Bulgarian Journal of Agricultural Science, 26 (No 5) 2020, 1034–1040

Economic aspects of extruded soybeans' usage in livestock and poultry

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Abstract

Berbenets, O., Pugach, A. & Lebedenko, O. (2020). Economic aspects of extruded soybeans' usage in livestock and poultry. *Bulg. J. Agric. Sci., 26 (5)*, 1034–1040

The market of products for soya processing which are used for feeding animals and poultry has been researched in this article. It was identified soy cake quality criteria. It was proved the need to check the products of soybean processing not only by urease activity but also by such important criteria as the existence and presence of trypsin inhibitors; PDI solubility in water and solubility in KOH. The complex of measures aimed at increasing the profitability of livestock production in Ukraine is justified: the European level standards for the quality of soybean processing must be adopted at the legislative level, to create the laboratories capable of carrying out all necessary studies, to enhance quality assurance.

Keywords: soy meal; soy cake; anti-nutritional factors (ANF); quality of soybean processing; urease activity; TIU; efficiency
Abbreviations: PDI – Protein Disperbility Index, KOH – Potassium Hydroxide, ANF – Anti-Nutritional Factors, TIU – Trypsin Inhibitor Units

Introduction

It is expected that in 2050, the world's population will grow from the current 7.6 billion people to 9.8 billion, with only 9 countries giving half of the growth – India, Pakistan, Indonesia, Nigeria, Uganda, Congo, Ethiopia, Tanzania and the United States (the latter due to migration). By 2024, according to its population India will take the first place and will overtake China which is the most populated country in the world today. Nowadays the latter has the population of 1.4 billion and India has 1.3 billion people (United Nations, 2017).

While fertility rates are falling almost everywhere, 47 less developed countries show high birth rates – 4.3 births per woman for the period of 2010-2015, on the average. As the result, it is expected that 26 African countries will double at least the size of its population till 2050 year.

Meanwhile, the population of Europe, Japan and other developed countries will go on growing old and decreasing, the influx of refugees and migrants will offset the reducing fertility, especially in Europe, but it won't prevent the overall reduction of population.

Scientists from the UN and Washington University assert that the population of the Earth will reach 11 billion people by the year 2100 (All-Ukrainian Informational-Analytical Monthly Newspaper "Migration", 2017).

The data, mentioned above, clearly demonstrate the expectation of doubling the consumption of food products, at the same time the segment of population, consuming animal proteins, is going also to be increased. In this regard, livestock and poultry should be increased, which, for its part, will require increased usage of feed protein.

And because of the fact that in the structure of the cost of livestock products, the cost of feed can reach 65-75%, it

is very important to find the ideal protein components of the feed. And, in our opinion, they are soybeans. Because soya, from all plant fodders, is the most complete food, according to its quality, and also due to the ratio of essential amino acids, it can replace very expensive and scarce animal feeds (dairy products, meat-bone meal, fish meal, blood meal, etc.).

To quote Svezhentsov et al. (2005, Lyviv), each 100 kilos of soybeans, which have been fed, can save up to 4 hundredweight of cereal crops, and it is no coincidence that in most countries, planting soya, its growing is steadily increasing. Further material will only prove it.

As Domoroshtenkova (2013, St. Petersburg) indicates, today soy meal is a feed ingredient for various kinds of food compounds and it is partly used as independent feed. High protein content and a balanced amino acid composition determine the higher feed value of soybean meal compared to other types of oilseeds meal, as well as fodder corn.

But as we know, in addition to valuable nutrients, soy products (soy meal, soy cake, full-fat soya) can contain the whole complex of natural anti-nutrients (Table 1), which reduce the fodder value of these products in the event of noncompliance with the maximum permissible standards. In most cases, these substances are thermostable and the correct wet-heat treatments can their activity to a safe level.

Commonly accepted methods for controlling the activity of anti-nutrients of soy meals are the testing of urease activity or trypsin inhibitors. The urease activity is a simpler and faster method, and when it comes to controlling the quality of soy cake and soy meal, we use it. The urease activity indicator is the level of protein denaturation and it shows if soy product has passed a heat treatment enough for inactivation of anti-nutrients and for usage in feeds.

However, in our opinion, these methods are not enough, and soybean meal should be checked for further PDI solubility in water and solubility in KOH, and not only for the activity of urease, which is unstable at temperature treatment. But, unfortunately, in Ukraine there is any laboratory that can evaluate the quality of processing soybeans for these indicators. And the purpose of the article is the desire to bring the information about the need for such a laboratory in our country to a wide range of producers and consumers of soya products.

