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INNOVATIONS OF AGRO-FOOD CHAINS IN UKRAINE

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Modern trends of agro-food provision are summarized with the systematization of the factors of external and internal environment, which affect the innovativeness of agro-food chains. The tendencies are highlighted and the transformational processes in the agrarian sector of Ukraine, which conditioned the destruction of economic relations and the breakdown of technological links of agro-food chains, the deterioration of the indices of safety and quality of agricultural raw materials and final food products, are disclosed. The challenges for the functioning of dairy products chain are analyzed with the substantiation of the fact that the process of introducing the complex of innovations and systemic methods of safety should cover all the actors involved, all the sectors and elements of production which ensure the safety and quality of agricultural raw materials and final food products. It was proven that the trends of using innovations in the dairy farming should be the achievements in the field of selecting cattle and fodder crops, modern technologies of forming and restoring the livestock to provide for the increase in its resistance and competitiveness. It was substantiated that it is an urgent issue for milk processing enterprises to implement technological innovations and to form long-term partnership relations with the suppliers of raw materials in order to diversify their product portfolio and offer quality and safe dairy products. It was substantiated that the functioning of agro-food chains will be conducted under the impact of environmental challenges which requires creating the conditions and prerequisites for a higher level of their flexibility to innovations, where the priority role should be attributed to state-private partnership in the elaboration and implementation of technologies.

Keywords: agro-food chains, dairy product chain, innovations, dairy breeding, processing enterprises, chain actors.

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INTRODUCTION

At the current stage of development of agricultural economy of Ukraine, one of the key directions of increasing its efficiency is the creation of the potential of agro-food chains of different product trends, namely, manufacturing of products of vegetative, animal and mineral origin. Regardless of the diversity of products, there are many problems, common for all the chains, which are derived from contradictory consequences of implementing the agricultural and land reforms, the transformation of economic relations, the breakdown of technological relations between the enterprises of adjacent branches of agriculture and food industry. The practical implementation of the course towards integration of the agricultural sector into the internal market of EU promoted the occurrence of a series of new challenges and thus pushed towards searching for modern mechanisms and instruments of solving them. The abovementioned statements prove the need to substantiate the principles and practical recommendations to ensure the competitiveness of agro-food chains on the principles of stability and implementation of innovations with the consideration of changes in the external and internal environment of their functioning as well as the specifics of the product and potential of the agricultural producer.

Production-and-sale chains in the sphere of food production are complex systems with low efficiency, especially the ones, formed by small producers, ensuring the competitiveness of which is possible only on condition of following the principles of stable development and active use of innovations (improvement

of products, technologies, business models, etc.) This requires substantiation of the scientific grounds for the functioning of agro-food chains on the principles of stability and innovation provisions on all the levels of the chain – production of agricultural products – processing – distribution logistics – consumption – recycling (disposal).

Scientific publications on the problems of forming and managing the agro-food chains in the 2000s were rather sporadic, as the main attention was paid to them during the previous periods, which formed a belief about practically complete exhaustion of their possibilities. But as early as since the 2010s both Ukrainian and foreign scientists, especially domestic practical experts, started their active search for the solution to the problem of chains [1–5]. Market environment requires each participant of the agro-food chain to be capable of collective and urgent response to the fluctuations in the market requirements, including operational efficiency and quality of supplies, wide assortment of products, providing with information about the origin and ways of production, etc. [6].

While generalizing the results of studies of foreign scientists, one can come to a conclusion that the innovative nature of agro-food chains is ensured by the following conditions: promoting the creation of favorable conditions for the development of inclusive innovative processes at each level of the chain; ensuring the access to information, knowledge, leading practices and the support in applying the latter; promoting the development of long-term partnership between interested participants of the agro-food business-models and spreading competitive approaches towards the organization of functioning agro-food chains [7, 8].

A recent decade has witnessed the development of a new paradigm of open innovations [9] which enhances the urgency of both theoretical and practical studies in terms of ensuring the innovative nature of agro-food chains. We agree with the assumption that conducting empirical studies on this scientific problem is still insufficient and requires further elaborations with the consideration of external and internal environment of the formation and functioning of agro-food chains [10].

It is noteworthy that the notion of open innovations was first used by H. Chesbrough [11], who used the systematization of the factors, influencing the traditional model of investigations and elaborations to note the occurrence of new ones, which became dominant in the innovative environment. In the author's opinion, the increase in the mobility of workers and in the number of innovation-oriented universities and research structures, the increased access of business newcomers to venture capital changed the conditions, in which the organizations implement the innovations [12]. The author supplemented the list of factors with such factors as expansion of Internet and social networks which increased the access to and exchange of knowledge [13]. Undoubtedly, the abovementioned factors impact the innovative provisions in all the links of the agro-food chain, but the manifestation of destructive phenomena in domestic practice is somewhat slowing down the processes of diffusion and introduction of innovative solutions.

