RESEARCH ARTICLE

Study of Physicochemical, Biochemical, and Organoleptic Properties of Vegetable and Fruit and Berry Biopectics

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Abstract

Aim: Pectin, its physicochemical, biochemical, and organoleptic properties are considered in work. It is shown that pectin is currently one of the most necessary food additives, which is used both in the food industry and medicine. As for the food industry, it is used as jelly and structuring, in confectionery production, in canning, in the production of beverages and juices. As for medicine, pectin is used to improve the health status, especially in children, to increase the active life of an adult, with a protective, dietary, therapeutic, and prophylactic effect for all categories of the population. **Materials and Methods:** We have used both standards, commonly accepted and special methods for assessment of raw materials, semi-finished, and finished products. **Results and Discussion:** At present, the issue of medicine and biology, the fight against malignant neoplasms and oncological diseases is on the agenda. Pectin is one of the drugs that can be considered as a remedy after its purification from the accompanying flavonoids and partial demineralization. **Conclusion:** The medical pectin is intended to be used as an independent drug and also as a substance of medicinal products used in the treatment of oncological diseases, in contrast to synthetic drugs, medical pectin is biocompatible with the human body and has no side effect.

Key words: Biochemical and organoleptic properties, food additives, medical pectin, pectin, physicochemical

INTRODUCTION

Pectin - one of the most necessary food additives, which is used as jelly and structuring, in confectionery production, canning, beverage and juice production, mayonnaise, fat, and milk products. Its role in the formation of complexes is excellent, which indicates the biological significance of it as a sorbent of ions of heavy metals and radionuclides.

Pectin substances are part of the cell wall of median plates, the cytoplasm of plant cells. They are present in almost all higher plants. Due to its specific properties, some important functions (regulation of the water regime of tissues, transport of water currents, and others) are involved in the stretching of the cell walls.

The study of pectin and its properties is currently topical because the severe environmental conditions caused by environmental pollution by waste products of chemical and microbiological industries, the presence of increased radioactive background in virtually all regions of the country, as well as the widespread introduction of medicines into medicine and veterinary medicine, in particular, antibiotics - all this has led to a decrease in the body's resistance to harmful factors and has changed the ecological relationship between humans and microorganisms.[1,2]

The species composition of the microflora that protects the body from infections and allergic diseases has changed,

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various kinds of opportunistic microorganisms have appeared, and a state of dysbacteriosis has arisen. On the other hand, a breakdown in the structure of nutrition leads to a deficit in the consumption of biologically active substances, resulting in a decrease in energy, a deterioration in health, especially in children, a reduction in the duration of busy life of an adult.[3,4]

The fight against malignant neoplasms is not only one of the most urgent problems in medicine and biology but also affects many aspects of the social life of society. Among the causes of death in most industrialized countries, malignant neoplasms rank second after cardiovascular disease.[5]

The issue of developing medicines for the treatment of oncological diseases, based on active components of natural origin due to their low toxicity and a wide range of pharmacological activities, is becoming acute.[6]

Depending on the purpose, pectin is isolated in two ways: Obtaining technical pectin that meets the requirements of the relevant industry; the preparation of pectin substances for the study of structure and condition in plant cells. For rational use of pectin and pectin-containing raw materials in the food industry and medicine, a comprehensive review of its physicochemical properties is necessary.[7]

Objective

The purpose of this work is to study the physicochemical, biochemical, and organoleptic properties of pectin obtained from fruit, berry, and vegetable raw materials by microbiological means.

Pectin (from the Greek word «pectos» - curled) is a part of the structural elements of the cellular tissue of all terrestrial plants; the most significant number is in the peel, lamellae and core, linking associations of cells of vegetables and fruits.

Accumulated over the past years, data on the chemical structure of pectin, their unique ability to form persistent gels, large anion exchange capacity, and serve as the basis for their full application in a wide variety of industries.[8]

The physicochemical properties of pectin, its further application depend on the quality of the plant material used, the conditions for extraction of pectin from this raw material, and also on the balance of functional groups.

MATERIALS AND METHODS

We have used both standards, commonly accepted and special methods for assessment of raw materials, semi-finished, and finished products.

The physical and chemical properties of pectins were measured by the following indicators: The content of free and etherified carboxyl groups, the degree of etherification determined by titration, relative viscosity (determined with the help of Ostwald capillary viscometer), molecular weight determined by the graphical method based on the calculation of the reduced viscosity numbers, and the Kuhn-Mark equation.

