MONITORING & EVALUATION OF THE QUALITY OF AGRICULTURAL PRODUCT IN BELARUS

Petr V. Rastorgouev

Institute of System Research in Agro-Industrial Complex of the National Academy of Sciences of Belarus, 103 Kazintsa Street, 220108, Minsk, Republic of Belarus

Abstract
Efficiency of modern mechanism of managing quality of agricultural products is reflected in specific indicators of its quality. The article contains analysis of major trends in shaping consumer and technological features of agricultural products, determines priority directions of improvements of system management of quality and safety of agricultural products in the Republic of Belarus.

Key words: *Quality, consumer and technological features, agricultural products, quality and safety management systems*

At present stage of development of the Republic of Belarus agro-industrial complex one of the most topical issues is to increase the efficiency of economic activities of agricultural organizations. In this respect currently a set of measures is being implemented in the republic aiming to identify effective ways of development of industry for financial recovery of agricultural enterprises (Gusakov 2014) (Myasnikovich 2014).

In this aspect, one of the significant reserves for increasing efficiency of agricultural production is to improve its quality, which positively impacts on the level of income both agricultural organizations and processing enterprises. In addition, output of agricultural products that are safe for human health and life, shaping high its consumer properties is ultimately aimed at meeting the needs of population in foodstuffs and food security of the country. Therefore sustainable output of agricultural products and raw materials ensuring high quality and safety is one of the most important challenges that agro-industrial complex of Belarus is faced with.

In order to track trends and analyze changes in consumer and technological properties of major types of agricultural products output should be monitored, allowing appropriate assessment of effectiveness of current agricultural quality management system that helps determining priorities for improvement.

In the course of analysis of trends shaping quality of agricultural products one of the most appropriate options is to assess its compliance with requirements of the applicable technical regulations in the field of technical standardization. Despite the fact that technical regulations generally contain quite generalized characteristics of consumer properties of products (this applies primarily to animal products), such method offers advantages of quality assessment as it makes possible comparative analysis at country level.

In relation to major animal products such regulations are:

STB 1598-2006 “Cow Milk. Procurement Requirements”;

STB 987-95 “Slaughtering Pigs. Technical Requirements and Specifications”;

GOST 5110-55 “Slaughtering Cattle. Determining Fatness”.

In accordance with requirements of these documents cattle is divided into categories - upper, middle, low fatness and lean; pigs range from category 1 to 6 and non-standard; milk - extra (introduced since 2008), premium, first and second grade.

Extra grade envisages low content of somatic cell count (300,000/cm^3) and microorganisms (up to 100,000 CFU/cm^3). For premium grade the threshold values of the above-mentioned indicators are 500,000 cm^3 and 300,000 CFU/cm^3 respectively. It should be noted that domestic requirements for

extra grade not only satisfy the requirements for raw milk applicable in the European Union, but also in regard to the content of somatic cells exceed it (*Safety of Food and Agricultural Products. Substantive Legislative Acts of the European Union*, 2006).

Using the above-mentioned gradation, it is worth considering trends shaping quality indicators of major livestock products. As results of monitoring show the situation differs for various kinds of products.

So, starting from 2005 till 2011 (excluding 2009), the proportion of premium quality milk (since 2008 - the premium and extra grades combined) has been increasing (Figure 1).

