatory requirements.

Physicochemical parameters, organoleptic properties, vitamins C, β-carotene, etc. were determined by standard methods [8-16].

Macronutrients K, Na, Ca, Mg on a FLAVIO flame photometer, other trace elements were determined using an atomic adsorption spectrograph, amino acids on an amino analyzer.

3. RESULT AND DISCUSSION

Summarizing the theoretical review, the experience of related specialties and, having completed a set of experiments, we found that rice flour is positively indicative of the production of several canned products for long and short-term storage: different types of sauces, meat and vegeTable (pastes, stews, pasta, cereals, various second courses) and even highly concentrated sugar-containing canned food - jams, jam, desserts, and others.

The research revealed the advantages of rice flour, rice cereal in the production of canned goods from a technological point of view, which are shown in Table 1. Based on constant research, it was found that rice flour is most suitable for use as a thickener, a structuring agent, a water-binding component, a sweetener in the production of canned food long-term and short-term storage like sauces for various purposes, creams, jelly, desserts, marmalade jams, second meat and vegetable, meat and fish dishes (paste you, pasta, stews, meatballs, ravioli, etc.).

Rice groats are white and especially shelled brown in color suitable for the production of cereals

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such as "Porridge for health", desserts, pilafs, stuffed vegetables, etc.

Since the production of flour and peeled cereals is less time-consuming, energy-intensive, simpler, cheaper than the production of starch and their price is relatively lower, this will reduce the cost of canned products while maintaining its traditional food taste, nutritional and biological value. It is very important that rice, rice flour do not contain gluten - an irritant of the gastrointestinal tract, and therefore canned food with rice products are more dietary, which is also important for human health.

Rice and flour from it are 100% positive for use in the production of canned food, as they have a neutral taste, clean aroma and biologically valuable, taste improve, but do not reduce the traditional food taste properties of the finished product.

Table 1: Benefits and suitability of rice flour in the production of canned food

Indicators and their characteristics	Types of canned food			
	Sauces	Meat, second courses	Desserts, Jelly	Jams
The use of flour	Universally			
The taste is neutral	Does not distort the natural taste and does not worsen	Does not distort the taste of canned meat and vegeTable	Does not change the taste of the main components	
Light color	The color of the main components (prescription) products is kept natural			
The method of adding flour to the recipe mixture	Both dry and hydrated			Hydrated
Influence on the structure of the finished product	Increases viscosity, promotes the formation of a good sTable consistency characteristic for sauces	It binds water in the ratio: 1: 4; 1: 4.5. Increases the finished product	Forms stable gels, which makes the appearance of canned food palaTable and attractive	It promotes the formation of a jelly-like jam-sTable, granular structure in jams with a significantly lower content of sugar and dry substances in the finished product
Effect on the nutritional and biological value of canned food	It increases the nutritional and biological value of canned food by the content of protein, free amino acids, mineral elements, vitamins, primarily group B, and dietary fiber contained in rice.			
				Reduces sugar and dry matter, eliminates synergies at high temperatures, which is important and valuable when using jam and jams in the confectionery industry
Fat	not detected			
The presence of gluten (protein) - a gastrointestinal irritant in:	not detected			
rice cereal (brown, white)	not detected			
flour	not detected			
Allergic properties	not detected			

Based on experimental studies and literature data, the Institute studied the properties, characteristics, nutritional and biological value of starch, rice flour and polished, polished, peeled cereals, the results are presented in Table 2.

