DEVELOPMENT OF COMPLEX TECHNOLOGIES FOR PROCESSING OF RICE BRAN WITH OBTAINING OF THERAPEUTIC OIL AND MEDICINE – PHYTIN

Tashmenov R. S.
Candidate of technical sciences, Associat professor
M.Auezov South Kazakhstan State University, Kazakhstan
OrymbetovaG.E.
Candidate of technical sciences, Associat professor
MyrkhalykovZh. U.
Doctor of technical sciences
M.Auezov South Kazakhstan State University, Kazakhstan
Enjun Gao
Professor, Shen Yan University of Chemical Technology, China
Shakiryanova Z.M.
Master of technical sciences
M.Auezov South Kazakhstan State University, Kazakhstan

Abstract

In this article, showed effectiveness of obtaining therapeutic, edible oil and medicine-phytin and researched the viability of using waste generated during processing of rice - rice bran. Carried out research on the qualitative and physical - chemical characteristics of rice bran and defined quantitative content of phytin in raw materials and substances.

Keywords: Rice bran, oil, phytin, technology

Introduction

The problem of efficient processing of secondary raw materials for producing competitive products is relevant for all industrialized countries. Considering great potential of the fat-and-oil production and pharmaceutical enterprises in the Republic Kazakhstan, the recycling of secondary resources in the food industry is appropriate and effective. Nowadays achieved great success in high-performance and creating synthetic medicine. However, products derived from vegetable raw materials, occupy a significant place in medical practice and constitute about one-third of the total number of

medicines. The annual harvesting and processing of vegetable raw materials are tens of thousands of tons, at the same time, to better satisfaction of the needs of health medicines and expanding range of high-performance low-toxic medicine are necessary to search for new sources of natural bioactive compounds and development on the basis of technology of complex use of raw materials. A particularly important problem is the development of modern technologies for the production of biologically active substances from the available cultivated and promising in terms of introduction of medicinal and food plant materials. One of the most important tasks of the pharmaceutical and food industry is development new medicines and food products. Therapeutic, edible rice oil and medicine - phytin will satisfy all needs of the cosmetics and fat-and-oil production. In this paper are solved the problem of obtaining new food and pharmaceutical products and waste management by complex using waste of rice production - rice bran (Tashmenov R. S., Myrkhalykov Zh. U., 2012, Tashmenov R.S., 2008, Kamilov H. M., Tashmenov R.S., 2008, Tashmenov R. S., Sagdullaev S. S., 2010, Tashmenov R. S. et al 2011, Tashmenov R. S. et al 2012, Tashenov R. S. et al 2014).

Particularly important problem is the development of modern technologies for the production of biologically active substances from the available cultivated and promising in terms of introduction of medicinal and food plant materials.

One of the unique biologically active species raw materials for food products are waste of rice production - rice bran. Rice bran serve as a source of valuable raw materials for cosmetic production: wax, essential fatty acid, rice starch and proteins. They include Tocopherol (vitamin E), ferulic acid, lecithin and vitamins A, PP, E and C.

Rice bran oil contains three antioxidants: Tocopherol, tocothreeenol and oryzanol, which act on free radicals, removes toxic substances from human body and fight with aging process. It contains a wide range of nutrients, including essential fatty acids, phosphatides, vitamins and minerals.

Rice bran as well as rice bran oil effectively reduces cholesterol and coagulability of the blood, prevents the formation of atherosclerotic plaques, and provides prevention of complications of atherosclerosis. Also rice bran oil has antiphlogistic action, neutralizes oxygen free radicals, and increases anti-tumor immunity. Rice bran oil is used in preparation for protection against sunburn, sun protection and as hair conditioners.

Natural rice bran oil is recognized worldwide as health oil. Kazakhstan has a large amount of acreage of rice. Such factors as good location, clean water, modern equipment and the latest technology in the

production of oil considering availability of powerful research laboratory, guarantee to produce high quality design rice bran oil and its derivatives.

The average content of phytin of rice bran about 4.0% (Sobolev A., 1992, Popov P.S., 1993).

One of the new, promising directions in the application of phytin is their use as medicine. Nowadays are famous more than 100 phosphorus-containing medicines.

