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Organizational basis of the development of innovative functional food products by the Ukrainian enterprises of deep walnut processing

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Abstract

Keywords:

Walnut
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Introduction. Ukraine industrial enterprises, engaged in deep processing of walnuts, have a significant export potential. The lack of methodological bases for the development of innovations by domestic enterprises reduces this potential.

Materials and methods. An approach of the analysis of value chain was used, marketing functional and process approaches were used to. The research uses also: fundamental interviews with experts, laboratory experimental studies, production and implementation of the developed innovative products. Developing of innovative products was conducted on the basis of Quality Function Deployment methodology.

Results and discussion. The results of our research demonstrate that Ukraine is involved in the process of diversification of the world edible oil market and innovations development. The industry of deep walnut processing provides a kernel walnut for the confectionery and animal feeding, edible walnut oil, industrial oil and oilcake, which can be processed into food products or used to feed livestock on the domestic and foreign markets. Remains (wastes) from production can be effectively recycled or used in other industries. In addition, walnut kernels are also considered to be a product of the edible oil industry. Other by-products of walnut are being studied. In the development of the industry of deep walnut processing, as well as in the short term prospect, the focus is on the confectionery kernel and walnut oil. In the course of the industry development, innovative by-products will be developed through exploration and support of the development of alternative ways of using remains as they arise.

The value of obtained results is the possibility of using the obtained theoretical and methodological conclusions, recommendations and regulations for agrarian and food processing enterprises to solve the problem of competitiveness of the enterprise and its products when exporting in the conditions of high dynamics of business environment based on the system relations of the manufacturing enterprise in the industry of deep walnut processing.

Conclusion. The model of the value chain for the processing of walnuts and the technology of production of new products is offered.

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Introduction

In a market economy, domestic producers have a goal both to increase their profits and to achieve an appropriate level of competitiveness in the market [2]. To solve these problems, the most pressing issues are the scientific definition and development of system approaches to the marketing of innovative activities of business entities [2, 14]. Such a task is complicated by the variety and difficulty of fixing the forms and manifestations of behavioral strategy and tactics in the conditions of the dynamism of the environment [3].

In our previous studies, it has been established that the competitiveness of industrial enterprises depends, in large part, on the extent to which the target markets are thoroughly investigated and specific measures to adapt products to the requirements of these markets have been developed. The methodology of enterprise competitiveness management is developed based on three key elements, namely, dynamic capabilities, innovation, quality (“DIQ”), and the dependencies between the characteristics that arise during the process of deployment of the quality function when designing innovative products are determined. Our research shows that Ukraine industrial enterprises, engaged in deep processing of walnuts have a significant export potential in the industry for deep processing of walnuts [5, 8, 11, 16, 20, 22, 24, 26, 28, 30, 32, 34,]. This is confirmed by the growing demand for products provided by walnut processing enterprises and the development of raw materials based on the unique natural conditions in Ukraine [8, 10, 15].

Establishment of constraints in the added value chains for food products based on their limited availability [1] can significantly improve the competitiveness of enterprises in the foreign markets [2], especially for transition economies such as Ukraine’s [3]. Restrictions that are created by the markets can be mitigated or eliminated to a large extent based on the transformation of elements of the marketing complex of a small manufacturing enterprise into the parameters of the quality of the desired product and the process parameters [4]. The methodology [4] also allows setting requirements for equipment and for manufacturing operations that are included in the operating instructions for each step of the production process. A promising way to increase the competitiveness of the subjects of the value chain in the oil and fat industry [5, 6] for deep walnut processing is the certification according to the European quality standards [7, 8] and ensuring the recycling of waste products for biofuels [9, 36]. However, domestic agrarian and processing enterprises face a number of institutional constraints on organic certification [7]. A possible way for overcoming these constraints is to develop comprehensive and systematic measures to ensure the development of innovative products and their generalization in the form of typical provisions for domestic enterprises of the oil and fat industry.