Materials and Methods

Soya is a universal product that has food, healing, forage, technical and agrotechnical value, several hundreds of different products are made of its seeds. In addition, legume protein contains all the essential amino acids and is also rich in vitamins, which, moreover, are involved in protein metabolism, rich in fats, and therefore they are especially valuable as ingredients for fodder. And as soon as scientists and manufacturers all over the world had realized this, they started to use soy beans actively, as well as they thoroughly studied their effects on the body of both humans and domestic animals. Zaprometova (1986, Moscow) devoted her research to the chemistry and biochemistry of legumes. Jausen (1994) studied the methods of soybean processing and their influence on protein quality and oil digestion. Indicators of pigs' digestion when feeding soya were studied by Polishchuk (1998), Semenov (1994, Poltava) made experiments of feed processing to determine the efficiency of soybeans for young pigs in different technological methods of feed processing, Gilbert (1999) studied the Global protein market and the Global fodder market. As we can see clearly, this topic has long been interested in both foreign scientists and domestic ones, because its value can hardly be overestimated for solving food problems and food security. According to FAOSTAT, world leaders (top ten) of soybean production are: USA, Brazil, Argentina, China, India, Paraguay, Canada, Ukraine, Uruguay and Bolivia. All agencies of the world closely monitor the trends in soybean production, and all experts say that its crop area and its gross soybean harvest will only increase (2014-2018).

But the nutritional value of any product depends not only on the content of amino acids, but also on their ability to be absorbed by the body of livestock and poultry. Unfortunately, lot's of raw proteins of legumes, and especially soy, contain natural toxic substances that pose a risk to the health of livestock and poultry. So, soybeans and products of their processing (soy meal, soy cake) contain a number of anti-nutrient factors (species and their influence are detailed in Table 2). Podobed (2003), Svezhentsov et al. (2005) and others have devoted their research studies of anti-nutrient factors and their effects on animal productivity, as well as reduction of their effects on the body.

So, raw soybeans have a detrimental effect on animals. The presence of anti-nutrient factors affects digestion and the use of energy and other nutrients, biologically active substances and minerals of the feed. That is, first of all, protease inhibitors that affect the absorption of protein, there are trypsin inhibitors in soy beans. Lots of studies of both world and Ukrainian scholars are focused on this subject Ferket (1999), Domoroshtenkova (2013), Trofimov & Zaharov (2014), Podobed (2003) and others.

In world practice, there are many methods for processing soybeans to inactivate anti-nutritional factors and to improve nutrition. The studies of Dolud & Luht (2016) are focused on some of the most common methods, namely, they are: steam treatment, boiling, frying and further grinding, boiling ball explosion or explosion in pneumatic tube, micronising (infrared processing), expanding (pressure conditioning), wet and

dry extrusion. For example, at the University of Göttingen, experiments with different methods of preliminary grinding, conditioning and mechanical impact have been carried out in order to find out the effect from five different types of treatments. The effect of thermal treatment on the reduction of anti-nutrient factors (ANF) in soybeans and the effect on broiler production (2016) were also studied.

Another topical issue is to define uniform standards and norms for assessing soybeans' quality and their processing products. As for our neighbors, in Russia, Domoroshtenkova (2013) is studying and exploring this issue, who is stressing the need to bring the Russian standard for soybean meal to European ones. This issue is even more critical for Ukraine, which is the eighth largest producer of soybeans and is the 6-th largest exporting country.

The conducted review proves the relevance of selected research topic.

Results and Discussion

In the domestic agrarian market, for many years, as well as crops, soya has been taking the leading positions in export and processing for food and feed purposes and it's also strategically important in providing food and economic security of the country (Kernasyuk, 2017).

Traditionally, soya is one of the most popular legumes in the world, which is annually cropped in the area of 120 million hectares. According to the world's agrarian scale of production, it also takes leading positions of one of the most important oilseeds. Its considerable distribution is caused by especially valuable nutrient composition, high economic efficiency of production, as well as by its universal use in food, feed and technical purposes. Soybeans are used as beans, soy cake, oil, soybean protein concentrate, composed of 60–65% protein and soy protein isolate composed of 90–92% protein, soy milk powder and other products of its processing. Thus, it is certainly a strategic crop of both world and the domestic agrarian sector.

