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PROBLEMS OF INNOVATIVE ACTIVITY DEVELOPMENT AT FOOD INDUSTRY ENTERPRISES OF UKRAINE

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Abstract

An active introduction of advanced achievements of science, which provides structural changes in the economy and stimulates the production of innovative high-tech products, can be considered as the prevailing tendency for the latest developments in the world. The results of a study on the relationship between the dynamics of basic food consumption in households and the dynamics of first-time registered diseases among the population of Ukraine emphasize the need to develop a health food industry based on innovative technologies and innovative functional food products (IFFP).

The study used materials of the Ukrainian State Statistics Service for a period of 2005 - 2015, materials of the State Register of Food for Special Dietary Consumption, Functional Food Products and Dietary Supplements. Methods of correlation analysis, analysis and synthesis, grouping and description were used for data analysis.

There are presented the list, features, benefits and main producers of IFFP in Ukraine, checked by state sanitary and epidemiological expertise. However, despite their existing benefits of eating IFFP in the form of prevention or mitigation of the disease of the person, their share does not exceed 3 - 5% of all known food products in Ukraine. The results of the analysis of innovative activity at the food industry enterprises of Ukraine show the negative trends of enterprise innovation development. Most of the investments in innovative projects are carried out at the expense of business entities. Unstable dynamics is also a characteristic feature of the funds flow of enterprises for the implementation of innovation.

Thus, the main problem of the domestic food industry, concerning the production of IFFP, consists of not enough or even complete lack of proper funding. Therefore, in order to increase the food industry enterprises innovation activity, it is necessary to significantly increase funding from the state and have changes in the legislation.

***Key words**: Innovative functional food products, Innovative activity, Sources of funding.*

1. Introduction

The prevailing trend of the latest development in the world can be considered as an active implementation of advanced achievements of science and technological development, which provide an impelling impetus to structural changes in the economy and stimulate production of innovative high-tech products. So, today the activation of innovative activity is the most effective way to ensure the sustainable development of the enterprise, industry or country, and increase their competitiveness by intensification of their competitive advantages.

Particularly important is the implementation of this process in the food industry, which requires the implementation of newly created or improved innovative technologies and production of food products with new nutritional and functional properties on their basis. These technologies and new products are the basis of the possibility to solve the priority tasks for today - to create the industry of healthy products in Ukraine to provide entire population with them with the goal of improving the health of consumers, improving their quality of life, preservation of the gene pool of the nation. Such changes in the food industry are caused by the requirements of the modern nutritional science - the need to provide all sections of the population

with available healthy products, because the health of a person depends on the structure and quality of the diet (Vozianov [1]).

2. Prerequisites, condition and prospects of innovation activity of food industry enterprises development

2.1 Study of the relationship between consumption of the main food categories and incidence of the Ukrainian population

Today one of the most important environmental factors determining the health of the population is human diet. Complete and balanced diet creates the conditions for normal physical and mental development, affects the body's ability to resist the influence of adverse environmental factors. Scientists have proved a certain modifying action of chemical factors of low intensity that causes a nonspecific impact on human health. It is based on a systematic violation of homeostasis, which, as a result, causes an increase in the number and the worsening of almost all diseases associated with the influence of both environmental and social factors.

To study the relationship between dynamics of consumption of basic foodstuffs in households and dynamics of first time registered diseases among the population of Ukraine there has been performed a correlation analysis of relevant statistical data series over the period of 2005 - 2015.

Let's outline two key variables that characterize the object. The independent X variable (Table1) (the amount of food consumed on an average per one month per person) affects the value of the variable Y (Table 2) (the number of first time registered diseases of the population), which, therefore, is the dependent variable. Next, we have at our disposal n pairs of sample observations on the variables X, Y (1), (2) (i.e. spatial sampling):

$$x_1, x_2, x_3, \dots, x_n; \quad (1)$$

$$y_1, y_2, y_3, \dots, y_n. \quad (2)$$

In linear models, the correlation between the studied indicators is measured by using the linear Pearson correlation coefficient (r) by the formula (3):

$$r_{xy} = \frac{n \times \sum(x_i \times y_i) - (\sum x_i \times \sum y_i)}{\sqrt{[n \times \sum x_i^2 - (\sum x_i)^2] \times [n \times \sum y_i^2 - (\sum y_i)^2]}} \quad (3)$$