The idea of the development is based on the investigation of the value chain for innovative functional food products from walnut kernels and to develop system measures in the activities of enterprises of industry for deep processing of walnuts aimed to increase the added value of these products and ensure its competitiveness in the foreign markets. The working hypothesis is that the lack of methodological bases for elaboration of a plan for innovative management in the conditions of the Ukrainian economy reduces the export potential of agrarian and processing enterprises of the industry for deep processing of walnuts. It is expected that the development of methodological base will increase the efficiency of enterprises in industry for deep processing of walnuts.

Materials and methods

Applied methods and theoretical approaches

The research uses such principal methodologies as fundamental interviews with experts, problem-oriented group discussions, critical literature review, results of laboratory experimental studies, results of production and implementation of research and small batches of the developed innovative products. The development of innovations in the industry for deep processing of walnuts was carried out on the basis of marketing [2, 12, 14], functional [1, 3, 17, 21, 23, 27, 31, 33] and process approaches [6, 35, 37, 19, 25, 29]. To get a complete view of the stages of product flow from the raw material base to production and to the final consumer, an approach to the analysis of the value chain was used [16, 24, 26, 32, 34]. Economic and mathematical methods [3, 18, 28] and the theory of constraints [1] have been used for the development of provisions of new products. Also, developing of innovative products was conducted on the basis of Quality Function Deployment methodology [4]. For the formulation of certain theoretical positions in the process of fulfilling the set scientific tasks, there were used general scientific methods such as scientific abstraction; morphological analysis, generalization, analysis of hierarchies.

Structure of research

This paper considers the following problem issues:

1. Research of the current state and trends of the vegetable oil market in Ukraine and in the world in the following directions: research of the global production of vegetable oils; study of the global consumption of vegetable oils; study of the features of the international vegetable oil market; research of market of high-oleic oils and oilseed crops; study of the features of the investment activity and activities of producers of vegetable oils;
2. Investigation of the value chain in the production of innovative products of the industry for deep processing of walnuts in the following areas: the study of the value chain in the oil and fat industry; determination of the value chain in the industry for deep walnut processing; support of commercialization of new types of edible oils; competitiveness of the value chain in the international business; penetration into the global agribusiness value chain;
3. Investigation of the competitiveness of the enterprise of deep processing of walnuts in the following areas: the concept of the enterprise competitiveness; methodology of enterprise competitiveness management; methodological approach to innovation development in the industry for deep processing of walnuts; development of the marketing strategy for managing enterprise's innovative activity in the industry for deep processing of walnuts; design of functional food products made from walnuts;
4. Development of innovative functional food products made of walnut based on the marketing design.

Results and discussion

Research of the current state and trends of the development of vegetable oil market

The global vegetable oil market is expected to exceed 200 million tons by 2020 due to the growing popularity of healthy, organic and unrefined vegetable oils, which is supported by high demand for vegetable oil worldwide (Figure 1) [10, 11].

From the point of view of consuming as a food product, vegetable oils are considered to be a healthier alternative than animal fats [8, 17], since they contain more unsaturated fatty acids [23, 29, 31, 33]. In particular, walnut oil is widely used in cooking, medicine, cosmetics and other industries [5, 15, 17, 21, 27, 31].