Table 2: Comparative characteristics of rice products

Indicators, units measuring	Rice Starch	Rice flour	Rice, groats	
			Polished (white)	Husked (brown) unpolished
General Characteristics	The main component of processed rice, broken during processing, is present in the endosperm of the grain, accounting for 90-93% of the dry matter of rice	Made from ground polished rice, which consists more of starch and does not contain gluten.	Polished rice, the size of which is not less than ¾ of the length of whole rice = Ready rice	Enriched with natural minerals (iron, phosphorus, silicon, magnesium, potassium, iodine, calcium) and vitamins (biotin, thiamine, niacin, B6), fiber, beta-glucan lost during grinding
Use in the world practice				
Features	As - filler, thickener in the production of sauces, desserts, bread, jelly, sweet syrups, meat products; - emulsifier, stabilizers in dairy products; - the basis for dry creams, sauces, soups, various mixtures of ping-dings, jelly; - a builder in the production of oriental sweets, marmalades, fillings for pies, while the consumption is 4-7%, sugar consumption is reduced to 10%	As a thickener (in small quantities) in sauces, goulash, meat products, desserts, pastries, especially in Asian cuisine when baking sticky coconut cakes and sweets, bread.		As a filler in the production of second courses (pilaf, cereals, side dishes for meat, fish, vegetables, fruits, berries)
Disadvantages		Products are dry because flour absorbs a lot of moisture, it is necessary to take this into account and give more liquid and less flour. Not used for yeast dough, due to lack of gluten. Products bake longer and at lower temperatures than wheat flour products		
Benefits (lack of gluten (protein) (protein) in rice, which contains gliadin - a digestive system irritant	It is recommended for dietary food if there is a problem with the digestive system (constipation, gas in the intestines, diarrhea, etc.) intolerance			
Allergenicity	Not allergic			
Popularity, the prevalence in the world:	-	-	Popular, 2nd culture by volume	
In the Kuban	Is being introduced	Introduced, mastered	Popular, 2nd culture by volume	

Table 3: The chemical composition of rice products

Indicators, units measuring	Starch		Rice flour			Rice, groats	
	Corn	Potato	Finely ground	IR-Treated	Thermoplastic Extruded	Polished (white)	Husked (brown) unpolished
Mass fraction per 100 g of product							
Water g	13.0	20.0	9.0	Not investigated	Not investigated	14.0	14.0
Proteins, g	1.0	0.1	7.4			7.0	7.3
Fats, g	0.6	0.0	0.6			1.0	2.0
Carbohydrates, including	83.5	78.2	80.2			74.0	63.1
Mono- and disahara, g	0.0	0.9	0.7			0.7	3.1
Starch, g	83.5	73.3	79.1			72.9	55.2
Dietary fiber, g	1.7	1.4	2.3			3.0	9.0
Ash, g	0.2	0.3	0.5			0.7	4.6
Mineral substance							
Silicon mg	-	-	-	Not investigated	Not investigated	1240.0	1240.0
Potassium mg	15.0	15.0	50.0			54;100.0-202	202.0
Calcium mg	7.0	40.0	20.0			8.0;24-40	66.0
Magnesium mg	1.0	0.0	30.0			24-50;0-16	96.0
Sodium, mg	30.0	6.0	22.0			12;26-89	89.0
Phosphorus mg	20.0	77.0	119.0			21-96;150-328	328.0
Sulfur, mg	-	-	-			80	60.0
Chlorine mg	-	-	-			133	133.0
Iron mg	0	0	1.3			1.0-1.02	1.8-2.6
Manganese, mcg	Not investigated					1250.0	9630.0
Aluminum, mcg						-	912.0
Vanadium, mcg						-	400.0
Zinc, mcg						1420.0	1800.0
Copper, mcg	Not investigated					250.0	560.0
Boron, mcg						120.0	224.0
Fluorine, mcg						50.0	80.0
Selenium, mcg						-	20.0
Nickel, mcg						2.7	51.6
Molybdenum, mcg						3.4	26.7
Chromium, mcg						1.7	2.8
Iodine, mcg						1.4	2.3
Cobalt, mcg						1.0	6.9
Vitamins:							
B1 (thiamine), mg	0	0	0.06	Not investigated	Not investigated	0.08	0.5
B2 (riboflavin), mg	0	0	0.03			0.04	0.1
B3 mg	0	0	-			-	0.6
B6 mg	0	0	-			0.18	0.5
B9, mcg	0	0	-			-	35.0
Choline, mg	0	0	-			78.0	85.0
Biotin (Vit. H), mgk	0	0	-			3.5	12.0
Folacin, mcg	0	0	-	-	-	19.0	-
E mg	0	0	6.3	-	-	0.40-0.45	1.0
PP (niacin nicotinic acid, mg	0	0	1.4	-	-	1.6	3.8
β-caronite, mcg	0	0	no	-	-	no	no
C mg	0	0	no	-	-	no	no
Pantothenic acid, mg	0	0	-	-	-	0.4	-
Essential amino acids, g / 100 g							
Valine	-	-	0.42	0.48	0.49	0.40	Not investigated
Isoleucine	-	-	0.33	0.36	0.38	0.39	
Leucine	-	-	0.61	0.76	0.80	0.73	
Lysine	-	-	0.26	0.32	0.33	0.29	
Methionine	-	-	0.13	0.18	0.19	0.15	
Triokhin	-	-	0.24	0.29	0.31	0.26	
Trintofan	-	-	0.75	0.11	0.10	0.09	
Phenylalanine	-	-	0.34	0.45	0.47	0.41	
Total Essential Amino Acids	-	-	3.08	2.95	3.07	2.72	
Replaceable amino acid							
Alanine	-	-	Not investigated	Not investigated	Not investigated	0.39	Not investigated
Arginine	-	-				0.60	
Aspartic	-	-				0.64	
Gaiden	-	-				0.19	
Glycine	-	-				0.4	
Glutamic acid	-	-				1.34	
Proline	-	-				0.36	
Serine	-	-				0.36	
Tyrosine	-	-				0.29	
Histin		-				0.14	
Total Replaceable Amino Acids:						4.71	
Total Amino Acids:						7.43	
Calories, kcal	343.0	313.0	356.0	-	-	333.0	283.8