The scientific articles of foreign scientists contain active discussion of modern trends in the functioning of agro-food chains, the distinguishing features of which are enhancing the level of globalization, complicating the chains of supplies due to their orientation on covering the whole world, and satisfying the consumption needs of different groups of consumers in terms of income. Here the development of agro-food chains in current conditions will occur under the impact of the following factors: increased demand for food; higher competition on agro-food markets; orientation on providing the energy safety at the expense of agriculture; growth of prices for food and volatility of prices; transformation of agrarian structures, agroindustrialization and globalization of food industry; change in the models of selling agricultural products and evolution of trade policy; climate change will increase the impact on agriculture; science and technology will become factors of enhance the efficiency of agriculture; higher risks due to natural and technological crises [14, 15].

Innovations play a relevant role in ensuring the stability of agro-chains, but higher competition in the market of agro-food decreases financial possibilities of chain participants regarding their elaboration and implementation. The overview of the Global Innovation Excellence Study states that the companies, involved in the production of food products and drinks, invest 1–2 % of their turnover of commodities into studies and innovative solutions compared to 5–6 % on average in other industries [16].

According to both domestic and foreign scientists, the result of innovations in agro-food chains is the elaboration and implementation of new products, technologies, marketing strategies, models of organizing agrobusiness and the formation of improved economic relations, etc. [8, 17, 18]. Thus, considering the potential possibilities of improving the functioning of agro-

food chains (AFC) based on innovations, one should consider their impact in terms of different directions of their implementation and immediate readiness of each participant of the agro-food chain to implement them. We believe that such approach will allow identifying the hidden reserves and spare resources, which should get involved into the technological processes, products, models of organizing business, etc., it will also allow substantiating the directions towards eliminating hindrances, activating the process of implementation of modern innovations, motivating technological staff who will support the accumulation and balancing the potential of chains with the purpose of enhancing their competitiveness. The aim of the article is to generalize weak points and unrealized potential possibilities regarding the efficient use of AFC potential and substantiation of trends, methods, instruments of activating the processes of implementing the innovations, systemic methods of safety, disclosing unrealized institutional and hidden social reserves and resource possibilities in terms of enhancing the stability of the interaction between the actors and accumulating the potential of the chains.

The introduction of the agrarian and land reforms in the 1990s was accompanied by the reduction of agricultural production and massive unprofitability of holdings and only the beginning of the 2000s marked the start of coming out of recession and improving the economic indices of entrepreneurial activity. The transfer from planning and administrative economy to socially oriented economy was accompanied with the destruction of economic relations and breakdown of technological relations, which were supported by administrative measures. It should be noted that since 2000 the structure of the agrarian sector has been considerably transformed. In particular, the number of food industry enterprises was reduced 1.6 times (down to 5.5 thousand units), including the 2.4-fold reduction of large and medium-size enterprises (down to 1.05 thousand units). At the same time, the number of holdings (agricultural ones, farms, small enterprises) decreased insignificantly (from 58.9 thousand down to 52.5 thousand) but the share of private peasant holdings was reduced almost by a quarter (from 5.3 million down to 4.1 million private peasant holdings (PPH) [19]. When the reduction in the volumes of growing agricultural products is compared against the mentioned trends, one may come to the conclusion that this was the factor, which conditioned considerable transformations in the geography of agroproducers: their structure has become more complicated, but it has also decreased considerably in terms of industrial possibilities, and the accessibility of transportation to food processing enterprises has deteriorated significantly.

The most representative object for the analysis of transformations, which have already passed, is the chain of dairy products. In particular, in 2000–2015 the number of cows decreased more than twice – down to 2166.6 thousand, including the number in the industrial sector (agricultural enterprises – ACE) – 3.7 times (down to 505.1 thousand), in the holdings of the population (HP) – almost 1.9 times (down to 1665.5 thousand), and the share of cows in ACE is 23.3 % [19]. The production of raw milk decreased by 16.2 % for the mentioned period (down to 10.6 million tons), including that of ACE – by 27.2 % (down to 2.67 million tons), in HP – by 13.1 % (down to 7.95 million tons), but the yield from one forage-fed cow increased: 3.3 times in ACE (up to 5352 kg), in HP – 1.5 times (up to 4437 kg) [19].