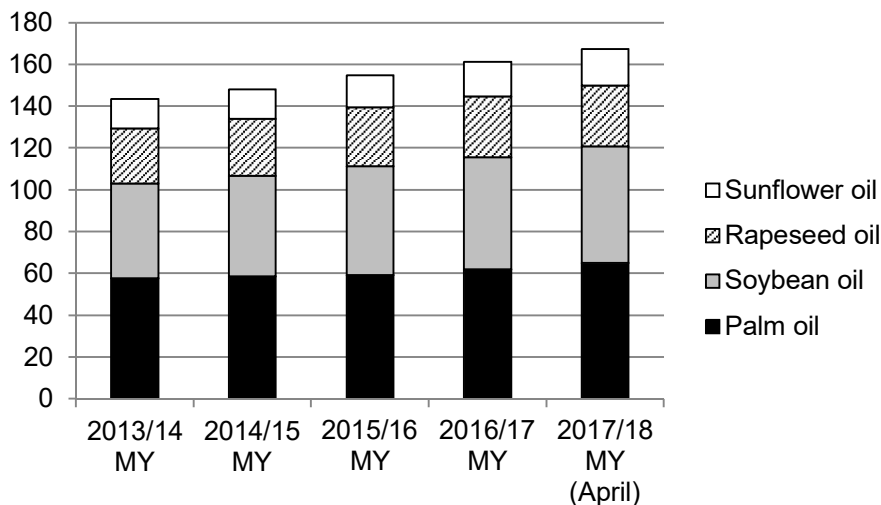


Figure 1. Dynamics of the global consumption of palm, soybean, rapeseed and sunflower oils, mln tons

Vegetable oils are oils or fats obtained from the plant. Their texture can be characterized as liquid and greasy. Most vegetable oils can be used in two ways: they can be used as cooking oil or for the production of fuels and diesel [7]. The most common types of oils include palm oil, soybean oil, rapeseed oil and sunflower oil. Palm oil is obtained from pulp of palm fruits, which are mainly found in the tropical belt of Africa, South America and Southeast Asia. It is estimated that about 90% of palm oil is used for food intake, while industrial consumption, such as cosmetic or fuel and diesel, covers the last 10% [10]. Palm oil is an industrial product with a total annual sale of approximately \$50 billion. Industrial raw materials used in the production of food and confectionery products, in the cosmetics industry, for production of detergents and biofuels are also an important food product in most developing countries [11].

However, the strong growth of palm oil production creates some serious problems in the strategic perspective [13, 15, 17].

In the early 2000s, trends in the destruction of rainforests of the planet reached a critical point with the accompanying increase in greenhouse gas emissions and loss of biodiversity. It became a burden for many markets, and large multinational companies that use palm oil faced various forms of protest, including consumer boycotts [10].

Significant consumption of palm oil leads to the problems with human health [6, 17]. Palm oil has a relatively high content of saturated fats. In the research of 2003, the World Health Organization provided compelling evidence that high levels of palmitic acid increase the risk of developing cardiovascular diseases. In the countries where fat reserves in the body are low and the amount of saturated fat from animal sources is limited, this risk is more moderate. However, with the development of the economy, the habits are changing and the dietary benefits of consumers, regarding the consumption of products rich in palm oil, may disappear [7]. According to the US Academy of Sciences, the content of trans-fats in palm oil based food products is not significant and does not have any known effects on human health, but it is still highly correlated with the risk of coronary heart disease [17].

Development of the walnut raw material base and its processing into innovative functional food products with increased added value that will be able to compete in the world market is one of the main ways of solving the above-mentioned problems [16, 20, 22].

The statistics from various sources show that Ukraine holds a strong position among the world's 10 largest exporters of walnuts (Figure 2) [10, 11].