The gelling power of pectins was determined with the help of Tarr-Baker tester, by preparing a standard jelly and determining its fracture strength.

The methods for studying the properties of pectins included: Total acidity according to GOST 5898-87; mass fraction of reducing substances - ferricyanide method according to GOST 5903-89; solids content - refractometric method according to GOST ISO 2173-2013; lead content - according to GOST 30178-96; arsenic content - according to GOST 26930-86; the content of cadmium GOST 30178-96; and mercury - according to MU 5178-90.

RESULTS AND DISCUSSION

In the work waste of vegetable and fruit-berry raw materials, such as pumpkin, carrot, squash, citrus, apple, and blackcurrant was used. This raw material is chosen not by chance.

The production of pectin is based on the use of apple pomace, beet pulp, and citrus peels. For northern regions these types of raw materials are not fundamental, the task of full utilization of local vegetable and fruit and berry resources acquires particular significance. In this connection, the work is set to use the waste of local vegetables, fruits, and berries to produce pectin. Data on the content of the primary biochemical indicators of this feed are included in Table 1.

The production of vegetable and fruit-berry pectin was carried out using an endo-polygalacturonase enzyme preparation in an amount of no more than 0.03% at a standard activity of PG = 3,000 units with a mass of vegetable or fruit-berry mead.

Then, physicochemical, biochemical, and organoleptic analyzes of the pectin obtained were carried out. The physicochemical characteristics of pectin are listed in Tables 2 and 3.

In the pectins obtained, the content of biologically active substances, such as B-carotene, Vitamin C, and carbohydrates, was determined. Data are included in Tables 4 and 5.

All the pectin examined by us can be used to produce medical pectin for the treatment of cancer. An essential step in obtaining medical pectin is its purification from the accompanying flavonoids and partial demineralization, as well as partial demethoxylation and depolymerization using a complex of enzymes.

Table 1: Biochemical indicators of the raw materials

Name of raw materials	SW, %	RW, мг/см	Protein, mg/cm	Total nitrogen, mg/cm3	Titrated acidity, мг/см	Total acidity, mg/cm³	Cellulose, %	G/cellulose, %	β-carotene, mg/100 g	Vitamin C, mg/100 g
Pumkin	5–8	250	0,31	0,045	1,39	3,42	27,8	18,3	10,95	8,1
Carrot	10–15	372	0,34	0,053	3,76	5,27	25,1	17,8	36,0	9,6
Zucchini	4–6	231	0,26	0,041	1,51	3,57	23,3	15,1	—	12,3
Apples	12–16	340	0,17	0,27	4,62	6,62	28,8	18,7	—	37,5
Citrus	10–16	215	0,088	0,012	3,4	5,0	26,0	16,3	—	71,0
Black-currant	17–22	189	0,25	0,04	3,67	5,26	17,6	16,1	—	330,0

Table 2: Physical and chemical characteristics of pectin

The name of indicators	Pumpkin	carroty	Cucurbitaceae	Apple	citrus	Currant
Humidity, %	4,7	5,2	4,5	4,9	5,5	4,7
Ash content, %	1,3	1,6	1,2	1,5	1,7	1,6
pH of 1% solution	4,0	3,5	4,0	3.4	3,1	3,2
Acetyl groups, %	0,62	1,3	0,17	1,3	1,2	2,1
Carboxyl groups, %	2,57	2,98	2,32	11,3	10,0	17,3
Cetoxyl groups, %	10,89	11,15	10,05	8,3	9,2	6,7
Degree of esterification, %	80,9	78,9	81,2	68,0	72,0	63,0
The content of β-carotene,	4,31	19,88	-	-	-	-
mg/100 g	2,6	3,5	2,8	10,7	21,2	85,0
The content of Vitamin C,	39,0	40,0	37,0	46,0	45,0	40,0
mg/100 g	65,25	113,8	122,5	118,8	122,5	107,5
Pectic acid, %	78	74	79	77	84	60
PB, mg/cm³	30,0	30,2	29,5	29,9	29.0	32,0
Temperature	5,3 5,0	5,1 4,6	5,2 5,0	5,0 4,5	5,3 4,9	4,6 4,4
Sorption of heavy metals, %						
Pb²						
1,2	34,9	28,4	35,2	30,2	24,2	35,0
pH						
7,8	47,5	41,0	45,1	41,8	31,0	47,0
Cu²						
1,2	24,6	23,0	24,5	24,0	22,0	25,0
pH						
7,8	33,0	30,5	35,0	34,0	28,0	37,0
Cd2						
1,2	26,0	25,0	24,5	26,7	20,7	27,0
pH						
7,8	38,0	35,0	36,5	36,0	30,0	39,0

The resulting molecules have a lower molecular weight and are predominantly composed of the residues of D-polygalacturonic acid. Due to this, medical pectin is better absorbed by the human digestive system and has a high affinity for galectin-producing tumor cells.