Table 1. Food consumption in households of Ukraine, 2005 - 2015

Main groups of products	Years										
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Meat and meat products, kg	4.0	4.7	5.1	5.1	4.8	5.1	5.1	5.0	5.1	4.9	4.6
Milk and dairy products, kg	21.7	22.3	22.1	22.6	19.8	19.2	19.1	19.6	20.3	20.3	19.8
Eggs	21	19	20	20	20	20	20	20	20	20	19
Fish and fish products, kg	1.8	1.9	1.9	2.1	1.8	1.8	1.7	1.7	1.8	1.6	1.2
Sugar, kg	3.6	3.2	3.2	3.4	3.2	3.0	3.2	3.1	3.0	3.0	2.8
Oil and other vegetable fats, kg	1.9	1.7	1.7	1.8	1.9	1.8	1.8	1.8	1.7	1.7	1.6
Potatoes, kg	9.6	8.7	8.3	8.4	8.0	7.7	7.9	7.8	7.1	6.9	6.6
Vegetables and melons, kg	9.1	9.4	8.7	9.3	10.1	9.5	9.9	10.1	9.4	9.0	8.8
Fruits, berries, nuts, grapes, kg	3.1	3.0	3.6	3.7	3.6	3.7	3.7	3.7	4.1	3.7	3.1
Bread and bakery products, kg	10.3	9.8	9.6	9.6	9.3	9.3	9.2	9.1	9.0	9.0	8.5

Table 2. Number of first time registered cases of diseases of the population of Ukraine, 2005-2015, (in thousands)

Main types of deseases	Years										
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Neoplasms	408	414	407	406	407	418	423	433	440	363	366
Diseases of the nervous system	754	764	752	753	754	750	744	724	704	651	653
Diseases of the circulatory system	2430	2431	2437	2478	2423	2390	2346	2318	2256	1880	1844
Diseases of the respiratory system	13894	13308	13946	13671	14528	14595	14148	13220	13293	11839	11862
Diseases of the skin and subcutaneous tissue	1936	1906	**1952**	1911	1890	1921	1881	1852	1856	1570	1567
Diseases of the musculoskeletal system and connective tissue	1600	1597	1569	1567	1544	1532	1490	1445	1444	1247	1246
Diseases of the genitourinary system	2185	2172	2132	2136	2140	2138	2095	2047	2046	1756	1779
Congenital anomalies (malformations), deformations and chromosomal abnormalities	53	53	51	51	52	52	55	54	55	48	48
Injury, poisoning and certain other consequences of external causes	2264	2289	2284	2263	2164	2217	2136	2140	2085	1723	1698

The obtained values of correlation coefficients are presented in the correlation matrix (Table3). The calculated pairwise correlation coefficients between ranks of variables identify the extent and direction of the statistical relationship between the input data. The value of correlation coefficient ranges from -1 to 1 and shows the degree of connection that has been defined on the scale of Chaddock (Table 4).

The analysis of results calculation and experience of previous studies of such issues revealed a number of important principles:

- Presence of significant direct correlation between the consumption of: meat, meat products, fish and fish products, and the growth of neoplasm and diseases of the genitourinary system.

- Presence of a direct strong correlation between the consumption of: sugar, fish and fish products, potatoes, bread and cereals, and the incidence of circulatory system diseases of the musculoskeletal system and connective tissue diseases of the genitourinary system.

- In part there can be also outlined a direct strong correlation between the consumption of: fish, potatoes and bread, and injuries, poisonings and diseases of the skin and subcutaneous tissue, as well as between the consumption of butter and other vegetable fats and respiratory diseases.

- Identified moderate dependencies can have a random nature and should not be interpreted as objective laws (with the exception of the relationship between sugar consumption and diseases of the nervous, urogenital system and skin).

Therefore, a direct relationship between food products and diseases of the population stresses the need to develop the health food industry, based on innovative technologies and new products, and its purpose is to serve the needs of the population in a healthy and functional food, as a major element in improving the quality of life and improve the health of the individual person and the population as a whole.

