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# Products of sea-buckthorn berries processing in parapharmaceutical production

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**Abstract.** Labour activity of the person during scientific and technical progress is complicated with increasing ecology pollution caused by active use of various chemicals for agricultural purposes, industrial use of toxic metals and other substances, radioactive components of different origin. The purpose of our research is to find out new vegetative raw material being a source of food fibers (in the given concrete case) and possessing high food and biological value which could become a basis for creation new kinds of foodstuff for medical and prophylactic use in the diet of the population directly involved in harmful manufacture at the industrial enterprises and living in ecologically polluted areas. We offer to use the sea-buckthorn berries oil cake as such source of raw material - the dry waste product from sea-buckthorn oil production, which possesses high biological activity and meets all listed above requirements.

## 1. Introduction

In order to develop scientifically based technology of manufacturing bakery products and pastas from wheat flour with sea-buckthorn processing products we investigated the influence of various dosages of the sea-buckthorn oil cake on structural and mechanical properties of dough as well as the bakery products and pastas quality indices. These products were made with a traditional technology of bread production. The products thus manufactured have high taste qualities and biological value.

Labour activity of the person during scientific and technical progress is complicated with increasing ecology pollution caused by active use of various chemicals for agricultural purposes, industrial use of toxic metals and other substances, radioactive components of different origin. The consequences of these processes are the catabolism of fibers, vitamins and other vital biologically active substances in the human organism and that in turn is the reason for sickness rate increase of the population directly involved in harmful manufacture at the industrial enterprises and living in ecologically polluted areas.

In this connection search of radio protective substances is very urgent.

Food fibers are not the most effective blockaders of radioactive substances in the human organism. Nevertheless, included in a daily diet and having a natural origin (in contrast with some even more effective synthetic radio protective medicines), food vegetable fibers reduce absorption, and in some cases increase radionuclide extermination in comparison with their natural extermination from the organism.

One of the possible ways of people feeding system improvement is application of modern processing technologies of new sorts of vegetable and fruit cultures. Thus, the usage of regional raw



resources is very important. It allows, on the one hand, cut down foodstuff cost price, and on the other hand, to enrich Siberian ration by an indispensable vitaminous mineral complex preventive current.

The purpose of our research is to find out new vegetative raw material being a source of food fibers (in the given concrete case) and possessing high food and biological value which could become a basis for creation new kinds of foodstuff for medical and prophylactic use in the diet of the population directly involved in harmful manufacture at the industrial enterprises and living in ecologically polluted areas.

The given source of raw material should meet certain requirements. It must be available, cheap, possess high food value and its stocks should provide the commercial use.

Besides the given raw material should have one more important characteristic - to possess protective properties, universality of use and wide spectrum of preventive influence on the human organism.

We offer to use the sea-buckthorn berries oil cake as such source of raw material - the dry waste product from sea-buckthorn oil production, which possesses high biological activity and meets all listed above requirements.

In accordance with the content of food fibers, the sources of vegetative raw material can be divided into traditional (cereals, vegetables, fruit, berries) and nonconventional sources of raw material (grass, seaweed, wood, etc.).

The sea-buckthorn berries oil cake is a nonconventional kind of raw material. It is a solid, dry product of yellow, brown or dark brown color.

We investigated the sea-buckthorn berries oil cake skimmed of fat ability to bind lead ions. The results of the experiment have proved the sea-buckthorn berries oil cake high connecting ability and thus, the expediency of its use in preventive diet of the industrial enterprises workers.

Problems of the research were defined on the basis of the received data:

- to study the opportunity of use the sea-buckthorn berries oil cake in foodstuffs production;
- to define the group of foodstuff to add the sea-buckthorn berries oil cake in, without essential change of technological process as this can cause the rise of the cost price without considerable change of organoleptic properties and as a consequence the lack of the consumer demand.

The article has an extending nature. In this connection some of presented results was published in the Russian scientific editions.