At first time organic phosphorus compound were used as phosphorus-containing medicine, in particular in ophthalmology and obstetrics (Sobolev A., 1992). Recently in medicine has been recognized phosphorus-containing medicine, which have anticholinesterase activity and fundamentally different from previously used phosphorus-containing medicine, both in chemical structure and mechanism of action. Along with anti-glaucoma and other anticholinesterase means now used phosphorus-containing vitamins and their analogues, medicines for prevention and treatment of diseases of the cardiovascular system, antifungal, antibacterial, anthelminthicagent, hormonal agents, stimulant of metabolism and other medicines.

Among the natural phosphorus-containing compounds of particular importance are calcium-magnesium salt ionizehexophosphoric acid (phytin) (Popov P.S., 1993).

Versatile and high biological activity of phytin due to the high content of phosphorus and transition metal ions. It is known that the main function of phosphorus content in the human body reaches 650 g, is associated with growth and maintaining the integrity of bone and teeth (Popov P.S., 1993). Another part of it is in the soft tissues and is involved in anabolic and catabolic reactions, which can be seen from the role of phosphate in the formation of high-energy compounds (ATF) and the phosphorylation of intermediate products of carbohydrate metabolism.

Calcium is one of the five the most common elements of the alive organism as (O, C, N, H). Besides the formation of bone calcium ions play a key role in many physiological and biochemical processes (for example, in the transmission of nerve excitation, maintaining the integrity of cell membranes, and so on).

The calcium intake of an adult organism reaches 1.0 is 1.1 grams/day (Popov P.S., 1993). The suggestion of a possible high biological activity of metal intermediates ioninsitgectophosphoric acid was actually confirmed in later synthesized coordination compounds with cobalt and gland recommended for the treatment of hemolytic anemia (Sobolev A., 1992).

Current study has shown the principal possibility of complex and low-waste technology of production of edible oil and pharmaceutical

medicine (Kamilov H. M., Tashmenov R.S., 2008, Tashmenov R. S. et al 2014).

I.

Considering the significant volumes of production and processing of rice in Kazakhstan, of particular interest is secondary raw material processing grain rice, rice bran, which can be the source of a number of physiologically and biologically functional components, including precious vegetable oils. However, currently this resource in Kazakhstan is practically not used. The present work is devoted to the study of secondary use of rice bran in the food industry.

This work has been conducted for studying the chemical composition of rice bran resulting from the processing of rice grown in the southern regions of Kazakhstan. This conditioned to the possibility of making and producing a large number of new products. High content in rice bran vitamins played a major role in nutrition, medicine, and chemistry. The most valuable components of rice bran are high-quality protein and edible oil, which is dedicated to research.

We used as object of research - rice bran. That output takes 10-12 % by weight of raw rice. We studied qualitative and quantitative characteristics of rice bran as a source of valuable biologically active substances, including oil and phytin. Quality characteristics of rice bran are presented in table 1.

Table 1 - Average content of rice bran on the main constituent substances, %

№	Index	Rice bran				
		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1.	Oil content	14.15	14.5	17.2	16.1	15.8
2.	Starch	37.54	38.05	37.8	39.44	39.7
3.	Crude protein	16.35	16.5	17.09	17.20	16.65
4.	Phytin	4.42	4.21	3.95	3.98	4.12
5.	Ash content	8.97	8.99	9.2	9.01	9.14
6	Humidity	8.3	9.1	8.5	9.0	8.7

As can be seen from table 1, the main component of bran, and grains of rice are carbohydrates, which are mostly starch, the content of which varies to 37.54...39.7 %. Along with carbohydrates bran contain a fairly high amount of oil (14.15...15.2) and protein (16.35...17.20).

In this work used methods of analysis which is widely used in the fat-and-oil production (Tashmenov R. S. et al 2011). The oil content of rice bran was determined in the apparatus as Zaichenko and Naaband the content of crude protein by Kjeldahl method. The quantitative content of phytin in raw materials was determined by the gravimetric method.

We first developed an integrated technology of processing of rice bran with obtaining therapeutic, edible oils and medicine - phytin. Below is described mentioned before developed technology.