Since early 2000s and until now the number of milk processing plants decreased twice (down to 392 – 2015), and that of dairy farms (DF) – down to 2614 (2015). Only in 2010–2015 the number of dairy farms decreased by 977 (27.2 %). There is relative concentration of production on this background: there is an increase in the share of medium (200–500 heads – up to 22 %) and large (over 500 heads – up to 10 %) enterprises which produce 44 % of products, and the share of small dairy producers (50–200 – down to 30 %) and backwarders (up to 50 heads – about 38 %) decreased. As of the end of 2016 there were 2107.1 thousand cows, including 1623.1 thousand in HP and 484 thousand heads in ACE (23 %). It should be noted that in 2007–2016 the sale of milk dropped from 5.5 million tons to 3.7 million tons (by 32.8 %), but the share of milk, produced at the dairy farms of ACE increased 1.5 times (up to 2.5 million tons), and its share – from 30.3 % to 67.7 %. The structure of milk, stocked in 2016: extra – 14.6 %, prime grade – 36.7 %, first grade – 42 %, second grade – 6.4 %, no grade – 0.3 % [20]. On January 01, 2018 the amendments to DSTU 2661:2010 “Cow’s drinking milk. General technical conditions” will come into force and only three kinds of milk will remain: extra, prime grade, and first grade.

The most significant negative, and often quite contradictory, consequences of reforms in the agrarian sector may be named as follows:

• a transfer from the model of organizing agriculture in collective farms/state-owned farms with the paternal role of the state to the model of complete responsibil-

ity of entrepreneurial activity for their own achieved results was accompanied by the destruction of organizational and legal forms and also the material and technical foundation of agro-food production, for instance, automotive parks, farms of different orientation, greenhouse holdings, subsidiary shops and enterprises, producing ready-made food products, *etc*.;

• the increase in the park of outdated equipment and technological machinery with their minimal updating or maintenance was accompanied with the decrease in the level of mechanization and technology of agricultural production, the return to manual and outdated technologies, the decrease in safety indices and quality of agricultural production and final food products;

• the change in the forms of ownership and property for land and the 6.5 times decrease in cattle for the recent quarter of century (down to 3.75 million heads), including cows – four times (down to 2.167 million heads), was accompanied with the 15–16-fold decrease in the introduction of organic fertilizers (down to 0.5 t/ha and only on the land where they were introduced – 2.5 % from the area of arable land) and exhaustion (dehumification) of soil (the decrease in the share of humus by 0.5 % – down to 3.1 %) [21];

• the transfer to a partnership model of relations between the producers of raw materials and food processing enterprises in the conditions of creating the market was of extremely complicated and contradictory character. It was conditioned by the small commodity structure and low level of technologies in the production and non-conformity of the raw materials to regulatory indices, which formed the low level of safety and quality of food products considerably;

• the main problem of dairy production – the contact of raw milk with air and outdated technologies of its processing. The introduction of milking equipment and cooler tanks for storage of raw milk, bought from the holdings of the population, solves the problem only to some extent. Ex-Soviet milk processing technologies are tuned to comply with the regulatory indices, foreseen in GOSTs. In this respect, the higher the amortization of the main equipment is, the simpler it is for the owners to solve the issue of closing the production or having radical modernization with the purpose of ensuring its compliance with the regulatory requirements of the laws of Ukraine, related to food products, technical instructions, standards, *etc.*

The practicing animal breeders believe that 1997–2006 were the years of realizing the destructive consequences of previous transformations and estimating the impact of decreasing trends, and since 2007 – the substantiation of scientific approaches to the exit of dairy farming from a long-term recession and their practical implementation. As over ten years have passed since that time, it would be logical to make a conclusion about the occurrence of "points of innovative growth", *i.e.* the holdings, involved in industrial production of such raw material as milk, its supply to milk processing factories for processing and production of modern assortment of dairy products.

This approach objectively urges towards the search for leading holdings, the determination of the most urgent problems, which they had to face at the stage of taking a decision about the development of dairy farming, estimating different variants of restoring farms, involved in industrial production of milk as raw material, the generalization of results, achieved by them, etc. It is also reasonable to disclose the possibilities of enterprises, involved in processing of raw milk, the introduction of technological and other innovations, the estimation of their impact on the performance and efficiency of entrepreneurial activity.

It should be highlighted that at the stage of a decision about the restoration, the majority of dairy holdings were on different stages of destruction of the material foundation of farms, the supply with dairy cows, their low genetic potential and performance, the staff of pre-retirement and retirement age, and mainly with manual servicing and milking cows, etc. The situation was even more complicated due to the fact that after dividing into shares and the privatization of agricultural land the problem of forming the fodder reserves, summer grazing of cattle and feeding it in stalls became extremely urgent. At the same time, the restoration of dairy farming in agrarian holdings should not be viewed separately, but only in close correlation with the processing of milk as raw material, otherwise it reduces both scientific and practical sense.

It is important to pay attention to those sources of information and objects of monograph researches which were used for the analysis. For instance, these were the materials of annual dairy congresses (DC), the latest one being held in March 2017. As a rule, the participants work in different sections: strategy of milk business and legislation; technology of milk production; veterinary science; challenges, strategies and innovations of milk processing business.