Rice protein is defective, amino acid deficiency in lysine and threonine. The mineral composition is extremely rich, contains almost all vital elements, and has catalytic properties. The use of rice flour and cereal are biologically beneficial and physiologically valuable.

Starch - a plant polysaccharide with a complex structure consists of amylose and amylopectin. The ratio of amylose and amylopectin in the starch molecule in different species is different (amyloses 13-30%; aminopectin 70-80%), both amylose and aminopectin in plants are formed in the form of starch grains, the structure of which has not been fully identified, but the properties are well understood (Table 4).

Table 4: Properties of amylose and amylopectin starch.

Properties	Amylose	Amylopectin
Molecular mass	50 thousand-2 million	1 to several million
Retrograde ability	High	Low
β-Milose Action Products	Maltose	Maltose β-relic decoder
Glucoamylose Action Products	2-glucose	D-glucose
Molecule shape	Linear	Branched, which determines a high degree of gelatinization

The rice starch molecule contains more amylopectin than amylose, which is why it has a high degree of gelatinization.

An important property of starch (both pure and contained in raw materials) is gelatinization, for which it is used in the production of food products.

Intact starch grains are insoluble in cold water, but can reversibly absorb moisture and swell easily. The increase in grain diameter during swelling depends on the type of starch, for rice, up to 200%.

As the temperature rises, the vibration of starch molecules increases, their intermolecular bonds are destroyed, which leads to the release of binding sites for interaction with water molecules through hydrogen bonds. The penetration of water, the increasing separation of large and long segments of starch chains increases the disorder in the overall structure, reduces the number and size of crystalline regions. With further heating in the presence of a large amount of water, a complete loss of crystallinity occurs, accompanied by a loss of grain shape. As a rule, large starch grains are gelatinized at a lower temperature than small ones.

The temperature corresponding to the destruction of the internal structure of starch grains is called the temperature of gelatinization, it depends on the type (source of starch raw materials) of starch (Table 5).

Table 5: The dependence of the temperature of gelatinization of starch on the source (raw material) of its receipt

Raw materials	Amylose Content, %	Gelatinization temperature, ºC
Rice (gluten free)	18	61-78
Corn (gluten free)	28	62-70
Waxy Corn (Gluten Free)	1	63-72
Tapioca (gluten free)	-	52-64
Buckwheat (gluten free)		
Wheat (gluten-containing)	26	53-65
Rye (gluten-containing)	-	57-70
Oats (gluten-containing)	27	56-62
Barley (gluten-containing)	22	56-62
Peas	35	57-70
Beans	24	64-67

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We studied the conditions for hydration of rice flour and cereal, at what ratio of flour and water the flour dissolves and gelatinizes, and at what temperature and time parameters. The criterion for evaluating the optimality of the process is selected indicator of the dynamic viscosity of an aqueous solution of flour when it is completely dissolved in a solvent.

