Application of pectin-containing concentrate from Portúlaca Olerácea in the production of first-grade wheat bread

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Abstract. With the help of food additives from plant raw materials, you can increase the nutritional value of the product and give it medicinal properties. Such additives include pectin, which is a natural detoxifier. Of particular interest are studies of pectins, which have high protective properties against radioactive metals entering the human body. The purpose of this study was to study the possibility of using pectin concentrate from purslane in the production of bread. The objects of the study were pectin concentrates from purslane; Wheat flour; bread samples. A bread recipe has been developed with the addition of pectin concentrate from Portúlaca olerácea (purslane). When adding the concentrate, the dimensional stability of the product improves, the porosity and specific volume of the bread increases. The amount of concentrate that has the most beneficial effect on the duration of fermentation and the quality of bread is 0.5% of the amount of flour. With this dosage, the best organoleptic characteristics are achieved. All physical and chemical indicators remain within the requirements of regulatory documents. This bread can be recommended for preventive nutrition, since pectin concentrate has a therapeutic effect on the human body. Analysis of bread made from first grade wheat flour by adding pectin concentrate 0.5% by weight of flour was carried out at the State Scientific Center for Quality Control. In our opinion, it is advisable to use pectin-containing concentrate from purslane, as the most accessible and cheapest raw material.

1 Introduction

The Khorezm region is located in the ecologically unfavorable territory of Uzbekistan near the Aral Sea. This situation has a negative impact on the health of the population, and consequences such as decreased life expectancy, increased morbidity and various

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pathologies of newborns are observed. In these conditions, a set of measures aimed at preserving the health of the population becomes of great importance. Such preventive measures include the creation of mass consumption products for therapeutic and prophylactic purposes.

Currently, various chemicals emitted into the atmosphere enter the soil, air or water and, moving along ecological links from one chain to another, ultimately enter the human body. With the help of food additives from medicinal plants, you can increase the nutritional value of the product and give it medicinal properties. Such additives include pectin, which is a natural detoxifier. Of particular interest are studies of pectins, which have high protective properties against heavy metals entering the human body. One of the most important directions for increasing the production volume of pectin-containing food products is expanding the raw material base through non-traditional sources and developing new methods for producing pectin products from traditional and non-traditional industrial raw materials. [1].

It has been established that pectins reduce the calorie content of food, the concentration of glucose in the blood, partially provide the body with energy, and affect the absorption of proteins, fats, carbohydrates and minerals. Lack of them in the diet can cause the formation of colic and intestinal cancer; is one of the risk factors for the development of early atherosclerosis, coronary heart disease, and diabetes mellitus. The use of pectins for the treatment of patients with diabetes mellitus leads to reducing the rate of increase in blood sugar after a meal without changing the concentration of insulin in the blood plasma [2,3].

The properties of plants that have a positive effect are determined by the activation of enzyme systems and increased energy supply to the body. Plant raw materials serve as one of the main sources of nutrients, which even in small quantities have a healing and protective effect. Of particular interest are studies of pectins, which have high protective properties against radioactive metals entering the human body. Pectins form insoluble complex compounds with them, which are practically not digested in the digestive tract and are excreted from the body. The therapeutic effect of pectin substances is due to its chemical structure. Polygalacturonic acid contained in pectin combines with certain heavy metals and radionuclides. The resulting salts are not absorbed through the mucous membrane of the gastrointestinal tract and are excreted from the body naturally [4–6]. Crude polysaccharide extract of purslane oleracea reduces blood glucose levels and modulates lipid and blood glucose metabolism in alloxan-induced diabetic mice, while reducing total cholesterol, triglycerides, and fasting blood glucose levels in type 2 diabetic mice (7,8).

1.1 The use of pectin in baking

In view of the deterioration of environmental conditions, accompanied by pollution of the environment and food, an urgent problem in bread baking is the development of technologies that provide for the enrichment of bread with dietary fiber, including pectin substances. The use of pectin in baking is due to a number of other reasons. Pectin, being a hydrocolloid, can improve the quality of bread. When using it, an increase in the specific volume and porosity of bread was observed; the structural and mechanical properties of the crumb improved, and an increase in its moisture content was also noted. Research has been conducted on the use of various types of pectins in baking production: apple, citrus, beet. Experimental data have shown that the optimal dosage is the amount of pectin 0.1-0.3% by weight of flour. Doctors have also found that bakery products enriched with pectin have a sorption, local anti-inflammatory and antitoxic effect [9].