Table 3. Correlation matrix of the relationship between food consumption and incidence of the population in Ukraine (developed by the author)

Parameters	Meat and meat products, kg	Milk and dairy products, kg	Eggs	Fish and fish products, kg	Sugar, kg	Oil and other vegetable oils, kg	Potatoes, kg	Vegetables and melons, kg	Fruits, berries, nuts, grapes, kg	Bread and Bread products, kg
Neoplasms	**0.720248***	-0.05869	0.274948	**0.552209****	0.275809	0.403706	0.353101	**0.594112**	0.414602	0.288337
Diseases of the nervous system	0.118765	0.364675	0.292552	**0.78663**	**0.694076**	**0.637813**	**0.820818**	0.374533	-0.08135	**0.758772**
Diseases of the circulatory system	0.213545	0.385849	0.373696	**0.853928**	**0.706113**	**0.649209**	**0.792309**	0.388144	0.066791	**0.740302**
Diseases of the respiratory system	0.277589	-0.00453	0.439655	**0.642348**	**0.507526**	**0.725633**	**0.583777**	0.477914	0.198583	**0.528862**
Diseases of the skin and subcutaneous tissue	0.24037	0.331403	0.408093	**0.8113**	**0.655891**	**0.603725**	**0.759817**	0.343797	0.109217	**0.716677**
Diseases of the musculoskeletal system and connective tissue	0.055482	0.483143	0.345317	**0.823996**	**0.748427**	**0.607913**	**0.864562**	0.254644	-0.10072	**0.830096**
Diseases of the genitourinary system	**0.707631**	0.356126	0.359994	**0.790806**	**0.695820**	**0.641612**	**0.813478**	0.367123	-0.02158	**0.762205**
Congenital anomalies (malformations), deformations and chromosomal abnormalities	0.254274	-0.11778	0.307941	0.442463	0.345759	0.449178	0.397718	**0.633969**	0.296813	0.321367
Injury, poisoning and certain other consequences of external causes	0.184571	0.447191	0.344268	**0.847136**	**0.695864**	**0.569184**	**0.816069**	0.294978	0.006903	**0.777448**

* Correlation coefficients illustrating a strong correlation.
** Correlation coefficients illustrating a moderate correlation.

Table 4. Value of the coefficient of correlation and the degree of correlation on the scale of Chaddock

The value of the correlation coefficient, r_{xy}	Degree of correlation
Up to 0.3	correlation is virtually nonexistent
0.3 - 0.5	weak correlation
0.5 - 0.7	moderate correlation
0.7 - 1	strong correlation

2.2 The main aspects of innovative functional foods

The researcher, author of many works in the field of technology and biotechnology of food Rogov [2 - 3], underlines that currently the creation of food products of new generation is getting particularly urgent, which is associated with insufficient provision of vital nutrients. These include: minerals, amino acids, dietary fibre, etc. Their deficit is observed among representatives of all sectors of society in both developing and developed countries. Innovative functional food products (IFFP) include food products of regular consumption, preserving and improving health and reducing the risk of developing diseases due to the presence of functional ingredients in their composition. They are not medicines, but prevent certain diseases, promote growth and development of children, slow down the aging process.

In proceedings of the Symposium "Functional Food: Safety Aspects", held in 2004 in the city of Karlsruhe, Germany, it is mentioned that the term "Functional food" was created for food products that provide beneficial health effects for people that go beyond nutritional effects. Such functional food products should not create any effects that may be adverse or harmful to health [4].

At the International Life Sciences Institute (ILSI, Washington), there is a working definition of functional food: "Food refers to functional, if it is, besides the adequate nutritional effects, demonstrate the beneficial effect on one or more of the specified functions of the body so that health status improves or disease risk decreases".

In other words, any product that claims the status of a functional food product should possess, in addition to the traditional nourishing qualities a significant therapeutic potential to regulate certain processes in the body, prevent and stop the progression of the disease, and provide a strengthening effect on human health.

The main objective of innovative food technology today is the making products with a high content of proteins and micronutrients that have the greatest demand on the world market. The main functional ingredients, which are recommended for the enrichment of traditional food products, are [6]:

- Vitamins.
- Vitamin-like substances.
- Macronutrients (Ca, Mg, P, Cl, K).
- Trace elements (Fe, I, Zn, Mn, Cu).
- Micronutrients of protein nature (amino acids, polpeptides).
- Micronutrients of lipid nature (fatty acids, phospholipids).
- Micronutrients of carbohydrate nature (dietary fibers, non-digestible oligosaccharides (prebiotics).
- Living intestinal microorganisms (probiotics).
- Para-pharmaceuticals.

For the production of such products it is necessary to conduct complex: physiological, chemical, hygienic and technological research. The basis of manufacturing competitive IFFP must be fundamental professional production of comprehensive research and testing [3].