## **2. The experimental technique**

Sea-buckthorn fruit of the crop of 2003 were taken as a feedstock. Analytical assay in accordance with the NKVT 14143-69, GF-IX, 231 item of the all-Union State Standard was taken to investigate the mineral structure after drying on the 40-50°C temperature. Determination of the ashes content in the analyzing specimen was carried out according to 24027.2-80 all-Union State Standard, and qualitative and quantitative composition of macro and microcells – by the atomic absorptive method of analysis.

To isolate extractive substances of different classes the method of dried preparation extraction by organic solvent of increasing polarity was used (diethyl alcohol, ethyl acetate, isopropyl alcohol, water). Extractive substances content was determined on the specimen shrinkage after the exhaustive extraction in the Socslet apparatus during the 20 or more hours. After the extraction the specimen will be dried on the 105°C temperature. Presence of different chemical compound classes was defined by extract absorption of ultraviolet and visible radiation.

Concentration cation calculation was made by graduated diagram construction. At the same time to acknowledge presence of metal cations in solutions some assays were analyzed by the atomic absorptive method.

We offered to use the sea-buckthorn berries oil cake for mass products, cheap enough to be used in diet of any group of the population, as only in this case it would be possible to speak about a positive effect of our experiment. Bakery and pasta seemed to be the most adequate.

We investigated the compatibility between the sea-buckthorn berries oil cake and wheat flour at kneading dough and baking bakery products. We also determined the optimum amount of the sea-buckthorn berries oil cake in wheat flour at manufacturing bakery and pasta.

The major factor influencing the quality of wheat flour is gluten. Gluten influences the quality of bread and bakery products. The parameter of gluten deformation must vary from 45 to 75 units.

We defined the quality and quantity of gluten with the special device (the indicator of gluten deformation). The results are submitted in table 1.

**Table 1.** Influence of the sea-buckthorn berries oil cake on gluten quality of wheat flour.

The content of the sea-buckthorn berries oil cake, %	The gluten content, r	Instrument readings of maximum concentration limit, unit.
control	38,18	96,0
3	36,36	90,0
4	36,24	85,0
5	35,44	75,0
6	34,88	72,5
7	33,72	70,0
8	33,12	67,5
9	33,08	67,5
10	32,0	67,5

The increase in correlation "sea-buckthorn berries oil cake: wheat flour" causes decrease crude gluten. It is possible to draw a conclusion, that for bakery products with high quality indicators it is expedient to add sea-buckthorn berries oil cake in quantity 3-5 % from flour weight.

The sea-buckthorn berries oil cake contains up to 30 % of fibers and its use in bakery products will allow to enrich them with albumens and amino acids.

The oil cake contains amino acids: glutamine and asparagine acids, argininen and lysine, etc. By content of free amino acids the sea-buckthorn berries oil cake 10-15 times exceeds wheat flour.

Adding 5 % of the sea-buckthorn berries oil cake to wheat flour (wheat flour products), causes the increase of the content of amino acids.

We studied the opportunity to use the skimmed of fat sea-buckthorn berries oil cake in bakery production, its influence on dough properties, the course of technological process and the basic parameters of finished articles quality.

In order to establish various dosages of the sea-buckthorn berries oil cake we baked in laboratory conditions. Unleavened dough was used. The sample without sea-buckthorn berries oil cake was chosen for the control. The experimental data are resulted in table 2.

**Table 2.** Sea-buckthorn berries oil cake influence on bread quality.

Parameters	Control	The amount of the sea-buckthorn berries oil cake added to the weight of flour, %				
		3	5	7	8	10
Specific volume, sm <sup>3</sup> / 100g	410	410	437	426	408	402
Porosity, %	75	73	79	78	73	70

Adding 5-7 % of the sea-buckthorn berries oil cake, changes the structure of bread. It increases its volume; porosity of crumb, structure of crumb becomes uniform and thin-walled in comparison with

control sample. The specific volume of bread increases by 3,9 - 7,0 %, porosity - 4,0-6,7 % in comparison with the control sample.