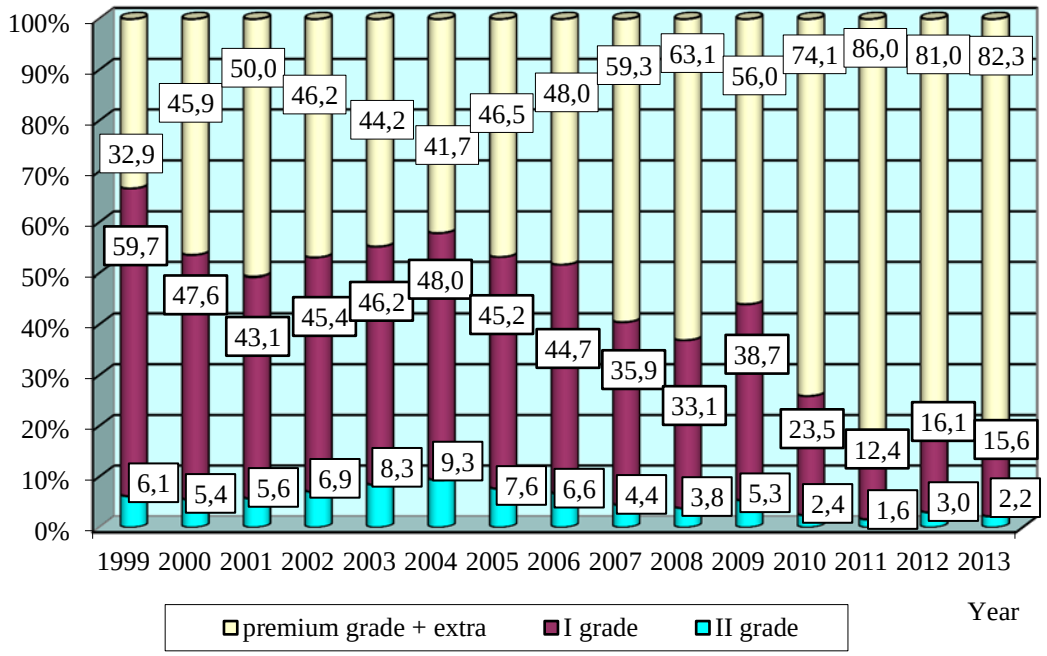


Figure 1. Dynamics of indicators of milk quality

However, in 2012 the branch saw a negative trend. Thus, according to the regional organizations' "Meat and Milk" share of milk not lower than premium quality was 81.0% (in 2011 - 86.0%), including 48.4% - premium grade (2011 - 50.1%), 32.6% - extra grade (2011 - 35.9%). The largest volume of milk extra grade was sold in Gomel and Minsk regions (377,364 and 446,755 tons respectively) (Ministry of Agriculture and Food of the Republic of Belarus, 2013).

Overall dynamics of decline in consumer properties of raw milk continued in 2013. According to the Ministry of Agriculture and Food of Belarus share of premium milk amounted to 52.4%, which is 2.0% higher than in 2011. However, growth in milk production premium was mainly due to a significant decrease in the proportion of extra grade milk - from 35.9 to 29.9%. Noteworthy is the fact that Vitebsk and Gomel regions are the best regions for this indicator in the reporting year - 34.6 and 33.4%, respectively. In general, it should be noted that the share of milk sales of premium and extra grade declined significantly - from 86.0 to 82.3% (Ministry of Agriculture and Food of the Republic of Belarus in 2014).

It is necessary to emphasize a significant increase in milk return in 2012, if the previous year the figure was 5,623 tons, in 2012 it increased and almost doubled - to 10,982 tons (Ministry of Agriculture and

Food of the Republic of Belarus, 2013), (Ministry of Agriculture and food of the Republic of Belarus, 2012).

At the same time a positive dynamics of increasing milk fat it should be noted. So, from 1990 to 2013 this indicator increased from 3.46 to 3.67 %.

Mass share of protein in 2013 in comparison with 2012 has not changed - 3.03% (with base value of this indicator of 3.0%). At regional level the highest protein content was observed in the agricultural organizations in Grodno region (3.07%), the lowest - in Mogilev (3.01 %).

Evaluating results of monitoring raw milk quality, it is worth noting that its improvement over the past 10 years has largely been the result of significant amounts of money invested in reconstruction of dairy farms within the implementation of the State Program of Rural Development for 2005-2010. Thus, during this period 1,477 dairy farms have been reconstructed and re-equipped.

At the same time emerging negative trends indicate that the effect of improving quality of milk by modernizing material and technical base of agricultural organizations decreases, and it requires more intensive use of other elements of the quality assurance system (stimulating production staff, staffing, implementation of quality systems based on international requirements etc.).

Lately quality control of raw milk has become more objective and reliable: statistics are sufficiently reflect the real situation. This is largely due to the process of obtaining permission to export domestic dairy products to the EU market (Usachova 2009), (Kozlovsky 2010), (Moshenskiy 2012).

Quality of livestock products was evaluated based on results of activities of processing enterprises. Appropriate data for beef is presented in Figure 2.