UAC's survey shows that world soybean production is 351.8 million tons, and the permanent world leaders of soya production are the United States, Brazil and Argentina, which harvested a record 286 million tons of soy in 2016/17, that makes 82% of world production. Also, the leading producers include China (12.9 million tons), India (11.5 million tons) and Paraguay (10.3 million tons).

The largest exporter of this type of legumes is Brazil, whose exports amounted to 62.4 million tons in 2016. Another leader is the United States, which exported 55.8 million tons of soy in 2016. Together, these two countries account for 82% of total world exports (Analytical Department of UAC, 2017).

In spite of the fact that China is one of the largest soybean producers, its own production is not enough to satisfy its domestic consumption, which is growing every year, and according to projections of world-known analysts, it is going to increase the next year. This is the main reason for the fact that "Under Heaven" is the largest importer of soy. The lion's share of this crop is processed here (86.5 million tons) and is used for food purposes (11.3 million tons) (Analytical Department of UAC, 2017).

Ukraine also keeps pace with the global trends, and in the years since its independence, Ukrainian soybean production has increased from 135 thousand tons to 4.3 million tons, out of which export was 2.7 million tons. Such results allowed it to become the largest producer of this crop in Europe and the 8th largest producer of it in the world (data: USDA). Soya is one of the most profitable crops for production, yielding only buckwheat and sunflower. In 2016, the profitability was 52%. In some regions of Ukraine, the indicator was even higher. The three leaders were Transcarpathian region (95.4%), Zaporozhye region (86.6%) and Kherson region (84.5%). The fact that Ukrainian producers were able to assess the prospects for growing this crop proves the increased production over the past 5 years due to increased yields and increased sowing area. So, in 2017, 1.99 million hectares were cropped by soya, which are 135 thousand hectares more than the previous year (according to the data of State Statistics Committee).

One of the reasons for soybean production in Ukraine is favorable natural and climatic conditions in the most of the country, as well as relatively low cultivation costs (compared with other countries). Comparing Ukraine with the largest soybean producers in the world, we may say that soybean production is the most expensive in the USA and China. While in Ukraine costs are almost 6 times lower. Although this difference is somewhat offset by higher yields in these countries, and hence more revenue. To make the cultivation of this crop profitable, governments provide subsidies to farmers or set minimum support prices (Analytical Department of the UAC, 2017).

Soybean prices also attract its producers. Since the main factors for growing soybean market are macroeconomic factors of soybean's suppliers and consumers, then soybean prices greatly depend on the level of demand for soy cake and soybean oil. The following are the main factors creating soybean pricing: the slowdown in the economic growth and China's financial market; increase of sown areas; appreciation of the dollar; significant market offer; falling oil prices; favourable weather conditions in some countries; increasing Indian demand for soybean oil; reduced export taxes in Argentina; large crop damage in Argentina caused by heavy downpour; devaluation of the peso and the real; large residual soy stocks.

So, it can be said that soybean market will depend on currency fluctuations, world oil market trends (soybeans, rapeseed, sunflowers, and palms), world demand of China and the European Union, as well as it will depend on the market of petroleum products.

In addition to oils, the main food products made from soy are: soybean milk, tofu, okara*, textured soy protein (TSP), soybean isolates, and others.

*(Okara is a by-product of soymilk production with a rich nutritional profile, particularly in proteins, fibers, lipids, and bioactive components. Okara is a gluten-free residue of soybean generated during soybean and tofu processing after aqueous fractions have been extracted. Okara is also referred as soybean, bean curd/dreg, douzha or tofuzha (Chinese), bejee (Korean) or tofukasu (Japanese). Around 1.2 kg of wet (fresh) okara waste was produced when 1 kg of soybean was processed for tofu).

People get food from soybeans for the production of several hundreds of various goods. In world practice, soybean grains are mainly used for processing butter, and soy cake and soybean meal are used for feed purposes as valuable high-protein food supplements for compound feedstuff.

In the food industry, non-fat soy flour is widely used for cooking baked goods, cereals and confectionery. Soybean oil is also used in the soap industry, paint and varnish industry. Protein soybean isolates are used by the textiles, perfumery, pharmaceutical and paper industry and for other technical purposes.

So, as we can see, the development of soybean production is an extremely promising area for Ukraine, and this requires at first, to develop national standards of quality and regulations which meet international quality standards; secondly, to provide producers with assistance from the State; thirdly, to be exporters of raw materials and final products as well.

At present, science has developed methods (Table 1), ways and techniques of anti-nutrient factors' inactivation of compound feedstuff components (Table 2), as well as preparing them for easy and quick absorption by the body of animals and poultry. Thermal treatment is the simplest and the most available method.