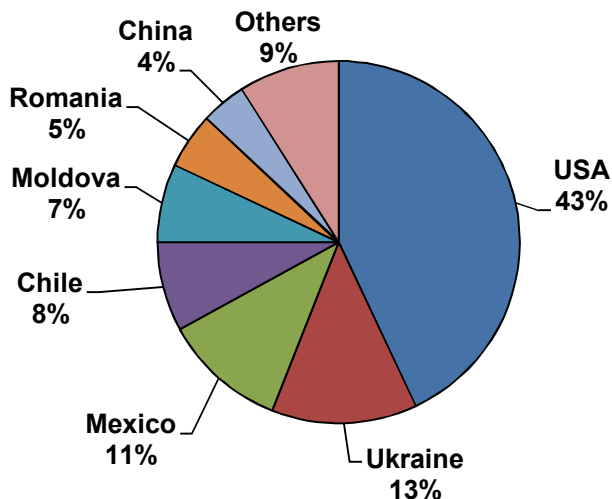


Figure 2. World walnut exports in 2014, shelled/metric tons

The world market for vegetable oil from walnut fruits is growing due to its wide range of applications [10]. Despite the fact that the world walnut market is rather specific, since production continues to be extensive and the area of land that is potentially suitable for walnut growing is very limited: walnuts usually occupy the area from 6 to 14% of the entire planet. Ukraine is lucky to be in this statistic. At the same time, walnuts do not require complicate care; the tree begins to bear fruits within 4-7 years after planting and can preserve this ability for centuries [11]. Therefore, the production of walnuts and walnut oil is very beneficial and does not cost much. According to experts, cultivation of one ton of walnuts is much cheaper than obtaining the same amount of wheat or grapes.

Data on the import and export shows that Ukraine is a net exporter of oilseeds and oils, refined edible oils, various wastes and other products (Table 1) [10, 11].

Table 1
Structure of the global oil exports by major exporting countries as of April 2017-2018 MY

Type of oil in the structure of the global exports	Ukraine's rating in the structure of the global exports	Share of Ukraine's oil exports in the structure of global exports, %
Export of soybean oil	7	1.5
Export of rapeseed oil	8	1.3
Export of sunflower oil	1	54.4

Therefore, these data justify that Ukraine will be involved in the process of diversification of the world oil and fat market and innovations development.

The supply of raw materials is only the beginning for any innovation [12]. Sale of raw materials in the world market cannot be a long-term effective solution under the lack of proper attention and investments as well as the appropriate environment [13, 14, 28].

Industry analysis

An industry can be defined either by raw materials processed by its enterprises or the end product/service intended for a particular market [5, 34]. In a broad sense, the industry includes all enterprises that are contractually bound to supply a particular set of products or services to the end users [6, 26]. The industry includes producers, processors, suppliers of raw materials and materials, exporters, retailers, etc. These entities form separate specific value chains [7, 24, 26,]. For this study and achievement of the program objectives, the value chain is defined as “a value chain of the industry of deep processing of walnuts for specific market”, which primarily refers the EU market [13].

According to the definition, the industry produces a walnut kernel for the confectionery and animal feeding, edible walnut oil, industrial oil and oilcake, which can be processed into food products or used for feeding livestock in the domestic and foreign markets [3]. In addition, walnut fruits are also considered to be a product of the industry [5]. Other by-products of walnuts are being explored. In the development of the industry as well as in the short term prospect, the focus is made on the confectionery kernel and walnut oil. In the course of the industry development, innovative by-products will be created by studying and supporting the development of alternative ways of using by-products as they arise [15, 35, 37].

The system for value chain management of the production in the oil and fat industry for deep walnut processing shown in Fig. 1 contains key elements that are represented by the main entities: producers of raw materials, i.e. farmers, gardeners (1); trading enterprises engaged in the purchase and sale of raw materials. i.e. a wholesaler / wholesale buyer (2); the main processors that perform primary processing of raw materials (peeling, sorting), i.e. processors (3); processors raw materials that produce crude oil (16) and walnut oilcake (17) from walnut fruits (secondary processing), i.e. oil producer (4); after the primary and secondary processing of the walnut fruits, the waste/residues (5) and a walnut shell (6), which are the input raw materials for biofuel producers, paint and varnish industry, cosmetics industry are created (7); crude walnut oil (16) serves as an input raw material for the production of finished products in the form of oil in bottles / ingredients (11) both by producers of crude oils (4) and processors that conduct refining, blending, flavoring (8) of walnut products; walnut oil cake (17) is a feedstock for walnut flour producers (9) and producers of livestock feeds (10); walnut flour is input raw material for confectionery industry (12) producing bakery products (13) and candies, and other products (14); all products of the industry for deep walnut processing are the input product for distribution (15).