In developed countries IFFP are widespread and their production is rapidly evolving. It is predicted that in coming decades the share of IFFP will reach 30% of the total food market. In many European countries the production of such products reaches 20% of the total volume. Leaders in the European market of IFFP are: Germany (36.3%), United Kingdom (21.9 %) and France (15%) (Dubinina *et al.*, [5]). This suggests that the issue of developing the technology and production of IFFP products in Ukraine is quite acute and relevant. However, in Ukraine the share of IFFP does not exceed 3 - 5% of all known food products.

In Ukraine there are not so many companies that produce IFFP (Table 5). This can be explained by the lack of adequate conditions for conducting high-quality research and development and commercialization of their results.

The main principles of domestic producers of IFFP are: focus on the production of food products that provide primary nutritional prevention of diseases, relief of currently existing diseases; use of organic and biologically healthy vegetable raw material; low temperature (not above +40 ^{0}C) processing of raw materials at all stages of production, including drying; affordability of products for the population, adequate balance "price - quality". Ecologically friendly production is ensured by the latest technologies using modern equipment. Except for products specified in Table 5, the enterprises produce high-quality: natural vegetable oil, various salad oils, functional food products, food for diabetics, partially defatted oil-meal and preventive phyto barrels. At SP LLC "Zhytomyrbioproduct" there is a certified quality management system according to DSTU ISO 9001:2009.

Scientific and production company "O.D. Prolisok" is the exclusive developer and manufacturer of a new generation of: multiprobiotics, functional products and enterosorbents. The uniqueness of multiprobiotics is their multicomponent composition and multifunctional nature. Unlike other multiple strain probiotics, their basis is the mix of individual microorganisms cultures, and a sustainable symbiosis that according to the structure and mechanisms of interspecific interactions is an analog of natural microbial communities, characterized by the amazing vital capacity. Multiprobiotics are manufactured in a liquid form, which does not require, in contrast to the dry forms of probiotics,

Table 5. List of functional food products in Ukraine, approved by state sanitary and epidemiological expertise (summarized by the author)

№	Name of the functional food product	Manufacturer	Claimant (provider or reseller)	No. of the conclusion of state sanitary and epidemiological expertise
1	**"Iodine, selenium, zinc, soluble fiber"**	SP LLC "Zhytomyrbioprodukt", Ukraine	SP LLC "Zhytomyrbioprodukt", Ukraine	05.03.02-04/457
2	**"Lutein with antioxidants"**	SP LLC "Zhytomyrbioprodukt", Ukraine	SP LLC "Zhytomyrbioprodukt", Ukraine	05.03.02-04/457
3	**"Omega-3 and vitamins C, E, A"**	SP LLC "Zhytomyrbioprodukt", Ukraine	SP LLC "Zhytomyrbioprodukt", Ukraine	05.03.02-04/457
4	**"Flower pollen (bee pollen)"**	SP LLC "Zhytomyrbioprodukt", Ukraine	SP LLC "Zhytomyrbioprodukt", Ukraine	05.03.02-04/457
5	**"Antistress complex"**	SP LLC "Zhytomyrbioprodukt", Ukraine	SP LLC "Zhytomyrbioprodukt", Ukraine	05.03.02-04/457
6	**"Simbivit® premium" with a mass fraction of fat 1,5 %, 2,5 %, 3,2 %**	LLC firm "O.D.Prolisok", Ukraine	LLC firm "O.D.Prolisok", Ukraine	05.03.02-04/1533
7	**Buns of series "Zdorovynka", enriched with iodised protein**	PE "Olimpia Tradinggroup", Ukraine	PE "Olimpia Tradinggroup", Ukraine	05.03.02-04/4703
8	**Functional food product "EPIGALIN"**	BHI - Biohealth int. GmbH, Germany	LLC "Universalne Agentstvo "PROFARMA", Ukraine	05.03.02-03/8663

long-term reactivation of the cells. Multiprobiotics begin to show its effect immediately after the human use because the bacteria are in the active state.

"Olympia Tradinggroup" has developed the iodinated organic additive "Iodine casein" and the industrial additive "Seleksen", which were approved by the Ministry of Health of Ukraine and obtained the hygiene certificate for food products enriched by "Iodine casein": bakery products, yogurt, milk and sour cream. The technology of manufacturing buns of the series "Zdorovinka" specifically to provide iodized products in kindergartens, schools and other educational institutions.