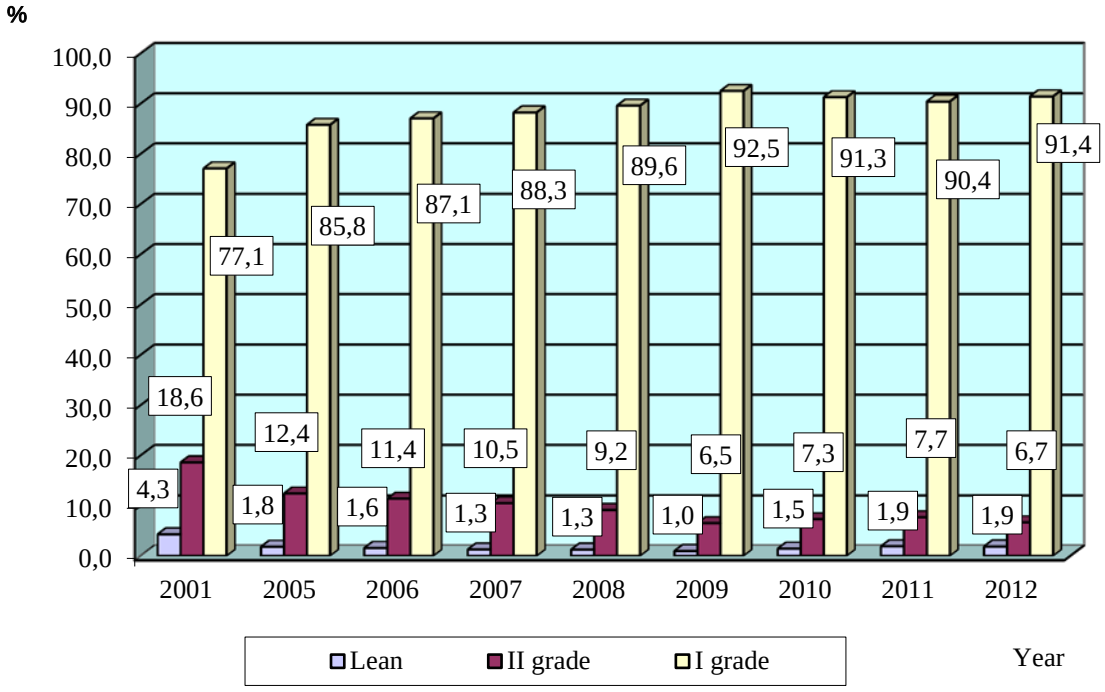


Figure 2. Output of beef by grades, %

Thus, the trend for increasing yield of beef first category in recent years has been quite stable. This trend was reversed only in 2010-2011 - the share of these products decreased to 90.4%, while in 2009 it amounted to 92.5%. However, in 2012 the output of the first category of beef has increased to

91.4%. Accordingly, the share of products belonging to the second category - 6.7% (2011 - 7.7%) has decreased.

In general, if the relevant trends are considered in the long term, the data in the figure indicate a certain improvement in quality of this type of animal products.

The process of change of pork quality produced by Belarus processing plants is shown in Figure 3.

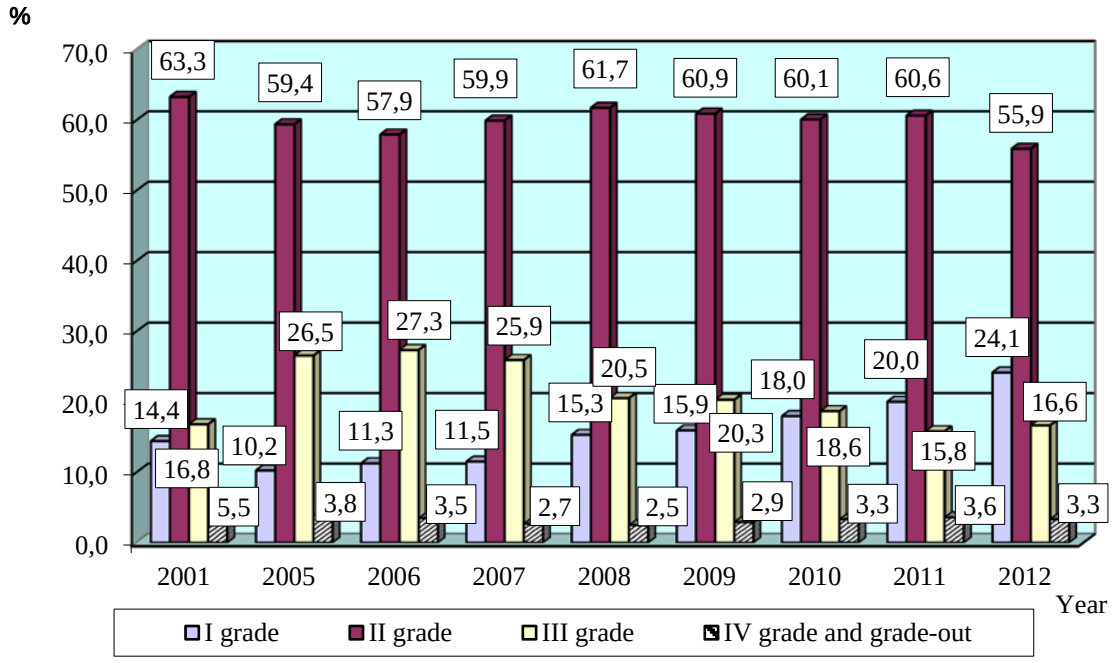


Figure 3 – Output of pork by grades, %

According to the provided data output of first category pork in 2001-2012 has slowly but steadily been increasing - from 14.4 to 24.1%. The most significant increase in its share (by 4.1 percentage points compared with the previous year) was observed in the last reporting year. At the same time the overall structure for categorizing products is still dominated by the second category pork - about 50-60%.

Thus, it is possible to say that there had been a long-term trend in improving quality of pork and in recent years the pace of improvement of its quality increased.