The first stage of purification of pectin is the sorption of coloring substances with activated carbon. As a result of the studies, it was found that two cycles of sorption are sufficient to purify the pectin solution from the accompanying coloring substances.

Table 3: Biochemical and organoleptic parameters of the obtained pectin

Biochemical and organoleptic indices	Fruit and berry and vegetable pectins					
	Pumpkin	Carroty	Cucurbitaceae	Apple	Citrus	Currant
SW, %	95,3	94,8	95,5	95,1	94,5	95,3
Power	80,9	79,8	81,2	68,0	72,0	63,0
esterification, %	30,0	30,2	29,5	29,9	29,0	32,0
Ballast	Powder					
Color	**Pale yellow**	**Light orange**	**Creamy white**	**Pale brown**	**Light yellow**	**Winered**
Taste	Tasteless					
Smell	Almost absent					
Content						
Plumb	Not found					
Copper	10,0	10,7	10,5	11,8	11,5	11,75
Zinc	0,3	0,4	0,41	0,3	0,31	0,3

Table 4: Content of some vitamins in raw materials and obtained pectins

Name of raw materials	β-каротин, mg/100 g		Vitamin C, mg/100 g	
	Raw material	Pectin	Raw material	Pectin
Pumpkin	10,95	4,31	8,1	2,6
Carrot	36,0	19,88	9,6	3,5
Zucchini	-	-	12,3	2,8
Citrus	-	-	37,5	10.7
An apple	-	-	71,0	21,2
Black currant	-	-	330,0	85,0

Table 5: Carbohydrate composition of pectin

Name of pectin	Xylose	Fructose	Sucrose	Maltose	Lactose	PB, mg/cm³
Pumpkin			+		+	65,25
Carrot			+		+	113,8
Cucurbitaceae	+	+				122,5
Apple				+		118,8
Citrus			+		+	122.5
Currant	+	+	+		+	107,5

Characteristic indicators of "Pectin" are the degree of esterification, molecular weight, solubility in water and hydrochloric acid, viscosity, gelling capacity, and the ability to sorb metals.

It is shown that all pectin, fruit, and berry and vegetable, have all of the listed properties. Pectin can form complexes and remove from the body heavy metals, biogenic toxins, antibiotics, and biologically harmful substances that can accumulate in the body.

The degree of esterification (72%) is best recognized as citrus, slightly worse - apple, a low degree of esterification in cranberry pectin. When 1% pectin is introduced into the antibiotic medium, the action of beta-lactam antibiotics of the penicillin line is reduced after 1 h and drops sharply after 24 h. The effect of other antibiotics (erythromycin, streptomycin, and tetracycline) is not significantly affected by pectin.

Among the many useful properties of pectin is its ability to neutralize the toxic effect of nitrates and nitrites on the human body. At present, doctors pay much attention to the harmful toxic effects of nitrates and nitrites on the body, especially infants, which manifests itself in the form of methemoglobinemia, which is the consequence of the oxidation of bivalent iron to trivalent, and the transformation of red blood into dark brown. These transformations cause the formation of tumors on all organs except bones. One can note that "pectin" can neutralize the effect of nitrates and

nitrites by almost 50% when introducing it into vegetable dishes in an amount of 0.5%.

Fascinating data were obtained when studying the bactericidal properties of the drug "Pectin." Studies conducted with both fruit and vegetable pectins showed their adverse effect on pathogenic microorganisms of purulent septic wounds. It manifests itself after 2 h, and after 96 h a significant decrease in the content of pathogenic organisms is observed (according to the data of the laboratory of the Central State Sanitary and Epidemiological Service of the Western District Moscow).

CONCLUSION

The medical pectin is intended to be used as an independent drug and also as a substance of medicinal products used in the treatment of oncological diseases, in contrast to synthetic drugs, medical pectin is biocompatible with the human body and has no side effect. Work in this direction continues.

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