In recent years, there have been celebrations of the National Farm Day, for instance, June 20, 2014, based

on LLC ACE named after Volovikov; August 15, 2014 – agricultural private leased enterprise Vidrodzhennia; August 18, 2015 – PAE Ukraine Eridon (1,000 dairy cows); June 15, 2016 – breeding farm Stepnoi (1800 heads of cattle, including 800 dairy cows); August 16, 2016 – LLC Vitchyzna (1125 heads of cattle, including 500 dairy cows); May 19, 2017 – milk producing complex Katerynoslavskyi (two complexes for 1,400 and 500 dairy cows); August 22, 2017 – PAE Piskivske (3,100 heads of cattle, including 1,100 dairy cows); September 12, 2017 the First European Farm Day – LLC Agrofirma named after Dovzhenko (700 dairy cows) which is a regional division of the agroindustrial holding ASTARTA. It should be noted that the number of cattle in ASTARTA is 29 thousand heads, including the milking herd of 15.6 thousand, located in 65 holdings. In 2013 the annual event was started, called "All-Ukrainian Day of Milk and Cheese".

Numerous participants, including foreign guests, take part in Dairy congresses and Farm days. Their main organizers are the Association of Dairy Producers (ADP) and the All-Ukrainian Agrarian Council (AAC). The members of ADP are 130 holdings, including 5 % of dairy farms and up to 20 % of dairy livestock of ACE. The land bank of ADP members is 2.2 million ha. The dealer companies, selling foreign equipment for agriculture and food industry, act as sponsors of these events. The agenda of these events is usually divided into two parts: theory and practice. The achievements and the key problems, which dairy business faces in Ukraine, are highlighted. There is active promotion of leading international experience in the formation of genetic potential of a dairy herd, its fodder foundation and maintenance with the purpose of achieving the indicative parameters of production; the constituents of the achieved results are disclosed. Their analysis and generalization of domestic and foreign experience allow suggesting the following scheme of stage-wise provision of innovation and competitiveness of the agro-food chains.

The retrospective analysis of the formation and functioning of the chains demonstrates that it is possible to enhance their stability and competitiveness in modern conditions based on systemic, complex, and differentiated approach to the elaboration and introduction of innovations. It means that the process of introducing the complex of innovations and systemic methods of safety should cover all the actors involves, all the sectors and elements of production which ensure the safety and quality of agrarian raw materials and final food products. In this respect the dairy product chains are the most complicated as their key factor is productive cattle. The latter is the main source of dairy business and includes the following constituent characteristics: key genotype of a cow and the performance of a dairy herd, fodder resources, technologies of servicing animals and obtaining raw milk, its storing, transporting and processing. Depending on the breakdown between the actual state of the working dairy farm and the quantitative values of the indicative indexes, the achievement of which is set as the aim of dairy business, more detailed presentation could be reasonable.

A KEY GENOTYPE OF A COW AND PERFORMANCE OF A DAIRY HERD

The first step to take for farms, which faced the choice of a promising model of development, is the determination of dairy farm specialization. It will be defined by the structure of the product portfolio of regional processing enterprises: raw material for the production of hard cheese, whole-milk products or technical products. The maximal volumes of raw milk production are achieved in case of optimal balance between cattle number and the area of fodder resources of the farm calculated as 0.7 ha of agricultural land per a dairy cow and 0.3 ha per one head of the rest of cattle (without cows). The farms are filled with cows according to the requirements of the enterprises to raw milk: Holstein – to manufacture the products from whole milk, Ukrainian Red/Black-and-White dairy cows – for hard cheese. The experience of holdings, which set a specific aim and relied mostly on their own possibilities to achieve it, demonstrates that at least 4–5 years are required to form a modern structure of a dairy herd with a high level of performance.

Noteworthy in terms of theory and practice is the exemplary experience of the development of a dairy farm PAE Piskivske. Milk production has a tendency to grow: 1294 tons (1998 – 300 heads) – 4510 (2001 – 330 heads) – 6094 (2006 – 678 heads) – 8278 (2011 – 856 heads) – 9440 tons (2016 – 1000 heads). These statistics are true regardless of the fact that this holding still has the material and technical foundation, dated back to the 1980s (cow sheds and on-ground silo buildings are built of reinforced concrete structures, cattle is kept loose on deep litter, there is a feeding pen, etc.). It was modernized to some degree, for instance, the fencing panels were removed, and plastic was installed instead, ventilators were installed in the cow sheds; milking halls were mounted as the "parallel" of 2 x 12 heads; strict isolation of silo from the contact with re-

inforced concrete constructions and environment was ensured; the vehicle park of self-propelled machinery, towed vehicles and linkage-mounted equipment was upgraded and expanded for the maintenance of farms, collection of fodder and feeding of animals; cooler tanks were installed for temporary storing of raw milk which was sent for processing; cheese production on site was started; the sale of raw milk was diversified: to the milk canning enterprise (the town of Ichnia) and the one, manufacturing baby food (the town of Vyshneve) as well as the members of the Jewish community (the city of Kyiv) who are supplied with milk with kosher status. The compliance with safety requirements and the correspondence of raw milk to quality standards (almost everything of extra grade) had a considerable impact on the price of implementation and ensured the increase in the efficiency of dairy production.