So, practice has proved the benefits of eating IFFP in the form of prevention or mitigation of a disease. The main problem of the domestic food industry concerning the production of IFFP consists in not enough, or even complete lack of proper funding. One of the obstacles to investors is the lack of resolution of important issues in the field of legislation.

2.3 Study on the status of innovation activities of food industry enterprises

In the development of the IFFP concept the primary role, which is to promote the development of fundamental knowledge, the creation of infrastructure and favourable conditions for innovative activity of enterprises of food and processing industry, should belong to the state.

Formally, all public institutions of Ukraine mention the dominant role of science and new technologies to increase the level of economic development of the country. However, there is a need for funding the innovation processes, creating favourable conditions for the development of innovations at the enterprises on the part of the state. Unfortunately, (Table 6) the reserves that are involved in the stock market, and long-term commercial bank loans are insignificant, and the costs of state and local budgets, including state trust funds, are insufficient [10].

Based on the analysis of innovative activity of food industry enterprises of Ukraine over the period of 2010 - 2015 (Table 7) it can be noted that the dynamics of innovation development of enterprises has a negative trend.

Studies have shown that in recent years there has been a decreasing trend in the number of enterprises that were engaged in innovative activities: from 352 food industry enterprises in 2010 to 178 enterprises in 2015.

Unstable dynamics is also typical for the flow of funds of enterprises for innovation activities, and in recent years there has been a decline in the number of enterprises that have been spending money on various aspects: from design to innovation introduction.

Table 6. Distribution of the total financing (funding) of innovative activity of food industry enterprises in 2010 - 2015 (developed by the author in [7-9])

Sources of funding	Years											
	2010		2011		2012		2013		2014		2015	
	amount, thousand EUR	in % total	amount, thousand EUR	in % total	amount, thousand EUR	in % total	amount, thousand EUR	in % total	amount, thousand EUR	in % total	amount, thousand EUR	in % total
Own funds	17019.54	87.49	27703.60	92.93	45100.68	90.13	47197.45	86.86	56501.66	81.36	47174.97	95.86
State budget	-	-	-	-	1.68	-	0.19	-	0.01	-	0.17	-
Local budgets	-	-	-	-	-	-	-	-	-	-	8.96	0.02
Extra-budgetary funds	-	-	-	-	-	-	-	-	-	-	-	-
Funds of domestic investors	-	-	-	-	-	-	-	-	-	-	-	-
Funds of foreign investors	-	-	300.19	1.01	-	-	4397.56	8.09	12.14	0.02	52.33	0.11
Loans	2425.26	12.47	1791.51	6.01	4926.48	9.84	2740.12	5.04	128882.37	18.55	1973.54	4.01
Other	7.35	0.04	14.92	0.05	11.89	0.02	-	-	48.22	0.07	-	-
Total	19452.15	100.00	29810.23	100.00	50040.73	100.00	54335.31	100.00	69444.40	100.00	49209.96	100.00

Table 7. Number of food industry enterprises by type of innovation over the period of 2010 - 2015 (developed by the author in [7 - 9])

Indicators	Years					
	2010	2011	2012	2013	2014	2015
General number of enterprises	2457	2383	2158	2243	1990	984
In % up to previous year	X	96.99	90.56	103.94	88.72	49.45
Including those engaged in innovative activities	352	384	398	420	334	178
In % up to the previous year	X	109.09	103.65	105.53	79.52	53.29
Those that spent money on: internal research	16	19	17	17	15	13
External research	10	13	12	11	8	7
Acquisition of machinery, equipment and software	204	245	231	235	203	92
Other external knowledge	18	16	16	20	15	6
Education and training of staff	43	63	23	71	81	X
Market introduction of innovations	21	30	75	25	16	X
Other	42	47	31	37	19	45

3. Conclusions

- Innovation activity in food industry of Ukraine is described as unstable, with a lack of balance of financial sources and a lack of clearly identified development priorities.

- To increase innovative activity of food industry enterprises it is necessary to increase significantly the funding from the state. But for this, the state financial policy for the promotion of innovation activities should be aimed at: stimulating the increase in volumes of own funds of the enterprises that are spent for the purpose of activation of innovative activity; building up the potential of public funding of innovation; increasing volumes of crediting of innovation projects; creating conditions for increasing investment in innovative companies.

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