The most popular on the market are the first and second category carcasses of pigs. The country has only a few businesses where sales of 1-2 categories carcasses reach 85-87%. These are Republican Unitary Agricultural Enterprise SHC “Zapadniy”, Republican Unitary Agricultural Enterprise SHC “Zadneprovsky”, SEC “AgroPlant Snov” SEC “October-Grodno”. For most agricultural organizations of the republic this indicator’s value often does not exceed 40%, which negatively affects the competitiveness of the final product (Meat and Dairy Industry Institute National Academy of Sciences in 2007).

Assessment of dynamics of grain quality in the country has been held by the specific share of food grain in the total volume of sales. The results are presented in Figure 4.

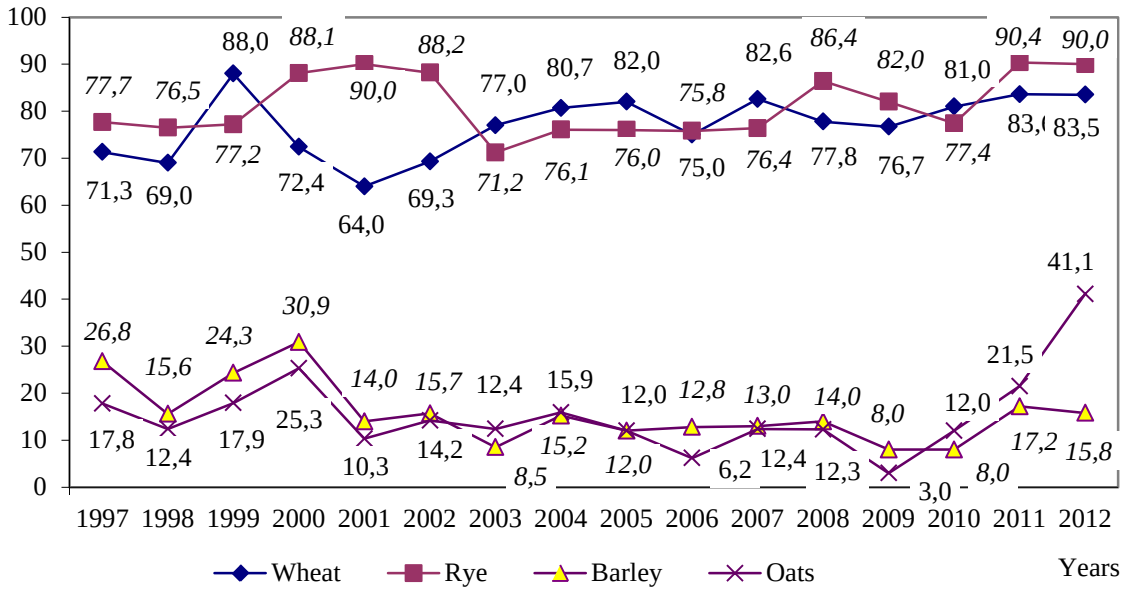


Figure 4 – Share of food grain in total volume of its sales, %

Obviously, at present in relation to any of the analyzed crops it is impossible to talk about a steady positive trend.

Thus, the share of food wheat rather strongly fluctuated over the years. After a slight decline in 1999-2001 its share has steadily increased, reaching 82.0% in 2005. Further dynamics of this indicator was fragile and its significant increase was not achieved - in 2012 83.5% of the food grains were produced. In 2013 this index witnessed a decrease to 80.9%.

For the rest of main crops (rye, barley and oats) during the investigated period constant fluctuations in the value of the specific share of food grains were also observed. So, amid favorable climatic conditions for grain consumer and technological properties in all major grain crops in 2011 were higher than in 2010, but in 2012 for most crops a reverse trend was typical. Thus, the share of food rye in 2012 was 90.0% against 90.4% in 2011.

It is worth noting that in 2012 the share of food oats jumped from 21.5% in 2011 to 41.1 %, whereas in 2013 it dropped to 37.5%.

Share of food barley is sufficiently low - 15.8%, although it increased compared to 2010 by about 8 percentage points.

Match of grain with one or another quality category (class, group, food or fodder) is determined on the basis of individual parameters. In this connection it should be noted that low share of food grains is largely due to the fact that agricultural organizations refer to these cultures, mainly as a grain intended for feeding purposes, and not bring it up to the standards of food condition. This is evidenced by indicators such as natural weight and the presence of small grains. While minor deviations indicators in fodder grain from the requirements for food of conditions can be eliminated by improvements - separation and selection of fine grain.

In this regard specific features of grain quality were monitored and the main are presented in Table 1.

Table 1. Indicators of grain quality harvested in 2012 and 2013, delivered to bakeries.