Viscosity was determined on a viscometer using the Heppler method with a falling ball. The time of the fall of the ball was measured in a cylindrical tube, inclined by 10 ° C with respect to the vertical, and filled with the test solution.

Studies have shown: when the ratio of dilution of flour and water is 1: 3; 1: 4; 1: 5; 1: 6; 1: 7; 1: 8 solution at a temperature of 90-98 °C, respectively, after 0.5; 1; 1.5; 2 minutes. becomes very thick, absolutely not pouring and therefore does not fit in this condition for introduction into the product; with a ratio of 1: 9 weight after 1.5 minutes densely pouring, viscosity 82.3 poise, with a ratio of 1:10, the viscosity of the solution 51.8 poise, with a dilution of 1:11; 1:12; 1:15; 1:20 solution when boiling after 1.5-1.3 minutes. becomes sticky, thickened with a viscosity of 48.9, respectively; 48; 32.6; 1.3 poise. That is, the higher the dilution of flour, the lower the viscosity when boiling and holding for 1.5-1.3 minutes.

Figure 1 shows the dynamics of the viscosity of the solution depending on the dilution of flour with water under the same heat treatment conditions (temperature, 98-100 ºC for 1.5-1.3 min). During this period, the flour is completely dissolved and gelatinized, and the smaller the dilution, but not lower than 1: 9, the lower the viscosity of the finished solution.

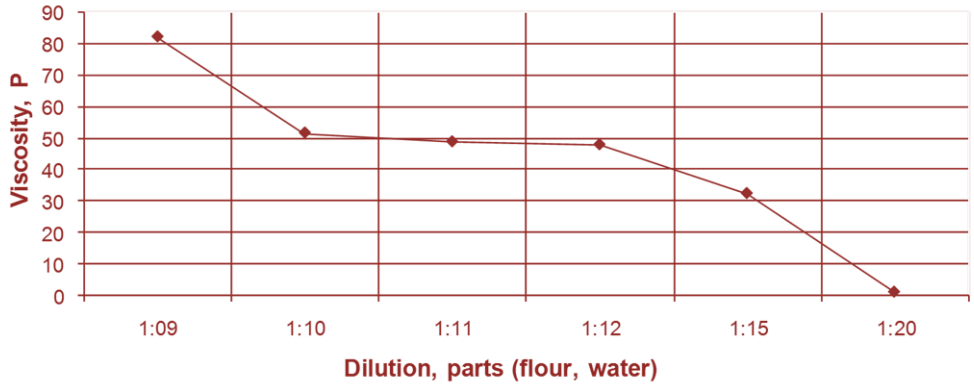

Figure 1: Dynamics of viscosity of a dynamic aqueous solution of rice flour when heated to its complete dissolution

The work performed shows that rice flour, rich in starch, as well as pure starch, dissolves well and provides high gelatinization of the solution, acting as a thickener. Flour, added to the recipe mixture, shows its gelatinizing properties in an aqueous solution, and therefore in the product only in the hot state when heated. This confirms the possibility of using flour in the production of canned food with a viscous consistency.

The value of rice flour as a thickener is that it contains starch rich in amylopectin (up to 85%), which ensures the formation of thermostable gels that do not cause retro-gradation of starch during storage of products.

Therefore, it is better to add rice flour to the recipe mixture in a hydrated form both in cold and in hot condition, depending on the product group.

Hydration (dissolution) of flour is most optimal when hot for a period of time (1-1.5 min), when the flour is completely dissolved in solution.

As a solvent, based on the formulation of the product, the conditions for its preparation can be, in addition to water, one of the liquid aqueous components of the formulation: juice, puree, mashed vegetable mass (in tomato sauces) or fruit (in fruit sauces, jam, jam) or oil etc. In jam, jam butter is mixed with sugar, which also gives good quality uniform mixing.