To substantiate rational mode of technological process of dough with the sea-buckthorn berries oil cake processing we investigated the processes of gas-generation and acid accumulation in dough, determining the period of its fermentation.

The gas-forming ability of flour with the sea-buckthorn berries oil cake is a little bit higher, than that one at a control sample.

### 3. Outcomes and discussion

Acidity of dough with the sea-buckthorn berries oil cake was higher by 0,1 °, than at a control sample. It can be explained by the fact that there are acids and sugars, which accelerate process of fermentation and acid accumulation in dough in the structure of these products. It can also be considered as a positive point in the technological scheme of bread production as it saves time on kneading dough.

One of the important ways of stabilization and intensification of bread and bakery production process is application of ferments promoting longer storage of bread, such as Potassium Bromate, ascorbic acid, etc. The sea-buckthorn berries oil cake keeps the bread from getting stale; therefore, there is no necessity to use ferments (chemical) during dough kneading.

Besides these products are enriched with ballast substances (cellulose), that is important in existing ecological situation. Bread and bakery products with the sea-buckthorn berries oil cake can be recommended for diet at schools, as those ones meeting all the requirements of a growing organism.

Now in order to improve the quality of pasta the big attention is given to searching and development of natural improving substances that would be safe and simultaneously as effective, as chemical additives. We developed technological schemes of pasta manufacturing: "Altay", "Biyskie" and "Vitamin" with the sea-buckthorn berries oil cake. We also estimated physical and chemical parameters of semi finished items and finished articles; determined structural and mechanical properties of dough. Change in elasticity and plasticity have allowed to define the optimum quantity of the sea-buckthorn berries oil cake to add.

The research has shown that the chemical compound of finished articles considerably differs from biologically active substances (BAS) traditionally rich in proteins, food fibers, and vitamins. The data are submitted in tables 3 and 4.

**Table 3.** The sea-buckthorn berries oil cake influence on pastas quality.

Parameters	Control	The content of the sea-buckthorn berries oil cake, %			
		3	5	10	15
Humidity, %	12,8	12,9	12,3	12,5	12,6
Acidity, grades	2,6	2,7	2,7	2,8	2,9
Ratio of volume increase at boiling	1,58	1,53	1,5	1,5	1,49

**Table 4.** The sea-buckthorn berries oil cake influence on organoleptic properties of pastas.

Parameter			The content of the sea-buckthorn berries oil cake, %			
			3	5	10	15
Condition of surface	smooth	smooth	smooth	a bit rough		rough
Colour	yellow	grey-yellow		light brown		brown

It was experimentally established, that content of the sea-buckthorn berries oil cake in dough up to 15 % does not considerably influence on rheological properties and hydraulic ability of gluten; however, the surface of products becomes rougher and the color of macaroni worsens. Nevertheless, due to the high content of food fibers and improved medical biological parameters pasta with the sea-buckthorn berries oil cake in amount of 5 - 10 % can be recommended for schoolchildren diet.

Mineral structure analysis shows that besides rather high content of macroelements, such as: sodium, potassium, calcium, iron, magnesium sea-buckthorn fruit are also rich of less widespread for medical raw, but not less important for an organism habitability microelement: manganese, copper, chromium and nickel.

It is known that magnesium has an impact on the growth, reproduction, haemopoiesis, immunity and metabolism. Zinc is necessary for some ferments functioning. These ferments ensure hypophysis and pancreas normal work. Copper forms ferments – oxidases that catalyse processes of amine and ascorbic acid oxidation. Also copper normalizes haemoglobin synthesis and red corpuscle ripening. Nickel takes part in haemopoiesis. Chromium livens up cytochrome oxidase ferment respiratory system and glucose metabolism in the organism. Thus, basing on the results of the conducted research sea-buckthorn fruit can be recommended as a feedstock to produce foodstuff enriched by vitally important complex of mineral substances.

Sea-buckthorn fruit pectin sorbate/complexing activity towards zinc and lead cations has been studied.