Crop	Natural weight, g/l		Moisture, %		Black dockage, %		Grain impurity, %		Gluten				Falling number, sec.		Small grain, %	
									Quantity, %		Group					
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Rye:																
- food quality	696	687	14,6	14,9	2,0	3,7	2,6	2,5	-	-	-	-	187	171	-	-
- feed quality	689	667	15,4	16,4	2,0	8,2	3,5	3,6	-	-	-	-	119	141	-	-
Wheat:																
- food quality	758	742	13,6	13,9	2,0	2,3	3,8	2,8	24	24	1–2	1–2	250	232	-	-
- feed quality	710	699	15,1	15,9	3,1	3,6	3,9	3,9	14	16	2–3	2–3	194	181	-	-
Barley:																
- food quality	666	650	13,2	14,1	1,3	1,8	2,4	2,9	-	-	-	-	-	-	4,6	4,9
- feed quality	610	619	15,2	15,2	3,1	3,7	4,5	3,6	-	-	-	-	-	-	9,1	10,0
Oats:																
- food quality	514	508	12,8	13,1	3,0	3,7	5,2	4,7	-	-	-	-	-	-	6,2	2,7
- feed quality	490	458	13,8	14,7	4,2	6,2	4,0	3,7	-	-	-	-	-	-	8,2	5,2
Coleseed																
1 grade	-	-	8,7	8,4	3,9	4,2	6,6	5,2	-	-	-	-	-	-	-	-
2 grade	-	-	12,2	11,6	7,0	9,3	12,9	13,0	-	-	-	-	-	-	-	-

Comparative analysis of quality indicators evidences that in 2013, most of them are worse than in 2012, which determined reduction of grain quality in general.

So, amid increasing moisture and trash natural weight decreased in almost all crops. The positive aspect is the reduction of share of grain impurities in virtually all crops, while reducing the falling number of food rye and wheat, as well as an increase in the proportion of small grains of barley are negative facts.

At the same time it is indicative that at general negative background there is a significant improvement in quality indicators such oats as natural weight and content of fine grain. Analysis shows that a powerful incentive to bring food grain of conditions resulted in a substantial increase of public order.

Major industrial crops - potatoes, sugar beet and flax should be assessed for the most important parameters that affect the final product quality and the level of unit costs of production in processing plants (Figure 5).

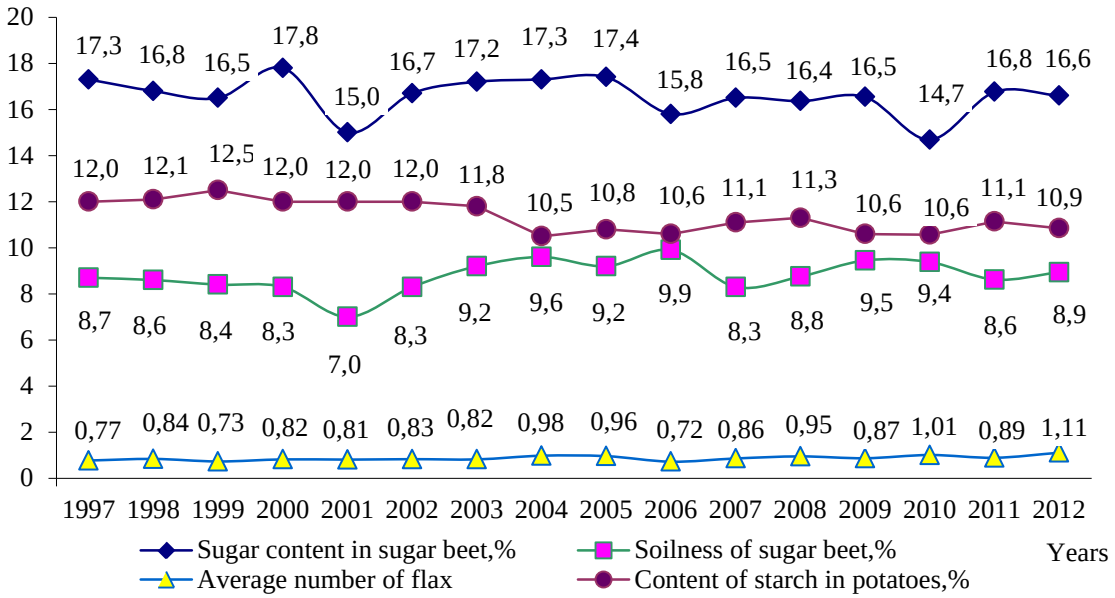


Figure 5 – Indicators of quality of industrial crops

Dynamics of indicators reflecting technological properties of crops indicates for absence of significant positive changes in the long run. This trend is sustainable.

So, from 1997 to 2003, the starch content in potato supplied to processing plants remained almost at the same level - about 12.0%. Given the importance of this indicator, such stability cannot be considered as a positive fact. Note that more than 20 years ago in Belarus higher rates were achieved. In 1985-1987 average starch content of potatoes ranged from 14.1 to 14.3%.