The fodder resources are the basis of the fodder chain. According to the experts, the economic indices in dairy farming are ensured with quality fodder by 60–65 %, by genetic potential of cattle – by 18–20 %, by proper conditions of raising, caring, feeding and keeping dairy livestock, which guarantees the compliance with sanitary-veterinary and hygienic requirements to the production, preservation of health and well-being of animals. Cattle should be provided with fodder according to the requirements to fodder chains (FC). The fodder chain of productive animals includes a number of factors, resources, technologies with special requirements, strict adherence to which will guarantee the production of safe and quality fodder. The supply of concentrated fodder, their mixing with other ingredients (silo, hay, rough feeds) and feeding the animals is the guarantee of producing safe and quality raw materials. Therefore, the prerequisites and key constituents of FC are as follows:

• creating specialized units at the farms, providing them with modern self-propelled machinery, agricultural and foraging machinery, qualified staff, certified seeds of fodder crops;

• following technological instructions regarding growing, gathering and storing (making silo) of different fodder;

• introduction of modern technologies of creating and using rotation and natural pastures;

• using technologies of preparing balanced diets for stall-kept cattle taking into consideration their age and species composition, meeting the requirements to safety and quality of fodder, *etc*.

The main requirement to the efficiency of the fodder chain is to ensure maximal conversion of fodder energy into the consumptive and quality resource for animals, and the conversion of this resource into milk. This is the thinnest place in the fodder chain, thus, this is a great field for the elaboration and introduction of agro-, zoo-, vet-, organizational and technological innovations. Contrary to the industry, where the evaluation of innovative activity of enterprises, involving the estimation of its level, is done every year, there is nothing like this foreseen for agriculture. In these conditions the agroproducers take their own decision on what innovations are reasonable for their implementation. A limiting factor is the actual financial possibilities for the involvement of any innovations. However, even now, and especially in future, the indicator of innovative activity may be found in the products, grown using innovative solutions, in particular, certified genetic resources; the system of technological regulations for growing, gathering (milking, slaughtering), storing raw materials and clear compliance with their requirements.

Alfalfa (or clover) and specialized silo hybrids of corn were introduced into the application with the purpose of expanding the range of agricultural crops, suitable for silo (foraging), enhancing its energetic value. For instance, the hybrid *Limagrain Latisana* (FAO index 320 – physiological ripeness of grain) is sensitive to the treatment conditions, thus the maximal yield is achieved only when intensive technology is followed. In Ukraine foreign producers offer both the whole line of equipment – from soil tillage to harvesting, and the innovative technology of silo production. It is based on the following requirements and factors: following the optimal period of harvesting (required content of moisture in a plant and milk-wax ripeness of grain), obligatory bumping and crushing of stems and grain of corn (up to 8–10 mm), careful preparation of storages, methods, terms (2 days) and humidity of mass (70 %) while laying silo (foraging), adding preservatives for complete preservation of its consumptive value and ingredients for breakdown of starch, covering with plastic and protective cloth, etc. Clear compliance with the technologies of foraging, which is rather hard to ensure in changing weather conditions, guarantees maximal preservation of their natural consumer appeal and energy values.

A relevant prerequisite of creating the energy-efficient fodder chain is the periodic evaluation of its components. The samples of all the components are

periodically taken and evaluated from the standpoint of energy value, ensuring the maximal conversion of ingredients, balance of nutrients, and, if required, their correction is performed.

The transfer to modern technologies of feeding animals extended the possibilities of forming balanced diets using different ingredients. In particular, there is a transfer from the approximate formation of diets in some holdings to the creation of fodder center, which have the preparation of fortified diets, balanced by the main ingredients for different groups of cattle. They are servicing dozens of dairy farms, located in several rural areas. However, this could be afforded only by large producers, for instance, on September 12, 2017 the agroindustrial holding ASTARTA opened the Feed center of industrial production of feeds: 2 mixers of 300 tons/day.