The data presented in the Table 2 clearly indicates the impossibility of using raw soybeans in feeding livestock and poultry.

Temperature, the duration of processing and the moisture of raw ingredients are essential when processing soybeans. If soybeans are processed by extraction (it is the most appropriate, safe and gentle method for processing soybeans), this allows to separate out the fat from beans as much as possible and to get soy cake with the most inactivated trypsin inhibitors and other anti-nutritional factors as well as with high-protein soy cake that is highly available for livestock digestion.

The technology of processing soybeans for the production of high-protein concentrate (isolate) is no doubt.

Concerning the production of soybean meal, which is obtained by frying beans or using extruders, there are great doubts about the quality of soybean meal, especially for pigs and poultry. The fact is that frying and extruding are hard processing methods, at the limit of insufficient or excessive product heating. In the first case (insufficient heating), the part of trypsin inhibitors and anti-nutrients are not inactivated, with overheating: one of the two amino groups of amino acids is destroyed, which weakens the availability of protein for the body of pigs and poultry.

In future, the principle lock (soy protein) – key (trypsin enzyme) does not work, while in the diet of feeding pigs and poultry everything should be balanced to the appropriate feeding standards, and in fact, livestock and poultry do not receive the essential quantity of protein. In addition, in case of ingestion in the body of livestock and poultry, raw trypsin protein becomes easily accessible for the "Escherichia coli", causing diarrhea and general intoxication of the body. Amino acids, having got from the feed into blood, stream throughout the body and cause the feeling of satiety in livestock and poultry, but they cannot build any protein molecule. Amino acids that

Table 1. Indicators and methods by which the world's analysis of soy cake quality is evaluated

Indicator	Method	Limits of acceptable quality of soy cake on the basis of indicators
Activity of Trypsin Inhibitor (ATI)	71-10 AACC (1973), amended Hamerstrand (1981) – is used in the USA. 14902:2001 (UNE-EN-ISO, 2002) – is used in Europe. TIU (the unit of trypsin inhibitors in dry matter) – is used in France.	< 4–5 mg TI/g 6000–8000 units of TIU
Urease activity (UA)	Ba:9-58 AOCS (1980); ΔpH / 5506 ISO (1988); mg of nitrogen / g / min. 30°C	0.02–0.20 mg/g
Solubility KOH 0.2%	Araba and Dale (1990)	80–88 %
The protein dispersion index (PDI)	Ba:10-65 AOCS (1977)	20–35 %

Table 2. Mechanisms of negative effects of anti-nutritional substances on the body of livestock and poultry (Domoroshtenkova, 2013, St. Petersburg; Ferket, P. R. 1999; Svezhentsov, Kravtsiv & Pivtorak, 2005, Lyviv; Zaprometova, 1986, Moscow)