During 2004-2006 starch content was 10.5%, 10.8 and 10.6% respectively (with baseline value of 15.0%). In 2007-2008 the value of this indicator increased slightly - to 11.1 - 11.3%. After its decline in 2009-2010 to the level of 2006 (10.6%) in recent years, the starch content fluctuates in the range of 11.0%. Thus, in 2012 the figure was 10.9%.

According to experts, allowances to procurement prices for potatoes as well as the timing of payments do not create proper incentives for agricultural organizations to cultivate potato varieties with high content of starch (Yarohovich 2008).

Quality of domestic sugar beet improved slightly, despite increasing integration links between producers of agricultural raw materials and processing enterprises. In 2007-2009 sugar content of sugar beet increased slightly compared to 2006 - 16,4-16,5% (with the baseline value of 16.0%). Nevertheless, in 2010 the figure at the end of harvesting period decreased significantly, reaching the lowest value in the last 14 years - about 14.7%. In 2011-2012 sugar content increased to 16.6%.

What concerns pollution of sugar beet - in 2006 it reached its maximum value for the last 9 years (9.86%). In 2007 pollution decreased to 8.3%, but in 2009-2010 it amounted to 9.4-9.5%. The main reason for such instability is the failure of technology of cultivation of this crop, as well as branch quality results highly depend on the weather. It was exactly the latter that resulted in reduction of pollution in 2011-2012 down to 8.6% and 8.9%.

The higher the content of alpha-amino nitrogen in the beet the less is yield of sugar. In 2006 the contents of this element in 100 g of beet averaged 1.94 mg/eq at the rate of 2.5 mg/eq. However, in 2007 this indicator increased and was close to standard, but refineries refused to take it into account when payments were made.

Meanwhile, in evaluating quality of raw sugar beet indicators like content of sugar, potassium, sodium and alpha-amino nitrogen are decisive. International practice (USA, Europe) evidences that sugar mills

pay farmers both for sugar and reduction of alpha-amino nitrogen. Tracking this indicator in Belarus shows it was high enough and unstable in recent years. So in 2008 content of alpha - amino nitrogen was 2.48 mg/eq in 2009, decreased to 2.24 mg/eq, and in 2011, according to the Ministry of Agriculture and Food the level was significantly below the standard - about 2.05 mg/eq. At the moment the content of alpha - amino nitrogen ranges from 2.1-2.3 on the enterprises (JSC "Gorodeya Sugar Refinery") to 2.4 mg/eq (JSC "Slutsk Sugar Refinery").

Increase in 1997-2008 of average figures of flax sales by domestic agricultural organizations should be considered minor and caused mostly by favorable climatic conditions rather than improving the situation in the branch and in 2009 its value had dropped to 0.87.

Analysis of long-term trends indicated an actual reduction of qualitative characteristics of flax and critical state of the branch. Thus, in 2004 the national average number of flax was at 0.98. Increasing quality of flax in 2010 to 1.01 was obviously connected with implementation of a package of measures aimed at improving efficiency of the branch and increased attention to the problems of flax industry from the government and state governing bodies to agro-industrial complex. In recent years there has been a trend towards improvement in quality of flax (2012 - 1.11).

In general, however, there is no stable positive dynamics of main indicators of crop production quality. Its fragile nature indicates a fairly strong dependence of quality of these products on natural factors.

It must be emphasized that results of monitoring of quality indicators would also allow assessing their significance in terms of economic efficiency: product quality is one of the factors that significantly impact on economic situation of both specific entities and a particular branch, as evidenced by the amount of losses and damages resulting from output of products not conforming to specified requirements.

Thus, calculations showed that losses of agricultural organizations, solely by reducing weight of wheat sales in 2012 resulting as a rule from high debris and moisture reached 15,894 million Rubles. It should be noted that this amount exceeds the amount of losses organizations incurred this year, which amounted to 12,786 million Rubles. As a result, only the loss in revenue by reducing the weight - margin of wheat production decreased by 1.3 percentage points amounting to 35.6% whereas it was possible to get 36.9% (Table 2).

Table 2. Losses from output of crop products failing to meet the requirements during 2012 (based on example of certain cereal crops)

Crops	Quantity, tons		Average sale price, th. Rub./ton	Losses in mln. Rub.	Receipts, in mln. Rub.		Prime cost of sold products in mln. Rub.	Rate of return, %	
	In kind	In credit weight			Actual	Prospective		Actual	Prospective
Oats	149,877	146,541	1,130	3,771	165,638	169,409	162,794	1.7	4.1
Wheat	1,111,689	1,101,253	1,523	15,895	1,677,327	1,693,222	1,236,654	35.6	36.9
Rye	588498	580,264	950	7,822	551,241	559,063	565,935	-2.6	-1.2

The situation is similar for other types of crop products. Thus the loss caused by reduction of crediting weight for oats totaled 3,770 million Rubles, which reduced the margin by more than 2 times - 1.7% vs. 4.1% possible. For rye a similar amount was 7,822 million Rubles, which consequently increased the loss ratio by 1.4 percentage points (-2.6 % instead of -1.2% that was actually possible).