Analysis of the subjects of the value chain in the industry for deep walnut processing and the functions performed by them should consider primary and secondary subjects and their respective roles. The main subjects are those who are engaged in the principal production activities in the value chain (supply, production, processing and sale of products) [26]. Secondary subjects are involved in the main activities of the value chain not directly – indirectly, but their actions affect the activities of the main subjects of the value chain [34]. Secondary entities offer support and provide services in the value chain. Some of the secondary subjects are policy and regulatory support agencies, financial support institutions and providers of business support services [13]. Further research should be specified in accordance with these two categories of subjects of the value chain.

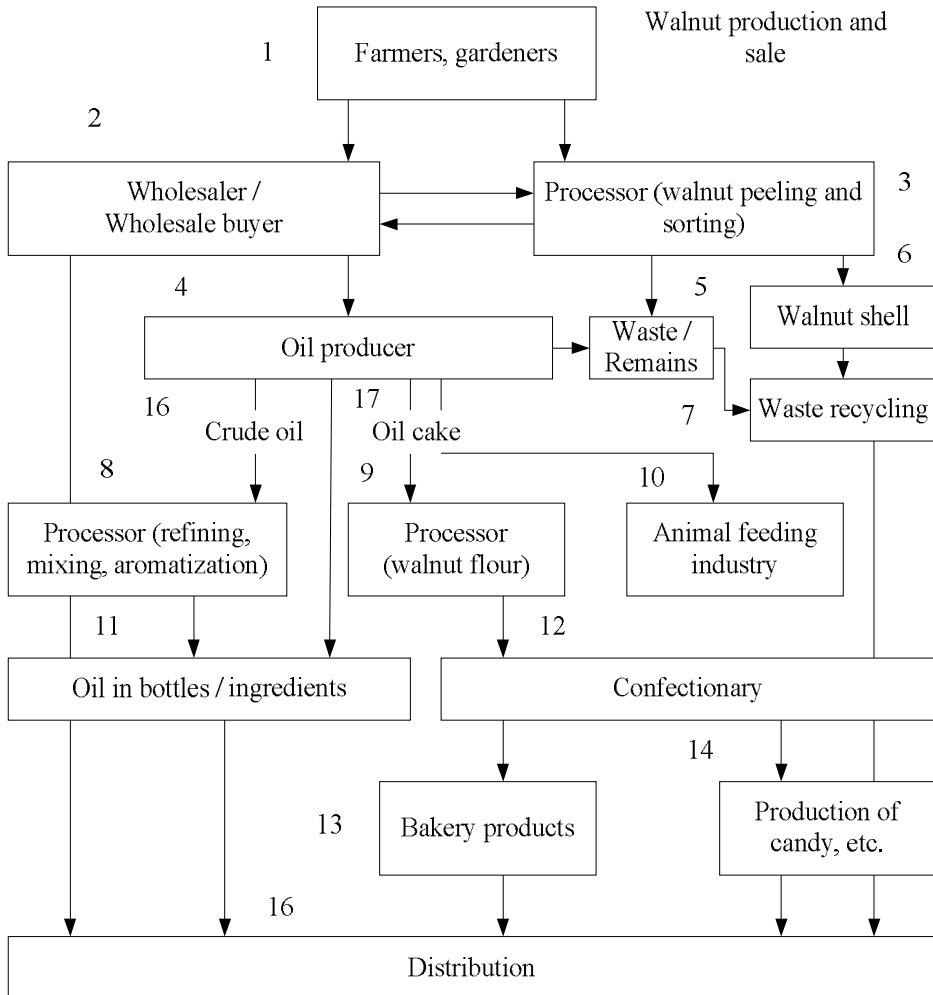


Figure 3. Cartographic model of the value chain for production in the oil and fat industry for deep walnut processing

Competitiveness of enterprises of the oil and fat industry

The current state of development of competition theories is characterized by a variety of subjects of analysis, which are the principles of activity in a competitive environment [12]. The actual difference between them is reduced to the difference in the number of variables that they cover and their predictive capacity for individual situations [13]. In addition, sectoral features are important factors of the competitiveness of enterprises [14].