The solubility of rice flour depends on the degree of dilution, temperature and heat treatment time, pH of the medium and on the type and amount of other components present.

It is established that rice flour is gelatinized, which increases the viscosity and density of the finished product. This is especially significant when making jam and jams.

The increase in the viscosity of jam, jam traditionally occurs due to the gelation of the product caused by pectin substances used in the formulation of the main raw material. At the same time, both the quantitative content of pectin and the pH of the medium along with heat treatment affect the gelation. This process occurs with a certain ratio of raw materials, sugar, acid.

The introduction of jam, jam, rice flour in the recipe accelerates the gelation process with a significantly low ratio of raw materials and sugar, significantly lower solids content in the product, while achieving the required structure of canned food.

In the production of canned food, including rice groats, it is necessary to know the optimal ratio of water (liquid) and cereals.

Traditionally, cereals, including rice, are used for cereals, pilaf, first and various dishes. Therefore, the norms of the liquid for cooking cereals, etc. worked out, are given in Table 6. According to the consistency of porridge, they are friable, viscous and liquid, it is determined by the ratio of water and cereals taken. The cereals are washed before cooking, while the cereal absorbs water up to 10-30% by weight. This amount must be taken into account in the calculation.

Table 6: The amount of liquid and salt per 1 kg of rice cereal

Name of cereals	Amount of water needed for cooking, dm^3	Amount of salt, g	Weight gain, %	The output of finished products, kg	Humidity, %
Rice:					
friable	2,10	28	180	2,8	70
knitting	3,70	45	350	4,5	81
liquid	5,20	60	500	6,0	86

Heat treatment: bringing to a boil, then adding at a temperature of 90-100°C, not less

Based on a set of studies, it was found that for the conditions of canning production, it can be expediently used:

- - rice flour as a thickener, structure-forming agent and partially filler in the development of sauces for various purposes; jelly, desserts, creams; jam and jams, etc.;
- - Rice groats as a filler in the production of a variety of cereals, pastes, pastes, second and first courses.

The obtained conclusion is the basis for the development of recipes and technologies for the production of new types of canned food for long-term storage: eastern sauce; confectionery jam,

includes all types of fruits and berries growing in the southern zone of Russia.

Rice flour is a part of new types of canned food as a thickener, structure-forming agent, and partially a filler.

The use of rice flour in the production of sauces allows us to achieve good food and taste qualities of canned food, the required pleasant consistency, the appearance of products enriched with a group of vital minerals, vitamins and other biologically active substances contained in rice, at a price slightly lower than traditional sauces produced by the industry due to the reduction in consumption expensive main raw materials (pasta, mashed potatoes) approximately not less than 10-20%.

Due to the inclusion of rice flour during boiling, the confectionery jam reaches the required consistency with a significantly reduced solids content - 45% compared to traditional - 66%, while maintaining the standard food-taste properties, texture, presentation. It is very important that the confectionery jam is not subject to degradation (delamination), synergism during subsequent heat treatment, i.e. lives up to its name - confectionery. Jam is used in the confectionery industry for baking pies, gingerbread, cakes and other confectionery. The decrease in solids in the finished product reduces the duration of heat exposure during boiling, which favorably affects the preservation of the natural aroma, taste of raw fruits and vegetables.

4. CONCLUSION

Rice flour is a good thickener, structure-forming agent, and filler in the production of canned products of long-term storage: sauces, jelly, desserts, creams, jam, jams, etc. Rice cereal, primarily unpolished, is a good filler that determines dietary properties in the production of the first and various main dishes, such as: cereals, pilaf, meat and vegetable products, including pastes, pastes, stews, goulash, etc. Using flour allows you to achieve a characteristic traditional consistency, gustatory properties with significantly less e expensive recipes, which leads to lower prices for finished products while maintaining and even improving the biological value of canned food.

5. AVAILABILITY OF DATA AND MATERIAL

Information from this work is available by contacting the corresponding author.

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