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**IMPROVEMENT OF EQUIPMENT FOR PRESSING RAW MATERIALS  
OF PLANT ORIGIN IN ORDER TO RATIONALLY UTILISE LOCAL  
NATURAL RESOURCES**

**ABSTRACT**

on the dissertation work of Muratzhankyzy N.  
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6D072400 – “Technological machines and equipment”

**The relevance of the work.** In the Address of the Head of State Kasym-Jomart Tokayev to the people of Kazakhstan 2023 “Economic Guideline of Fair Kazakhstan” several tasks that contribute to the development of the country are defined.

“...We are facing another very important task. We must make a real breakthrough in the agro-industrial complex. The potential of the agricultural industry is enormous. But we still do not fully utilise the available opportunities.

There are very large markets for products around Kazakhstan. There is a shortage of quality food products. Kazakhstan's strategic goal is to become one of the main agricultural centres of the Eurasian continent. If we want to achieve this goal, first of all, we must switch to high-level processing of products...”.

The agricultural sector is one of the main branches of the economy and not only the level of food security of the country, but also the social and political stability of the state depends on the degree of its development.

Human nutrition is the basic biological need of the organism for the restoration and creation of tissues, their growth, development and normal functioning. Regular nutrition ensures continuity of metabolic processes, normal health and increased efficiency. For normal life activity in the diet should be a set of products that provide the body with a sufficient amount of proteins, carbohydrates, fats, vitamins, trace elements. One of such product groups are fruits and berries, which due to their nutritional properties and distribution can become an important raw material base for enterprises of the processing industry. However, the range of fruit raw materials used is limited and requires the search for new crops of local zoning. In this regard, among fruit crops a special place is occupied by sea buckthorn, which is a valuable source of a number of important biologically active compounds. Kazakhstan has significant reserves of wild sea buckthorn. Sea buckthorn is widely used in food industry, medicine and other branches of national economy. Its fruits contain water and fat-soluble vitamins (A, B1, B2, B3, B6, C), lipids, polyphenols, carbohydrates, amino acids, minerals.

Like sea buckthorn berries, sea buckthorn juice contains all vitamins necessary for humans, about 200 active biochemical and mineral compounds, fibre, proteins and fats. Sea buckthorn juice has important properties for the human body - antioxidant, anti-inflammatory, anti-stress, antithrombotic, etc.

Nowadays, one of the main methods of juice production is the pressing method. Most of the modern presses are designed to press juice from certain types of fruit, it is very difficult to convert such equipment to press other fruits, even if it is possible, the juicing process is inefficient. For small-scale enterprises the existing conditions of juice pressing may be unacceptable. Therefore, there is a need to create universal presses that would work effectively with both crops characterised by high juice content and crops with low juice content.

To find a solution to the above problems, it is necessary to improve the design of pressing equipment. The optimal way to solve such problems is to achieve, as a result of equipping the design of the equipment with a mechanism of self-regulation of pressure in the working zone, an increase in the efficiency of the equipment, intensifying the process of juicing, providing a continuous change in the gap between the cone screw and cone-shaped nozzle, eliminating the need for manual force.

In the course of solving the set goal of the dissertation work developed tasks based on the research works of the following scientists: A. I. Peleev, M. L. Faivishevsky, S. G. Liberman, V. A. Maslikov, I. A. Rogov, A. V. Gorbatov, A. Y. Sokolov, Yu. T. Zhailaubaev, S. N. Tumenov, A. A. Ospanov, E. S. Spandiyarov, A. B. Ospanov, M. J. Erkebaev, M. Ch. Tultabaev, A. E. Tulgaliev, A. K. Kakimov, A. U. Shingissov, A. L. Kassenov, M. M. Kakimov, E. Z. Mateyev, D. R. Orynbekov, J. H. Tokhtarov.

Trends in the development of agrarian-industrial complex, including the improvement of the screw press structure in the production of processing of vegetable raw materials, testify to the relevance of these research works.

**The purpose** of the dissertation work is to improve the equipment for pressing of raw materials of plant origin with the help of the mechanism of pressure regulation.

In accordance with the set goal, the following **tasks** are defined in the work:

- determination of effective ways to improve equipment for pressing wild sea buckthorn products on the basis of literature examination, organisation and design of research objects;
- mathematical modelling of the pressing process when improving the equipment with the help of pressure control mechanism;
- experimental determination of the agreed parameters, describing various constructive and certain ratios of parameters depending on the improvement of equipment for pressing sea buckthorn products;
- development of the method of engineering calculation of the screw device for pressing and its implementation in production;

**Research objects.** Mechanism of pressure regulation of equipment for pressing wild sea buckthorn fruits; sea buckthorn fruits.