TECHNOLOGIES OF SERVICING ANIMALS AND OBTAINING RAW MILK

At present a wide range of technologies of caring, feeding and keeping dairy livestock is used in the industrial dairy farming, but their pinnacle is the technology of milking. The structure of dairy farms is diverse, thus including a number of milking equipment sets: from the improved ex-Soviet (individual milking into containers) to the robotic systems of voluntary milking (Delaval Company, Ukraine). It should be noted that in Ukraine the robotic systems have already been introduced at a number of farms, in particular, ALC Terezyne (1,000 dairy cows, average yield of 10,200 kg, with 8 milking robots – VMS of Delaval Company, the milking premises – Delaval, Diamond parallel 2 × 16, Kyiv region, the village of Terezyne); LLC Nova Nyva (2 robots are already working, 2 more will be installed to service 240 cows; the total number of cattle – 2,800 heads, including 760 cows, the yield per cow – 6,250 kg; Donetsk region, the village of Novokrasnivka, *etc.* This is the international level of solutions for dairy farming, but the implementation of robotic complexes is impossible without a number of technical, zootechnical, veterinary, organizational, technological, and other innovations [22], in particular, the creation of maximally comfortable conditions for cows and proper microclimate in cow-sheds (automatic regulation of fresh air via opening curtains and ventilation shafts for droughts, as well as installation of the cooling system – ventilators and irrigation), automatic regulation of the daylight, supplied for up to 16 hours a day; free access of cows to feeding tables, automated feeder, drinking bowls and a milking robot, deep litter and its periodic changing; formation of groups, comprised of first lactation cows, which are much easier to teach to the set procedure, compared to older animals. The stimulant, ensuring voluntary walking of an animal to the milking hall, is the possibility for a cow to obtain the additional portion of concentrates from the automated feeder. As a result, the frequency of milking of first lactation cows is 4–5, and closer to cow's drying off – one (2.78 on average) time a day; clear compliance with sanitary-hygienic and veterinary requirements of keeping cows (daily inspections, aimed at evaluating the physiological status and absence of any stress in animals, estimating the signs of diseases, *etc.*); individual approach to each cow; a robot recognizes an animal by the detector, installed into the ear-tag; each teat of a cow is separately milked; the procedures of working with the udder prior and after the milking are conducted in accordance with the programmed sequence; washing the technological equipment is done after each milking. Conducting the measurements of electrical conductivity of milk for each share of the udder (four pulsars and four meters) allows determining garget even if it is only in one part of the udder. At the same time, it allows localizing and using the poor quality milk, obtained from a problem cow, separately; improvement of feeding diets based on the preparation of balanced feed mixtures, given to animals twice a day, and each cow also receives additional concentrates in the automated feeder at the station of voluntary milking. The amount, which an animal eats for one time, depends on its performance and is controlled by a robot (1.5–2 kg).

Therefore, the scientific-technical progress in dairy farming lies in creating an automated (a milking robot) material-technical foundation, implementation of modern technologies of no tie-up keeping and voluntary milking of cows, storing, cooling and gathering milk.

STORING, TRANSPORTING AND PROCESSING OF RAW MILK

After cows have been milked, raw milk goes along the milk pipes to the tanks for cooling and temporary storing until the moment of accumulating a batch, its loading into the milk truck and transporting to the milk factory. During all these processes raw milk does not contact with air and the servicing staff, and the enlisted procedures should meet the requirements of the EU Regulations 852/2004 "On hygiene of food products" and the EU Regulations 853/2004 "On the hygiene of food of animal origin".

At the same time, due to different circumstances, the farms start with making their trial batches and then

expand their own production of dairy products. In this case the freshly obtained milk comes immediately to the own mini-shop, where different products are manufactured depending on the elaborated product portfolio. For instance, a mini-shop, located at the farm "Molochnyi krai" of PAE Piskivske, processes one ton of milk every day, producing several kinds of products: Gauda cheeses (with and without additives), "pigtail" cheese, ricotta, lactic cheese and sour cream. All the technological requirements of the production and regulated indices for raw material and final products are followed. The farm was visited by European commissioner veterinary officers twice and they were satisfied with its sanitary and hygienic conditions. Food products, produced at a farm, are sold in neighboring districts and cities rather fast.

PERSONNEL OF INDUSTRIAL DAIRY FARMS

The issue of finding the servicing personnel is especially urgent for the holdings, which are traditionally involved into milk production or restore dairy farms. As a rule, the list of the main specialties for milk production servicing includes the milking operators, cattle keepers, farm machinery operators, zootechnicians, veterinarians, production managers, engineers, etc. For some specialists, dairy production is a separate component in the list of their professional duties, covering the whole holding.