Research in this area has established that the addition of pectins to dough affects the biochemical, colloidal and microbiological processes of dough preparation: the initial

acidity increases and the pH decreases. The fermentation process in the dough is more active, and gluten strengthens. This ability of pectins predetermines their use in the processing of weak flour. There is also evidence of the positive effect of pectins on maintaining the freshness of finished products. In the baking industry, it is more advisable to use not dry pectin, but a semi-finished product - pectin extract (PE) [10]. The quality of flour determines the quantity and quality of gluten it contains. The quality of gluten largely determines the ability of flour to absorb moisture when kneading dough and retain the resulting carbon dioxide [11]. When adding pectin and pectin extract, the shelf life of bread freshness is extended by 12–24 hours, which is of no small importance in solving the problem of ensuring the safety of bakery products [12].

In baked goods, pectin improves the texture, yield, and moisture-holding capacity of dough. Pectin can be used to produce a biopolymer, which can be used for various purposes such as edible film packaging [13,14]

The purpose of this work is to study the influence of pectin concentrate from the medicinal plant purslane on the baking properties of first-grade wheat flour.

1.2 Purpose of the study

Possibilities of using pectin concentrate from the medicinal plant purslane in the production of first-grade wheat bread. Study of the effect of pectin concentrate from purslane on the quality indicators of bread.

1.3 Research objectives

1) study the effect of pectin concentrate from purslane in percentage doses on the quality indicators of bread; 2) determination of the main quality indicators of first-grade wheat bread with the addition of pectin concentrate. 3) microbiological analysis of the finished product. This study investigated the possibility of using pectin extract in the production of wheat bread.

2 Materials and methods

2.1 Materials

Aerial parts of purslane (lat. *Portulaca olerácea*) collected in early June from the lower part of the Amu Darya, Khorezm region. To conduct a general analysis in the higher classes of methods, the standard methods given in Article were used. The analysis was carried out not only on the leaf, but also on the aerial part as a whole. As well as tin bread with added concentrate.

2.2 Release of pectin substances

The production of pectin concentrate from the aerial part of purslane (fresh) began with the preparation of raw materials, which consisted of washing the purslane with running water. Then the raw material was crushed to 1-1.5 mm. and sent for hydrolysis-extraction [8]. The hydrolysis process was carried out with a solution of citric acid, pH 2.5, at a temperature of 40-45°C, for 1.5-2 hours with a hydromodulus of 1:5. The hydrolyzed mixture was filtered. The resulting pectin extract was neutralized, filtered and concentrated. The concentrate contains 4.8-5.1% pectin polysaccharide. The results are shown in table 1.

2.3 Determination of the content of macro-microelements and heavy metals in the obtained pectin polysaccharides

The samples were analyzed using an optical emission spectrometer with inductively coupled plasma Avio 200 ISP-OES (Perkin Elmer, USA). 0.1000 g was quantitatively transferred to Teflon autoclaves. 3 ml of purified concentrated nitric acid (HNO_3) and 2 ml of purified hydrogen peroxide (H_2O_2) were added to it. The autoclave was closed and a Berghof microwave digester (Speed Wave Xpert or a similar microwave oven) was installed. In this case, a command was given to unpack based on a specific program in the device interface. In this method, the number of specified autoclaves, as well as the temperature and pressure inside them, are automatically controlled by the device. The process information is controlled by a liquid crystal display. At the same time, the minimum temperature T (50^0C) and maximum temperature T (230^0C), pressure R [bar] max 40 [bar] in autoclaves were carried out under wet decomposition conditions for 35-45 minutes. The autoclaves were cooled to room temperature and the liquid mixture contained in them was poured into measuring flasks with a capacity of 50 or 100 ml (up to the mark). In this case, the autoclaves are washed 2-3 times, and then filled to the flask line with bidistilled water. The solution is thoroughly mixed, poured into an autosampler tube and placed on the autosampler in a certain numbered place. The position of each tube, the withdrawn mass and the dilution coefficient are entered into the program. (Thus that the device can automatically calculate the concentration). The mineralized solution is quantitatively analyzed using a Perkin Elmer Avio-200 inductively coupled plasma optical emission spectrometer (ICP-OES) (or an analog device) compared with a standard sample containing a number of macro- and microelements, heavy metal salts, and rare metals. The analytical results automatically calculate the precision and standard deviation (RSD) values by recalculating the results based on the sample weight and dilution values at the end of the process. The result is shown in Table 2.