Toxin	Performance
Protease inhibitors	Lower the activity of proteolytic enzymes – trypsin and chymotrypsin, which causes pancreatic hypertrophy, slow the growth of animals and absorbtion feed by the body.
Antigens	The soy protein concentrate contains substances with antigenic properties – glycinin and conglycinin, which increase the content of immunoglobulin in the blood serum of calves. When fed to calves, soybean protein concentrate causes gastrointestinal allergy, which slows the growth rate, deteriorates their development and digestibility of nutrients.
Phytohemagglutinin (lectins)	These are proteins that are specifically linked to sugar by glycoconjugates. Lectins are linked to glycoproteins on the surface of the microvilli that lining the small intestine, resulting in damage and inhibit the development of microvilli, which, in turn, causes a deterioration in the absorption of nutrients through the intestinal wall. Due to the damage caused to intestinal structure by lectins, there is impaired glucose, amino acids and the vitamin B12 uptake and ion transport gets worse. Lectins also cause agglutination of red blood cells. Lectins are contained in soybeans in the amount of 1.1–4.1%. Lectins are not heat-resistant and they are almost totally destroyed after 15 minutes of cooking beans.
Urease	An enzyme that catalyzes the hydrolysis of urea into ammonia and carbon dioxide. Its excess can cause excessive ammonia production during the process of urea metabolism. The urease activity is judged by the degree of neutralization of trypsin inhibitors, which must not exceed 0.2 of conventional unit pH.
Low molecular weight oligopeptide	It consists of two or three amino-acid residues or a glycopeptide, which consists of residues of one or two amino acids and sugar. It causes goitre in animals. Thermal treatment of feed is not always effective in its destruction.
Cyanogenic glycosides	Cyanide is released from glycoside in the form of HCN, with the help of glycosides enzymes. The hydrogen cyanide reacts with inorganic sulphur compounds, forming cyanogenic thioglycosides, which counteract iodine in the body and disrupt the thyroid function, causing poisoning in livestock and poultry.
Antivitamins	Vitamin antagonists E and D lower tocopherol level and cause muscular dystrophy and rickets, in some cases, they increase the need for vitamins B_{12}. Lipoxidase is also prepared from unmodified soybeans, which reduces the absorption of vitamin A and destroys carotene.
Glycinin and β-conglycinin	About 65-85% of raw soy protein consists of beta-conglycinins and glycinins, which are best, stored during heat treatment, β-coglycinin causes an allergic reaction in the intestinal epithelium. Glycinin is the formation of antibodies only after injecting. In general, antigens are the cause of allergic reactions in the intestine, damage the villi of the mucous membrane, reduce the surface of absorption of water and nutrients and result in the loss of energy and protein.
Tannins	These are polyphenolic substances which are contained in beans and sorghum. They form insoluble complexes with microelements, proteins and carbohydrates of feed and decrease its nutritional value. Tannins lower the growth of livestock and poultry, damage in the activity of trypsin and L-amylase, forming non-digestible complexes with vitamin B_{12} and reduce its absorption. It is possible to neutralize tannins by the extraction with methanol, ammonia or water-hexane mixtures.
Saponins	They contain steroid or triterpenoid compounds associated with sugar residues. It was found that they inhibit the activity of digestive and metabolic enzymes and form insoluble zinc complexes. Saponins give bitter taste to forage and have hemolytic action.
Stachyose+raffinose	The indicated galacto-oligosaccharides are undesirable components for livestock's diet. These low molecular weight polysaccharides are not absorbed by animal's body as a result of the alpha-galactosidase enzyme deficiency in the digestive system. In animal's body the stachyose and raffinose metabolism is not carried out by fermentation but by microbial digestion, which causes to the phenomena of dyspepsia and general discomfort. Soy beans contain about 6% of oligosaccharides, mainly raffinose and stachyose. These carbohydrates are not digestible, although mammals' microflora secrets enzymes for them. But it is useless, because the fermentation is carried out by pathogenic bacteria, resulting in gas released from the bloating stomach. This bacteria also causes diarrhea, deterioration in energy use and pigs' state of health. Norm < 0.2.
Phytic acid	Phytic acid is phosphoric acid, which diminishes the bioavailability of essential minerals: calcium, magnesium, iron, and zinc. It is also linked to protein, and therefore the degradation of phytic acid can increase its digestibility. In addition, it is known that as a result of phytate weakening by phytase enzymes, the availability of phosphorus increases. Therefore, recently the manufacturers of phytase enzyme advise to increase its content in fodders to mitigate the negative effect of phytic acid.

did not get into the body's energy-exchange fund through the portal vein get into the liver; the liver decomposes them to ammonia, which in the future must be removed from the body through the genitourinary system. All this leads to the fall in the growth rate of live body weight or lower other indicators of livestock and poultry productivity, as well as increases the cost of feed per each unit of production.

In order to measure the degree of soybeans processing to oil and soy meal, we cooperated with an enterprise that uses foreign (Bronto) extruders as well as domestic (Kharkiv) ones. We aimed to explore the quality of the soybean processing products. And due to the fact that there are no appropriate laboratories in Ukraine that could have studied soybean quality processing according to such important criteria's as the presence of trypsin inhibitors; PDI solubility in water and solubility in KOH, not just urease activity, we had to contact foreign laboratories, namely: the French laboratory "Artemis" and the American "IFIA".

The point is that if the PDI index is less than 20 units, it shows the degree of overheating, and the KOH solubility indicates insufficient heating degree of the product and in general, the availability of trypsin inhibitors proves the low access of protein.

At first, several samples were sent to the United States and the results obtained (Table 3) had not entirely satisfied us. First, the research study is very time-consuming and the price of research is unreasonably high, secondly, there is nonconformity of American standards with the standards of the European Union.

Therefore, we have chosen the French laboratory "Artemis", because of the sample sending speed, adequate duration of research, the results, and also the price satisfied us much more, and we have gained the opportunity for quicker operational control of soybeans processing.

Having taking the samples of production (soybean meal), which was made according to the specifications set out by the plant – the extruder producer, we found that soybean meal, according to Christele Legourd, was not affected by thermal treatment at all.