A key task for the farm personnel is to ensure gathering of highly energetic fodder, fortified feeding and quality care of dairy livestock with the purpose of obtaining high milking yields, timely determination of the signs of diseases and the reasons of possible stress of animals, their localization or removal. Three-time milking of cows (at 4 a.m., 12 p.m., and 8 p.m.) objectively demands establishing two groups of operators to work every other day, and the servicing staff – with the working schedule of one day in four – requires four groups of workers. In these conditions it is especially important to have such characteristics as tolerance, discipline and psychological compatibility of the staff members, complete trust between them regarding the objective estimation of the state of animals and the principle of obligatory transfer of information to the following operator (a keeper of animals). It is relevant for each staff member to have basic knowledge of physiology of animals and care for them as well as clear understanding and compliance with the requirements of systemic procedures of safety with the purpose of ensuring their observance. These are summarized in ISO/TS 22002-3:2011 "The Program of obligatory preliminary measures in ensuring the safety of food products – Part 3. Manufacture of agricultural products". If there is no knowledge, required in this field, the personnel should undergo the training in theory and practical application thereof. In order to ensure the continuity, there should be a training of required specialists right at their working places using the coaching method, followed by constant upgrade of professional qualities of the members of industrial units in growing and gathering fodder, milking raw milk, caring about animals.

Summarizing the abovementioned, the trends of using innovations in milk farming are technological, organizational-economic, biological, ecological, and socio-psychological. Here the specifics of the investigated object are determined by the biological nature, which first and foremost includes the achievements in the field of selecting cattle and fodder crops, modern technologies of forming and restoring highly productive dairy herds, which will allow activating the innovative development of the dairy products chain in a short period of time, ensuring the improvement of its stability and competitiveness.

MANUFACTURE OF DAIRY PRODUCTS

According to the estimates of the Chairman of the Union of Dairy Enterprises of Ukraine, V.P. Chaharovsky, at present 80 % of the gathered raw milk is processed by 20 companies, and the rest, 20 %, comes down to 150–160 enterprises, which actually do not impact the dairy market of Ukraine. These have not been modernized and are not capable of modernizing, so their fate is but one – bankruptcy [23]. Thus, the main producers of Ukraine are large dairy foreign companies and domestic enterprises which have great possibilities of efficient processing raw milk and are capable of offering a wide range of final dairy products. These include: LLC UK *Terra Food*, JSC *Molochnyi Alians*, *Danone Ukraine*, *Almira*, a Komo group of companies, *Zhytomyrsky maslozavod – Rud* company, LLC *Lustdorf*, SE *Milkiland-Ukraine*, *Wimm-Bill-Dann Ukraine*, *Voloshkove pole*. The rating of dairy producers was built by us based on the index of the amount of net profit of the enterprise for 2015.

At the same time, after closing trade relations with the Russian Federation, the following producers find new markets of sales and restore their potential in manufacturing dairy products: PJSC *Ternopilsky Molokozavod*, JSC *Dubnomoloko*, OJSC *Shostkinsky miskmolkombinat*, SE *Lactalis-Ukraine*, *Dobriana*, *Milk life*, *Molokia*, *Molochna rika*, *Danone*, etc. Therefore,

there are two priority tasks, facing the milk processing enterprises: on the one hand, they should modernize their industrial foundation using technological innovations, on the other hand, they should strengthen direct contractual relations with the suppliers of raw materials, promote the increase in the volumes of accumulating raw materials with the purpose of ensuring efficient use of the current innovative potential and the issue of modern assortment of dairy products.

Therefore, the mechanism of innovative provision of the dairy products chain is a multi-level hierarchy structure of the system of the main inter-related elements and their typical groups (participants of AFC principles, forms, methods and instruments, ways of provisions) as well as the ways of their interaction, including integration and disintegration, which impact the harmonization of economic relations between the actors of the chain, ensuring its competitive development.

In current conditions the aggravation of environmental factors (climate changes, increased globalization and integration processes, decrease in the national currency exchange rate, *etc.*) and internal environment (low profitability of agriculture, need to modernize the outdated funds, low level of integration of science and production, *etc.*) of AFC functioning will feel additional impulses, new challenges of external environment, thus, the chains should become more flexible and sensitive to innovations, have more resistance to the changes in the market-governed environment.

This brings forth the need to activate the work of scientific research institutions regarding the elaboration, scientific support of implementing innovations based on the state-private method of their financing. It should be noted that the state should assume the role of the activator in elaborating the innovations of the international level via state demand of the priority trends of research for the institutions of education and science. The example to this may be found in the approach to financing the innovative projects in EU countries by the Horizon-2020 program. Ensuring food safety in these countries is achieved within the framework of the following trends of scientific studies: resource-efficient chains of food – 25 projects were selected for the amount of finances of EUR 206 million, environment, climate changes, agriculture – 7 projects, the amount of financing – EUR 64 million, competitiveness of food industry – 3 projects, EUR 24 million, healthy food – 5 projects, EUR 85.5 million.

CONCLUSIONS

At the current stage it has become extremely important to strengthen positive tendencies in the agrarian sector based on disclosing hidden potential possibilities, involving unused resources and reserves, implementing innovative solutions and systemic safety procedures. Both foreign and domestic experience demonstrates that a key subject for it is the agro-food chain, which is the combination of intertwining, overlapping and inter-enhancing biological, technological, ecological, social and other requirements to raw materials and final products. As for economic interests, they are often of contradictory nature. Especially complicated in this respect are dairy products chains, where the technological requirements to the production of final dairy products are enhanced with strict requirements to the production of raw materials of animal origin, and thus, to the subjects of entrepreneurial activity.