2.4 The use of pectin concentrate in the production of pan bread in laboratory conditions

Pectin concentrate from purslane oleracea plants contains a large amount of pectin secretions, which interact with the excess nutritional load of proteins and starch in flour, causing increased heat resistance of protein-polysaccharide complexes that exhibit increased hydrophilic activity. It is very important that baked goods contain a proportion of tightly bound food. As a result, moisture is detected in smaller quantities during storage. All this is a high result and the expected shelf life of the products.

In addition, the use of pectin concentrate from purslane makes it possible to reduce the duration of the fermentation process, improve gas formation, improve the quality of the finished product, and achieve results in improving the porosity of bread and the specific taste, aroma and preventive properties.

To determine the effect of pectin concentrate from purslane on the quality of bread, a recipe for wheat bread made from 1st grade flour was chosen as a control sample. With increasing dosage of pectin-containing concentrate, the amount of gluten did not change, but the quality improved. The dough was prepared using no-spong technology. To assess the effect of pectin concentrate on the dough fermentation process, the change in acid accumulation was studied at various dosages. A bread recipe has been developed with the addition of pectin concentrate from purslane. The recipe composition of the studied bread

with different pectin content, the ratio of all components is reduced to the mass of flour and the assessment of the quality of the developed bread is presented in Table 3. Figure 1.

2.5 Microbiological analysis of bread

Analysis of bread made from 1st grade wheat flour by adding 0.5% pectin concentrate to the flour weight was carried out at the State Scientific Center for "Quality Control and Selection of Veterinary Medicines and Feed Additives." Test conditions: temperature 24.5C, humidity 41.8%. Five days. The results are shown in table 4.

3 Results and Discussion

Pectin concentrate from purslane is a viscous liquid of light pink color, having the smell and color characteristic of the original raw material. The sour taste, the character of pectic acid, is also due to the presence of citric acid in it. The pH of the extract is 6.2.

Table 1. The yield of pectin substances [15]

Plant name	Extraction temperature	Hydraulic module	pH of citric acid	Extraction time, h	Product yield PP
Portúlaca olerácea (above ground parts)	40-45^{0}C	1:5	2,5 pH	1-1,5	4,2 %

Table 2. The composition of mineral substances of pectin polysaccharides released from vegetable Portúlaca olerácea

Elements	Pectin polysaccharide Portúlaca olerácea	Pectin-containing extract 0,5% Portúlaca olerácea	elements	Pectin polysaccharide Portúlaca olerácea	Pectin-containing extract 0,5% Portúlaca olerácea
	mg\kg			mg\kg	
	1	2		1	2
Li	2,6	1,3	**Fe**	614,7	0
Sb	0	0,2	**Na**	1782,2	509,8
Sn	0	0	**Pb**	2,2	0,2
K	166294,7	53962,8	**Cd**	0	0
Ba	79,7	5,3	**Zn**	488,6	41,2
Cr	2,3	0	**Cu**	38,3	5,4
Mn	117,6	4,9	**Ag**	**0**	**0**
B	18,2	3,8	**Hg**	0	0
Ca	6926,0	165,0	**Co**	0	0
As	0	0	**P**	3678,2	1518,8
Mg	7309,8	1592,3	**S**	9,4	24,8

It was determined that the composition of the pectin-containing extract and the pectin substance Portúlaca olerácea contains vital elements Zn, Ca, N, K, Mg, Mn, P, S. Portúlaca olerácea have higher levels of potassium, sodium, calcium, magnesium, zinc, Phosphorus, sulpur and manganese.

Toxic elements such as Plumbum (Pb) were found in samples No. 1 (2.2 mg/kg) and No. 2 (0.2 mg/kg), Stibium (Sb) was found in samples No. 2 (0.2 mg/kg), not an increased,

permissible dose in pectin. Heavy metals such Stannum (Sn), Arsenicum (As), Cadmium (Cd), Argentum (Ag) and Hydrargyrum (Hg) were not found in any of the 2 samples.