Description of technology for oil: grinding rice bran, hydrothermal treatment, drying, extraction (oil extraction and production, refinement, filling (Karpilenko G. et al, 2005, Nikogda V. O., 2011). The raw material is subjected to hydrothermal treatment with subsequent drying of the material. Then carrying out –extraction, moisturizing oil-containing raw material at a temperature of 50-55°C with an aqueous solution of vegetable oil concentration of 0.2-0.4% when the ratio of the crushed oil-containing raw material aqueous solution oil (1.0:0.3)-(1.0:0.5), and drying was performed until reaching a moisture content of 6-8%. For extraction of oil from rice bran was used extraction method of periodic action. As the solvent used for extraction gasoline. Extraction was carried out at the ratio of raw material and the extractant, respectively 1:5. The extract was separated from the cake by filtration. The meal is added back to the extraction gasoline in the ratio of raw material and extractant, respectively 1:3. Next, the extract was separated from the cake by filtration and collected in one container. While the oil content of the meal was less than 1 %. Fat-free cake in the process of extraction meal contains from 25 to 40% of solvent and water. The solvent in the meal is in a bound state, in the form of micelles. After the process of extracting, from the meal separated the rest of the extractant by means of evaporation. As a result of this processing is stored food and the nutritional value of the meal. Mixed oil passed through the oil filter, which is cleaned from various impurities. Then rice oil is separated from the solvent in a vacuum evaporation apparatus. The resulting solvent after evaporation can be re-used for the extraction process. And oil is directed to the refinement.

During research identified optimal parameters of hydrothermal processing of crude rice bran, pre-moistened up to 16-18 %, 45-50 min; the temperature of the heating bran at the end of the heat treatment process 105-107 °C; the content moisture in the cooked bran 6-7%.

Next process is receiving phytin from low-fat rice bran. The raw material is subjected to fermentation (hydrolysis of biopolymers) and extraction of phytin. For this extractor was filled calculated amount of 0.5% solution of the enzyme preparation amilorinozine p10x and rice bran. Next was acidified up to pH=4.5 and was stirred for at a temperature of 45-50°C. For separation of the extract suspension was passed through a centrifuge. Extract of phytin was separated from the insoluble residue and bleaching. Phytin besieged at pH=7 from the clarified extract. Precipitated from the solution of phytin was separated by filter. The precipitate was washed with water and squeezed for removing water. Unloaded the precipitate was dried in a dryer at 90°C and grinded. Further crushed phytin alloy preformed. For

this phytin was moistened starch paste and the wet mass was passed through a universal granulator. The wet granules are scattered evenly and dried at temperature of 80 °C to a residual moisture content of 7.5-8%. Next conducted a dry granulation and dusting. The dusting was carried out in the mixer, which along with pellets gave a mixture of starch and stearic acid. The resulting mass alloy preformed.

Qualitative and quantitative indicators of phytin were determined by the content ionizehexophosphoric acid (IHPA). We have developed a spectrophotometric method standardization substance for the quantitative content ionizehexophosphoric acid, which is the basis of the phytin molecule (Tashmenov R.S., 2008). The method is based on spectrophotometrically (λ=510 nm) excess from ionizehexophosphoric acid amounts of iron (III) forming a colored solution when interacting with sulfosalicylic acid.

The analysis was carried out as follows: 0.25 g (accurately weighed) of a substance of phytin was dissolved in a small amount of 0.1n HCl, in a volumetric flask 50.0 ml. After dilution of the sample, the volume of solution bring to the same HCl solution up to the mark, mixed. From the resulting solution of phytin took 2.50 ml aliquot parts, was placed in a glass with a capacity of 80-100 ml, added a bit redundant, but the exact volume of solution (4-5 ml) of iron with a titer of 0.56 mg/ml. We mixed and defended within 3-5 minutes. The precipitation of the iron complex was separated from not reacted amounts of iron (III) by filtration through a paper filter into a volumetric flask of 50.0 ml, which is pre-infused 3.0 ml of 10% aqueous sulfosalicylic acid solution. The filter cake was washed with distilled water 4-fold. Then the volume of wash water containing unreacted iron (III) brought purified water to the mark, mixed. The optical density of the resulting solution was measured on a spectrophotometer SF-26 in a cell with a layer thickness of 10 mm at λ=510 nm relative to purified water. From the calibration graph to find the number not reacted iron (III). Mass share IHPA in phytin calculated by the formula:

$$\text{IHPA} = \frac{\left(Fe(III)_{in} - Fe(III)_{res.}\right) \cdot 2.9547 \cdot V_s \cdot 190}{V_{al} \cdot g}\ \%,$$

where: $Fe(III)_{in}$ – initial quantity of iron (III), mg;

$Fe(III)_{res}$– not reacted iron (III), mg;

2.9547 – index of conversion (molecule IHPA: 4 atoms Fe);

V_s – volume of prepared solution for analysis, ml;

V_{al} – volume of aliquot solution, ml;

g – shot of ionize phosphate Ca or ionize phosphate Mg.

Table 2.Content of the ioninsitgectophosphoric acid in the phytin substance

№	Substance	Ionizehexophosphoric acid, %
1	Phytin	77.41
2	Phytin	77.94
3	Phytin	77.80
4	Phytin	77.68
5	Phytin	76.97

Thus, the content ioninsitgectophosphoric acid in the substance of phytin contains not less than 77 %.

Received phytin in their qualitative and quantitative indicators fully complies with the requirements of normative documents.

From low-fat rice bran obtained medicine - phytin (calcium-magnesium salt ionizehexophosphoric acid) can be widely used in medical practice (Tashmenov R.S., 2008).

Thus, the above study shows the feasibility and effectiveness of using rice bran as a comprehensive source of therapeutic, edible oil and medicine-phytin, which has high nutritional value and therapeutic effect.

References:

Kamilov H. M., Tashmenov R.S. Obtaining a mixed magnesium salt ionize phosphoric (phytin) from rice bran. Materials of scientific-practical conference "Topical issues of education, science and production in pharmacy". Tashkent, 2008.

Karpilenko G.,Kazakov E. Biochemistry of grain and grain products. 2005, 512 p.

Nikogda V. O., MartovshukV.I., MartovshukV.E., Gulushanyan A. P. and others Method of production of vegetable oils from oil-containing raw materials /Patent RF №2430963. Published 10.10.2011.

Popov P.S. Definition of phytin in the seeds. //Methods biochemical research in the breeding of oilseed crops. - Krasnodar, 1993. p. 87-88

Sobolev A. A. Distribution, generation and utilization of phytin in higher plants// advances in biological chemistry,1992., p.248-260.

Tashmenov R. S., MyrkhalykovZh. U., Kaldybaeva G. Copyright certificate № 27433, 2012 Way tof obtaining inosine phosphoric (phytin) from rice bran.

Tashmenov R.S. Development of methods for quantitative determination of phytin. Materialy IV mezinarodni vedesko-prakticka conference "Evropskaveda XXI stoleti - 2008". Praha, 2008.

Tashmenov R.S. Dynamics of extraction of salt inosine phosphoric from rice bran. Pharmaceutical Bulletin. Almaty, 2008. No. 3-4. p. 13-15.

Tashmenov R. S., Sagdullaev S. S. Application of amilorinozine p10x upon receipt of derivative ionize phosphoric from rice bran. Materials of scientific-practical conference "Integration of education, science and production in pharmacy". Tashkent, 2010.
Tashmenov R. S., Kaldybaeva G., Togatayev T.U. Development of technology insists that magnesium. Proceedings of ISIC "Auezov reading-10". Shymkent, 2011, S. 214-216.
Tashmenov R. S., Kaldybaeva Y., Togati T. C. Optimization of hydrolysis of biopolymers from rice bran. Proceedings of the Regional Scientific Practical Conference «Updated Kazakhstan in the modern world" achievements and prospects of development. Shymkent, 2012, p. 186-188.
Tashmenov R. S., Orymbetova G., Myrkhalykov Zh.U. Using of secondary by-products of rice to obtain rice oil. International scientific journal "Science and world" №4(8), 2014, volume 1, P. 112-115.