Generalization of approaches to the definition of competitiveness [2, 12, 14, 22] has allowed to propose an author's approach to the defining the competitiveness of a manufacturing enterprise as a set of its capabilities and ability to produce products that are

can satisfy current social needs and abilities that lead the enterprise to a state in which its market and financial stability is provided by means of specific competitive advantages.

Figure 4 shows a non-waste competitive technology for production of innovative functional food products from walnuts, which provides comprehensive use of raw materials, processing of nut into oil and oilcake, processing of remains [15] into biofuels [9, 11], selection of the obtained products and their distribution depending on the values of qualitative indicators between such application areas as confectionery industry, livestock and poultry feeding, baking industry, spice production, biofuel production, paint and varnish industry, cosmetic industry [5, 22].

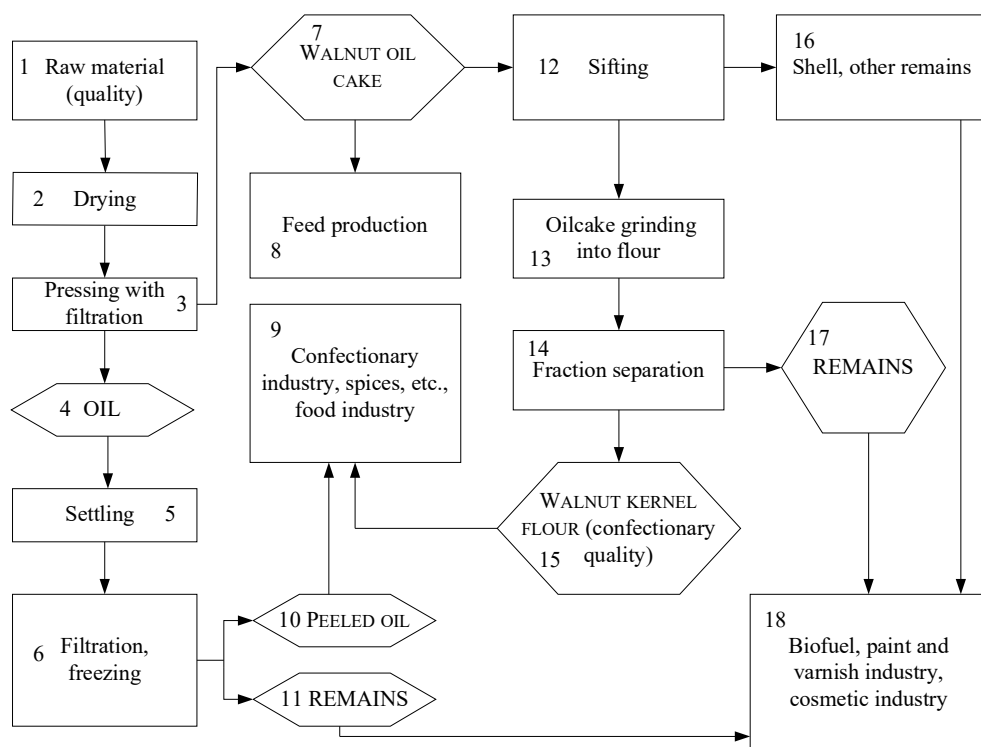


Figure 4. Non-waste competitive technology for production of innovative functional food products from walnuts

The proposed technology is implemented in the following way: raw materials and information on its qualitative characteristics serve as input resources (1); raw materials are connected with the elements of the system from its preparation to the technological process of processing – equipment for drying, operator, change in quality indicators (2); (3) – a complex of equipment and procedures for the processing of raw materials into oil (4) and oilcake (7); oil (4) serves as an input for the operation of the complex for settling (5), filtering and freezing (6); the output of these elements of the system is pure oil, information on its quality indices (10) and remains (11); walnut oil cake (7) is an input resource for the operation of the feed production complex (8) and sifting (12), grinding (13), separation of fractions

(14); the input resources for the complex operation on fraction separation (14) are the shell and other remains (16,17) and the confectionery walnut flour (15); the final elements of the system are complexes for the production of confectionery, spices and other food products (9) and production of biofuels, paint and varnish industry, cosmetic products (18).