Table 3. Recipe and quality of bread with different pectin content

Raw materials	Control values [16]	Pectin content, % by weight of flour			
		0,25	0,5	0,75	1,0
Flour, kg	kg	1 kg	1 kg	1 kg	1 kg
Salt, kg	0,013 kg	0,013	0,013	0,013	0,013
Yeast, pressed bakery, kg	0,015 kg	0,015	0,015	0,015	0,015
Water, gram	By calculation				
Bread indicators					
Crumb moisture, %	42	42,5	42,8	43	45
Crumb moisture content, % (after 24 hours)	40	41	42	42	44
Crumb moisture content, % (after 48 hours)	37,5	39,5	40,5	40	43
Specific volume, cm3/100 g	295	320	330	315	310
Crumb acidity, degrees	2,6	2,65	2,7	2,8	3,0
Porosity, %	71	74	76	73	72

Based on research, it was found that with various dosages from 0.25 to 1.0% of pectin-containing concentrate in the recipe composition of bread, the porosity of the bread changes compared to the control: the optimal porosity of 76% was achieved with a dosage of pectin of 0.5% by weight of flour (table 2). An increase in pectin content worsened the organoleptic properties, the crumb became denser, darkening was observed, it did not loosen, and the porosity decreased by 5% compared to the optimal one (at 0.5% pectin). With an increase in the dosage of pectin, the moisture content of the crumb increases from 42.5% with 0.25% pectin to 45% with the addition of 1.0% pectin, and an increase in the acidity of the crumb is observed from 2.65 to 3.0. Apparently this is due to the fact that pectin itself has a higher acidity. The specific volume of bread increases with a certain dosage of added pectin, i.e. up to 0.5% and amounted to 330 cm3/100g, then decreases.

As the research results show, when pectin concentrate is added, the acid accumulation process is more active. This is explained by the fact that pectin concentrate contains, in addition to pectic acid, polygalacturonic acid.

Fig. 1. The influence of the amount of pectin extract from purslane on the quality of wheat bread made from 1st grade flour

Table 4. Test results

№	The name of indicators	Regulatory documents for the test method	Parameter meaning		
			Requirements for RD	Actually	vagueness
1	Detection and recording of suspected coliform bacteria and Escherichia coli	GOST 31747-2012 p.8	Not allowed	absent	
2	Determination of the total number of microbes in 1 gram of product	GOST 26669 - 85. п.2	No more 300 CFU 1g/sm^3	less 300 CFU 1g/sm^3	
3	Determination methods - number of mesophilic aerobic and facultative anaerobic microorganisms	GOST 10444. 15 p.b	No more 300 CFU 1g/sm^3	less 300 CFU 1g/sm^3	
4	Effect and counting of sulfite-reducing bacteria growing under anaerobic conditions	GOST 29185-2014 p. 9	Not allowed	absent	
5	Method for detecting bacteria of the genus Salmonella	GOST 31659-2012 p.8	Not allowed	absent	
6	Methods for identifying and determining the amount of coagulum of azo-positive staphylococci and Staphylococcus aureus	GOST 31746-2012 p.4.	Not allowed	absent	

4 Conclusions

In the article, the optimal technology for isolating pectin substances from purslane was selected and an analysis was made of the content of macro-microelements and heavy metals, which clearly differ from pectin polysaccharides obtained from other products. An analysis was performed comparing bread obtained with the addition of pectin concentrate. Obtaining such results is probably due to the moisture-holding ability of pectin substances, due to the presence of free carcinoids boxyl and hydroxyl groups in the polymer molecule. It should be noted that the addition of pectin made it possible to extend the shelf life of products.

Presumably, this is due to the fact that pectin substances compete with starch in the process of water absorption and reduce its hydration; So during the baking process, pectins are able to release additional moisture, due to which the bread is moistened and the starch in its composition is gelatinized. There was an increase in such indicators as the specific volume and porosity of bread, and the structural and mechanical properties of its crumb improved. An increase in its moisture content was also noted, which is presumably due to the water-holding ability of pectin substances, due to the presence of free carboxyl and hydroxyl groups in the macromolecule. The addition of pectin polysaccharide from *Portúlaca olerácea* to bread not only improves the texture of bread but also enriches it with vital minerals.

In our opinion, it is advisable to use pectin-containing concentrate from *Portúlaca olerácea*, as the most accessible and cheapest raw material.

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