### **Research subject.**

1. Chemical composition of sea buckthorn extract;
2. Change of juice yield during pressing of sea buckthorn raw material. 2;
3. Changes in the density of sea buckthorn extract;
4. Changes in pressure during pressing process;
5. Changes in structural and mechanical properties of the product during pressing process;
6. Determination of the productivity of the pilot plant;
7. Change in the capacity of the pilot plant;

### **Scientific novelty.**

- The screw press equipment for juice pressing is improved as a result of equipping it with the mechanism of self-regulation of pressure in the working zone;
- equations of mathematical modelling of pressing process at equipment improvement with the help of pressure control mechanism are obtained;
- the technique of engineering calculation characterising quantitative and qualitative specificity of equipment improvement for pressing of wild sea buckthorn products is developed. The consistency of the obtained results is proved by the correspondence of the results of mathematical modelling and experimental studies.

### **Field of application.**

The results of the scientific and developed design of the screw press relate to the food industry and can be used in the relevant industries, in particular, fruit and berry production of the agro-industrial complex of the Republic of Kazakhstan, as well as in catering facilities.

**Practical significance of the work.** As a result of equipping with the mechanism of self-regulation of pressure in the working zone, the improved screw press equipment for juice pressing is improved in the laboratory of the department of 'Technological equipment' of the Research School of Food Engineering NPJSC 'Shakarim University named after Semey' and research laboratory of NPJSC 'Kazakh Agrotechnical Research University named after S. Seifullin'.

Experimental press equipment for juice production with the mechanism providing uniform pressure distribution in the longitudinal direction of the screw is confirmed by the patent of the Ministry of Justice of the Republic of Kazakhstan from 19.04.2024 № 9032.

Equations characterising the methodology of engineering calculations of the screw device for pressing are proposed.

**Author's personal contribution.** Development of engineering fairness of mathematical model and technological calculation of press equipment and selection of spring of simple mechanism of pressure regulation of press equipment.

### **Approbation of the practical result of the work:**

The main results of the dissertation work were reported at scientific-practical conferences of different levels, such as: XIV International scientific-practical conference «Actual achievements of European science-2018», (15-22 June 2018), Sofia:Bel GRAD - BG ODD, (Sofia, Bulgaria 2018); Materials of the international scientific-practical conference «Innovative development of food, light industry and hospitality industry» (22-23 October 2020) - Almaty: ATU, 2020.

**Publications.** According to the results of research work in accordance with the subject of the thesis published 13 scientific papers, including 2 abstracts at international conferences, 3 article in a journal on the international database Scopus and Web of Science, 1 analytical review, 5 articles in scientific editions submitted by the Committee for Quality Assurance in the field of science and higher education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and received 2 patent.

### **Scientific results proposed for defence:**

- the results of theoretical and experimental studies of obtaining juice from wild sea buckthorn products on the experimental equipment.
- obtained parameters of the rational mode of the pressing process through the mechanism of pressure regulation.
- results of engineering calculation of a screw press device.

**Structure and scope of the thesis.** Structural elements of the thesis: introduction, review of scientific, technical and patent literature, theoretical research, methods of experimental research, analysis of the obtained results, conclusion, appendix 7, list of used sources 91. The work consists of 125 pages, 43 figures, 16 tables in typed computer text.

### **Evaluation of the completeness of the solutions to the set tasks.**

1. The analysis of the process of pressing sea buckthorn and the structure of the equipment necessary for the implementation of this process allowed to determine the improvement of this process by developing a mechanism for pressure regulation.

2. Interdependencies of processes in intensification of pressing process, cost-pressure characteristics of press-pressing and moulding devices are considered, the system of mathematical modelling of effective juice compression in harmonious interrelations of productivity and pressing pressure is developed. The presented expert system of mathematical modelling and the nomogram constructed in this way provide a method of engineering calculations, which helps to choose a compatible variant of intensification of the pressing process.

3. The dependence of intensification of the pressing process was characterised by the ratio of various structural and determinable parameters, the

optimum parameters were experimentally investigated. The optimal parameters for juice separation  $\omega=14.653$  rad/s velocity and  $\delta=6 \cdot 10^{-3}$  m aperture are known.

4. Equations characterising the methodology of engineering calculations of intensification of the pressing process intensification by improving the press screw device are proposed. The qualitative complex analysis of indicators is carried out, as a result of which it is established that the obtained products do not reduce consumer characteristics and increase their energy and nutritional value.