Having analyzed, we came to the conclusion that it is necessary to make its individual settings of operating modes (temperature, feed rate) for each extruder and to set several operating modes of it. Having sent dozens of samples to France and having received the results of research studies (Table 4), we were able to bring qualitative indicators to the approved standards of the European Union.

In the European Union, two methods of detecting trypsin inhibitors in soy are used: chemical method and photometric. The laboratory "Artemis" conducted a chemical analysis of soybean meal. The standards of trypsin inhibitors content were established within 6000–8000 TIU/g. Photometric method is characterized by the presence of 2.5–4 mg/g TIU.

Having analyzed the data in the Table 4, we can say that soybean processing parameters do not correspond to the standard indicators, and therefore such soybean meal is unacceptable for feeding pigs and poultry. In this case, each extruder must be established and calibrated separately.

Table 3. Soybean product quality results (data from IFIA *, USA, mediated by Baltic Control/ Ukraine Ltd., Odessa)

Sample number	Sample name	Sample date	Protein Solubility, Index in 0.2% K	PDI (Protein Disperbility Index)	Trypsin inhibitor activity, mg/g	Protein, %
688611	Soyabean Product	21/11/2016	91.5	15	12.5	43.10
688612	Soyabean Product Herbal Soya	21/11/2016	91.2	20	16.2	42.90

IFIA* – International Federation of Inspection Agencies

Table 4. Quality results of soy products (data from Artemis Laboratoire, France)

Sample №	Sample name	Sample date	Protein, %	PDI	Protein soluble KOH 0.035N – %	Protein solubility (KOH 0.035N) – %	Antitrypsin factors – TIU/g
172349557001	Soybean Protein Product	30/12/2016	47.2	20.3	43.2	91.4	32839
172349558001	Soybean Protein Product	02/02/2017	46.2	21.3	41.8	90.4	31036
172349559001	Soybean Protein Product	17/01/2017	48	24.6	44.4	92.5	39275
172349560001	114 Herbal Soya	17/01/2017	48	23.8	44.9	93.6	19231
171714901	Soya	25/04/2017	47.8	15.40	43.05	90.1	15354
171714902	Soya	25/04/2017	48.9	12.10	42.50	86.9	12658

Index: Protein (Dumas cerected Kjeldhal), research method – NF EN ISO 16634-1
Index: Protein dipersion index (PDI), research method – Outsourced – Internal method
Index: Protein soluble KOH 0.035N, research method – Outsourced – Internal method
Index: Protein solubility (KOH 0.035N), research method – BIPEA method
Index: Antitrypsin factors, research method – AOAC method

PDI is within normal parameters, the indicators of the of trypsin inhibitors content are very high, these mentioned samples have , on average, 34383 TIU/g (norm is 6000–8000 TIU/g), solubility in KOH is too high, indicating insufficient thermal treatment. And only the last two samples are conditionally valid for using in livestock and poultry feeding.

Conclusions

Having conducted this study research, we can conclude that without proper quality control of soybean processing products, it is impossible to use soybean meal for feeding pigs and poultry. Soybean processors profit from the sales of soybean oil, and they are not interested in the quality of soybean meal, as in by-product, at all. Only those farms with pig or poultry farms and soy processing plants are interested in getting of good quality soybean product for using in pigs and poultry feeding. But they do not have the possibility to conduct such research studies in Ukraine.

Due to the fact that in Ukraine there are several oil extraction plants producing soy cake and oil, which work under contracts with mostly just poultry farms, while feeding pigs, almost 60% of farms use soybean meal, but not soy cake, and as a result, have European equipment and European genetics, but Ukrainian efficiency.

Therefore, in order to increase the profitability of livestock production, it is necessary to adopt the European quality standards of soybeans processing at the legislative level. We should also highlight the need of appropriate laboratories for livestock industries, which will be able to conduct research studies according to the criteria described above.

The use of soybean meal without control of quality results in significant farming losses. If soy is overheated, then there is up to 50% of soy protein in the diet, but it does not get into the body's exchange fund. And protein gives up to 70% of all available protein due to soy products in livestock and poultry diet. Thus, we forecast the low productivity of livestock and poultry and feed consumption increasing per product unit. In the case of inadequate soybean processing, losses may be much higher due to the inaccessibility of the protein for animal body. Soybean meal is quite expensive and the use of low-quality product leads to quite significant economic losses.

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Received: November, 12, 2019; *Accepted:* November, 28, 2019; *Published:* October, 31, 2020