The experience of the prominent holdings, involved in industrial production of milk, demonstrated that while building new dairy farms it is required to have starting expenses of about USD 10–15 thousand per one cattle stall, which allows taking a conclusion that the restoration of dairy farming on modern material-technical, genetic, organizational and other basis is affordable only for medium and large agroindustrial holdings. Most holdings as key actors of dairy products chains will restore the farms, based on their own possibilities mainly. This requires much more time, but it is important to solve problems taking into consideration all the components: the status of the material foundation and the possibilities of its technical-technological modernization, available genetic resources of farms and the ways to enhance them, the creation of a modern fodder foundation, the formation of innovative culture, oriented at achieving strategic and tactical targets of development.

The orientation of AFC actors on the activation of the processes of elaboration and implementation of innovations will promote the increase in the quality parameters of agricultural products and food, the optimization of expenses for their production and bringing to the final customer. Building intrasectoral, intersectoral, operational, financing and investing relations between AFC participants will promote achieving their stable and competitive functioning both in internal and external markets.

Інновації агропродовольчих ланцюгів в Україні

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Узагальнено сучасні тренди агропродовольчого забезпечення та систематизовано чинники зовнішнього та внутрішнього середовища, що впливають на інноваційність агропродовольчих ланцюгів. Висвітлено тенденції та розкрито трансформаційні процеси в аграрному секторі України, що зумовили руйнацію економічних відносин і розрив технологічних зв'язків агропродовольчих ланцюгів, погіршення показників безпечності та якості сільськогосподарської сировини й кінцевої харчової продукції. Проаналізовано виклики у функціонування молокопродуктового ланцюга та обґрунтовано, що процес впровадження комплексу інновацій та системних методів безпечності повинен охоплювати усіх задіяних акторів, сектори та елементи виробництва, які забезпечують безпечність та якість аграрної сировини та кінцевих харчових продуктів. Доведено, що напрямами використання інновацій у молочному скотарстві повинні стати досягнення в області селекції худоби та кормових культур, сучасні технології формування та відтворення стада, щоб забезпечити підвищення його стійкості та конкурентоспроможності. Обґрунтовано, що для молокопереробних підприємств актуальним є реалізація технологічних інновацій та формування довгострокових партнерських відносин із постачальниками сировини, з метою диверсифікації продуктового портфелю та пропозиції якісної та безпечної молочної продукції. Обґрунтовано, що функціонування агропродовольчих ланцюгів буде здійснюватися під впливом нових викликів зовнішнього середовища, що вимагає створення умов та передумов до вищого рівня їх гнучкості до інновацій, де пріоритетну роль повинна відводитися державно-приватному партнерству в розробці та впроваджені інновацій.

Ключові слова: агропродовольчі ланцюги, молокопродуктовий ланцюг, інновації, молочне скотарство, переробні підприємства, актори ланцюга.

Инновации агропродовольственных цепей в Украине

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Обобщены современные тренды агропродовольственного обеспечения и систематизированы факторы внешней и внутренней сред, влияющих на инновационность агропродовольственных цепей. Освещены тенденции и раскрыты трансформационные процессы в аграрном секторе Украины, обусловивших разрушение экономических отношений и разрыв технологических связей агропродовольственных цепей, ухудшение показателей безопасности и качества сельскохозяйственного сырья и конечной пищевой продукции. Проанализированы проблемы в функционировании цепи молокопродуктов и обосновано, что процесс внедрения комплекса инноваций и системных методов безопасности должен охватывать всех задействованных актеров, секторы и элементы производства, которые обеспечивают безопасность и качество аграрного сырья и конечных продуктов питания. Доказано, что основными направлениями использования инноваций в молочном животноводстве должны стать достижения в области селекции животных и кормовых культур, современные технологии формирования и воспроизводства стада, чтобы обеспечить повышение его устойчивости и конкурентоспособности. Обосновано, что для предприятий, перерабатывающих молоко, актуальными являются реализация технологических инноваций и формирование долгосрочных партнерских отношений с поставщиками сырья, с целью диверсификации продуктового портфеля и предложения качественной и безопасной молочной продукции. Обосновано, что функционирование агропродовольственных цепей будет осуществляться под влиянием воздействия внешней среды, создания предпосылок к более высокому уровню их гибкости к инновациям, где приоритетная роль должна отводиться государственно-частному партнерству в разработке и внедрении инноваций.

Ключевые слова: агропродовольственные цепи, молокопродуктовная цепь, инновации, молочное животноводство, перерабатывающие предприятия, актеры цепи.

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