Wide introduction of our results will allow not only to raise food and biological value due to decrease in sugar content, enrichment by biologically active substances, but also to use rationally practically unlimited resources of local raw material.

This reorganization of bakery products assortment is an important measure for health preservation of the population directly involved in harmful manufacture at the industrial enterprises and living in ecologically polluted areas.

#### 4. Conclusion

Thus, according to conducted researches outcomes the following conclusion can be drawn:

- The analysis of sea-buckthorn fruit mineral structure has shown presence of necessary macro and microelements complex in them: potassium, sodium, magnesium, calcium, iron, manganese, copper, zinc and chromium.
- The spectrophotometric research has shown presence of different classes biologically active compounds in sea-buckthorn fruit. These compounds ensure wide spectrum of plant pharmacological effect: chlorophyll containing compounds, complex of bioflavonoids, carbohydrate components, anthocyanins, tannins, organic acids, etc.
- It is determined that sea-buckthorn fruit are rich of pectin raw: pectin matters content in them reaches 15%. The main properties of sea-buckthorn fruit pectin matters are determined. These parameters are satisfactory according to the standardizing of pectin matters that are extracted from berrylike raw.
- The fact of high level of lead extraction by sea-buckthorn fruit pectin matters was established. Maximum degree of the lead cation extraction by pectins at pH = 10,5 is 80% from initial concentration of  $Pb^{2+}$  (20 mg – equivalent  $ml^{-1}$ ) during contact time 60 min. Thus, pectin sorbate activity is 415 mg/g.

#### References

- [1] Mann J I and Cummings J H 2009 Possible implications for health of the different definitions of dietary fibre *Nutrition Metabolism and Cardiovascular Diseases* **19** 226-9
- [2] Yang B and Kallio H 2002 Composition and physiological effects of sea buckthorn (*Hippophae*) lipids *Trends Food Sci Technol.* **13** 160-7
- [3] Cenkowski S, Yakimishen R, Przybylski R and Muir W E 2006 Quality of extracted sea buckthorn (*Hippophae rhamnoides* L.) seed and pulp oil *Can Biosyst Eng.* **48** 3.9-3.16
- [4] Erkkola R and Yang B 2003 Sea buckthorn oils: towards healthy mucous membranes *Agro Food Ind. Hi-tech.* **3** 53-7
- [5] Basu M, Prasad R, Jayamurthy P, Pal K, Arumughan C and Sawhney R C 2007 Anti-atherogenic effects of seabuckthorn (*Hippophaea rhamnoides*) seed oil. *Phytomedicine.* **14**

770-7

- [6] Ramasamy T, Varshneya C and Katoch V C 2010 Immunoprotective effect of seabuckthorn (*Hippophae rhamnoides*) and glucomannan on T-2 toxin-induced immunodepression in poultry *Vet Med Int.* Article ID: 149373
- [7] Lavinia S, Gabi D, Drinceanu D, Daniela D, Stef D, Daniela M, Julean C, Ramona T and Corcionivoschi N 2009 The effect of medicinal plants and plant extracted oils on broiler duodenum morphology and immunological profile *Romanian Biotechn Letters.* **14** 4606-14
- [8] Xing J, Yang B, Dong Y, Wang B, Wang J and Kallio H P 2002 Effects of sea buckthorn (*Hippophae rhamnoides* L.) seed oil on burn wounds in rats *Food Chem Toxicol.* **47** 1146-53
- [9] Tiwari S and Bala M 2011 *Hippophae* leaves prevent immunosuppression and inflammation in 60Co- $\gamma$ -irradiated mice *Phytopharmacology.* **1** 35-48
- [10] Li T S C and Beveridge T H J 2003 Sea Buckthorn (*Hippophae rhamnoides* L.): Production and Utilization *National Research Council of Canada.* 101-6
- [11] Wang Y C 1997 Analysis on nutrition elements of sea buckthorn *Hippophae.* **10** 24-5