Evaluation of results of monitoring quality of agricultural products in the republic shows at lack of sustained progress in improving it. Therefore, attention should be paid to the need of creating a com-

prehensive and effective quality management system in agriculture, capable of enhancing the competitiveness of domestic agricultural products, ensuring sustainable improvement of its consumer and technological properties.

With regard to output of products safe for human health and life at present stage in addressing this issue a growing importance is acquired by systemic approach to quality management and safety.

In Belarus much attention is paid to implementation of quality management systems and safety of agricultural products in accordance with requirements of international standards. Implementation and certification of quality management systems and food safety based on international standards ISO 9000, ISO 22000 series and HACCP principles is an effective way to ensure their safety, quality and high competitiveness on the international food market.

At the same time, introduction of certified quality systems at domestic enterprises that are not engaged in export sales is also becoming common practice.

In Belarus STB ISO 22000-2006 “Food Safety Management Systems. Requirements for Organizations of the Food Chain” and STB ISO / TS 22004-2006 “Food Safety Management Systems. Guidance on the application of STB ISO 22000-2006” have been developed and approved based on international standards. On April 1, 2009 STB ISO 22005-2009 “Food Safety Management Systems. Traceability in the Feed and Food Chain, General Principles and Basic Requirements for Development and Implementation” came into effect.

Introduction of HACCP is the most effective way to ensure product safety in agriculture. From 2001 implementation of production control has been going in many agro-industrial complex processing plants interconnected with quality management system and HACCP food safety. Essence of the system is in control elements and stages of production process where there is the highest probability of factors leading to output of dangerous products. Therefore, this system is an important way of organizing production control to ensure proper level of quality and safety.

Studies have shown that the country has set up a national regulatory framework that establishes requirements for HACCP system and its certification procedure, guidance documents on its application by processing companies have been developed.

Dynamics of certification of food quality and safety management systems based on principles of HACCP and ISO 22000 in recent years is shown in Figure 6.

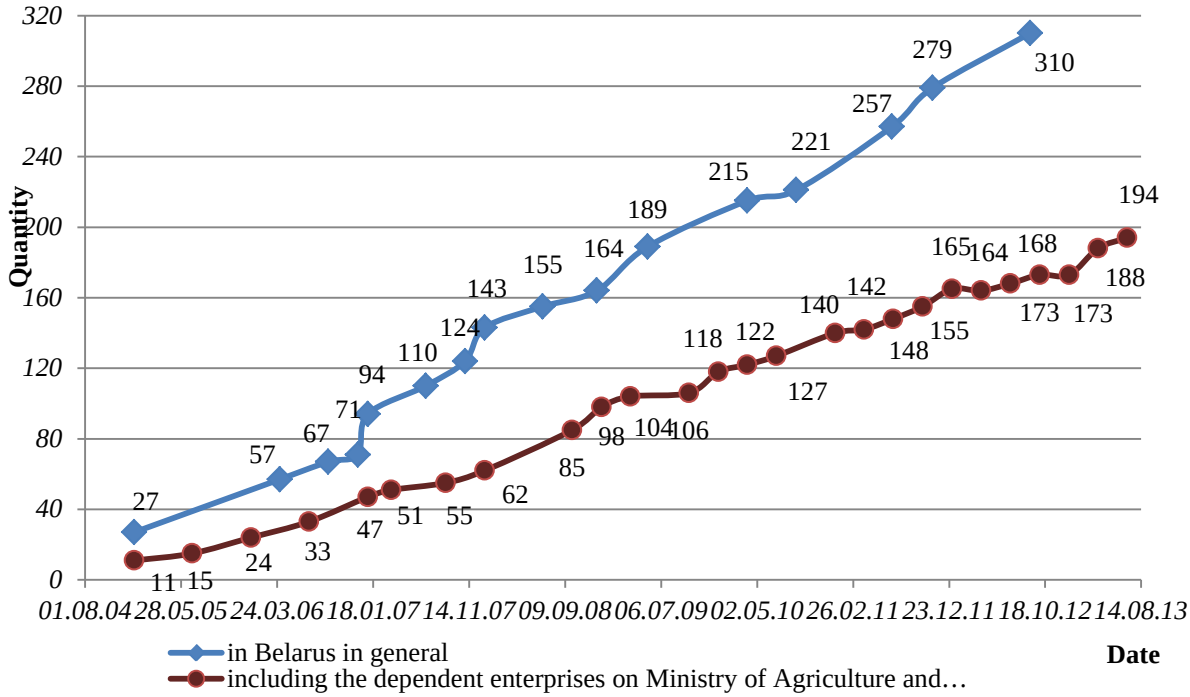


Figure 6 – Dynamics of Certification of Food Quality and Safety Management Systems based on HACCP and ISO 22000 Principles

It should be noted that by 1 January 2013 in the Ministry of Agriculture and Food 148 HACCP based systems of quality and safety products have been certified. 61 of them by dairy enterprises, 21 – by meat processing enterprises, 32 – by bakeries, 13 – by poultry farms and 21 – by enterprises of other branches. On top of this 25 quality management systems that meet ISO 22000 international standards have been certified (Ministry of Agriculture and Food of the Republic of Belarus, 2013).