Thus, the proposed technology involves a non-waste production cycle and it can become the basis for diversification of production, differentiation of markets and ensuring a number of unique competitive advantages for manufacturing enterprises, as well as the involvement of agricultural enterprises of the oil and fat industry in agro-industrial and agro-food chains of various levels.

Application of measures of innovative products creation

The scientific and technical levels of the developments correspond new developments in Ukraine in terms of equipment and the best world analogues in terms of products [15, 17, 19, 23, 27, 33, 35, 37]. The developed equipment and products have undergone the examination by the State Sanitary and Epidemiological Service of the Ministry of Health of Ukraine.

When designing innovative functional food products, the methodology of deployment of the quality function [4] supplemented by the authors' methodological developments has been used. There were two groups of experts that conducted evaluation of different characteristics of products and production process. The results of experts examining were statistically approved by using Kendall's coefficient of concordance and Pearson's coefficient of correlation. The results of designing are as follows:

- list of characteristics of the elements of the process of production of projected products in connection to consumers wants and complex of marketing of enterprise. This characteristics meet the requirements of a gradual process of Quality Function Deployment in next pair-order: customers' needs and wants → complex of enterprise marketing, customers' needs and wants → product characteristics, product characteristics → components characteristics, components characteristics → process characteristics, process characteristics → production characteristics;
- weighting coefficient for implementing Quality Function Deployment (QFD) of the product range of TM "Food of Heroes", Private Joint-Stock Company "Vinnytsia Pasta Factory", Private Joint-Stock Company "Vinnytsia Food Factory". Given coefficients were used to compare competitiveness of developed products with existed analogues (Walnut oil *M. Graham & Co. Oil Color*. United States of America; La Tourangelle artisan oil. United States of America. Virgin organic walnut oil. France, etc.) [21, 23]. In addition, the current product specification is adopted as an analogue. CAS 8024-09-7 of the Chemical Abstracts Service (American Chemical Society) for the Juglans regia l food product. seed oil Class: Oils: Vegetable Oil and Fish Oil (Marine);
- houses of quality built in the process of designing consumer innovative functional food products from walnuts. On the basis of given results there are changes made to adopt the assortment of products to customers wants and to develop corresponding marketing complex.

Conclusion

1. The results of the research meet the goals of Ukraine's sustainable development presented on September 15, 2017 by the Government of Ukraine in the National Report "Objectives

of Sustainable Development: Ukraine”, which defines the basic indicators for achievement (OSD).

2. The practical value of the results of the research and developments is the possibility of using the obtained theoretical and methodological conclusions, recommendations and regulations on the creation of innovative functional food products from walnut fruits for agrarian and food processing enterprises to solve the problem of competitiveness of the enterprise and its products when exporting on the basis of the compliance of production with the modern standards and norms on the global market in conditions of high dynamics of the business environment taking into account system links of the manufacturing enterprise.
3. The developed model of the value chain for production in the oil and fat industry for deep walnut processing can be used for creation of innovative products with their own partial value management systems by studying and supporting the development of alternative ways to use by-products as they arise.
4. The developed non-waste competitive technology for production of innovative functional food products from walnuts can be used for the creation of innovative products in the industry of deep processing of walnuts. It has a non-waste cycle of combination of elements and is the basis for diversification of production, differentiation of markets and creation of a number of unique competitive advantages for production enterprises of the agro-food chain, as well as the involvement of domestic agricultural enterprises of the industry of deep processing of walnuts in global agro-industrial and agro-food chains.
5. The obtained results of marketing products modeling can be used for connecting different properties of new products and marketing complex of enterprise with characteristics of production plant.

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