Taking into account that livestock production is associated with the highest risk of output of products dangerous to human health, exactly this branch should receive the most attention in terms of safety: according to International Office of Epizootics (OIE), in assessing risks the share of animal products accounts for 90% (for products of non-animal origin - 10%, respectively).

Among performance indicators assessing performance of the Republic of Belarus Veterinary Service aimed at ensuring safety of livestock products it is expedient to refer to the following information:

2005 - Recognition of the Belarusian Veterinary Services high performance in the OIE official report;

2006 - Certificate of OIE to recognize the Republic of Belarus free from FMD;

2008 - Certificate of OIE to recognize the Republic of Belarus free from rinderpest;

2011 – Reduction to the level of 1995 the amount of acute intestinal infections in the country per 100 thousand people by more than 2.2 times (from 293 to 135 cases).

In general, monitoring of agricultural products quality and safety system indicates that in recent years the country created sufficient material base, developed and updated documentation for regulatory technological support, compliance, which allows making quality products that are safe for health. At the same time, organizational and economic mechanism does not fully provide for solution of this problem, resulting in reduced export potential. However, still there are high risks of output of products with low consumer and technological properties, high content of harmful substances.

This determines the relevance of process of further improvement of domestic mechanism of agro-industrial complex product quality control to ensure sustainable output of agricultural products, corresponding to modern requirements of the world market.

The problem could be solved through the following actions to improve it in order to achieve sustainable output of safe products that are competitive in their qualitative parameters on external and internal markets of agricultural products:

- Development of legal support system oriented at market mechanisms for regulating quality and responsibility for safety of agricultural products;

- Development, implementation and certification of food safety and quality assurance systems at agro-industrial enterprises;

- Optimization of the list of quality and safety controlled indicators of agricultural products in accordance with requirements of the world market and establishment of an appropriate control system;

- Establishment of an effective mechanism to stimulate quality of products;

- Development of a complex mechanism of information support to innovation in agricultural enterprises in order to ensure quality and safety of agricultural production.

In order to improve the mechanism of legal support to safety of products it is necessary to develop a set of technical regulations governing safety issues for all major agricultural products.

It is necessary to implement the principles of the HACCP system and ISO 9000 at large-scale agricultural enterprises through pilot projects to ensure safety and quality management system in large agricultural enterprises, primarily in the output of livestock products.

Accounting requirements of the world market in the field of quality control and safety products includes:

- Creation of a mechanism of arbitration control of quality and safety of food products and agricultural raw materials in the course of export-import operations;

- Harmonization of the list of indicators of quality and safety for all animal and plant products, including those sold on the domestic market, in accordance with the requirements of the European Union and the member states of the Common Economic Space;

- Development of new technical regulations for assessing quality of animal products - cattle meat and fattened pigs.

In developing the standards it is necessary to take into account that these would apply to imported products and, therefore, should protect domestic market from imported unsafe food products. Application of common standards would unify security mechanism for both imported and exported products, which guarantees protection of consumers from products inappropriate in terms of quality and dangerous, as well as ensure unobstructed access to foreign markets.

Creation of economic incentive mechanism that would ensure output of competitive foodstuffs is an urgent task. In this respect among modern instruments encouraging quality of products should be both rewards and appropriate penalties for unsatisfactory production results.

The main elements of this mechanism should be:

- Imprest system depending on the quality of supplied products;

- Payment of bonuses as well as stimulating output of raw materials with specific properties using a flexible level of differentiation of purchase prices;

- Concessional target lending for improvements and improve quality of agricultural raw materials etc.

Mutually beneficial cooperation between processing and agricultural organizations would significantly improve quality of raw materials, economic results of the entities in both branches.

Information support of innovation to ensure quality and safety of products includes:

- establishing a monitoring system for safety and consumer properties of agricultural products;

- ensuring transfer of agricultural production organizational and technological standards to agricultural enterprises.

Development in proposed areas would generate effective market mechanism of managing quality and safety of agricultural products, widespread use of various methods of regulation of different issues, to obtain additional income both by agricultural organizations selling high quality raw material and processing enterprises resulting from output of competitive products with high added value.

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