Quality of poultry meat as a basis of export potential of the meat products

Yu O Lupenko¹, N Hr Kopytets¹*, V M Voloshyn² and O M Varchenko³ and K O Tkachenko³

¹National Scientific Centre "Institute of Agrarian Economics", 10, Heroiv Oborony st., Kyiv, Ukraine
²National Science Centre "Institute of Agriculture of the National Academy of Agrarian Sciences of Ukraine", 2-B, Mechanical Engineers st., Chabany, Ukraine
³National Agrarian University Bila Tserkva, 8/1, Sq. Soborna, Bila Tserkva, Ukraine

*E-mail: nataliia_kopitets@ukr.net

Abstract. The purpose of the article was to study the quality as a basis for the export potential of Ukrainian meat products and to determine the conditions for its improvement. The following methods were used: abstract-logical; monographic; comparative analysis; statistical; tabular. The results of the research show that the problem of quality assurance of both agricultural products in general and poultry meat in particular is most relevant in both domestic and foreign markets. It covers all participants in the food chain "production-processing-sale-consumption". Product quality is the main factor in the stable development of production and ensures the export of domestic products. It is established that the production of poultry meat in Ukraine fully meets domestic demand and has reserves for export. It is substantiated that the recognition and provision of competitive advantages in the international and domestic markets can be achieved only by those enterprises that implement international standards of product quality and safety, constantly upgrade technological equipment, introduce new technologies and have highly qualified personnel, create their own feed and raw materials processing.

1. Introduction

The problem of quality of agricultural products, finding ways to improve it, analysis of threats arising in the food chain "from the field to the table" in the process of growing and processing of agricultural raw materials, ensuring compliance with national legislation on European quality and safety standards is extremely acute and relevant current stage of development of the agricultural sector of Ukraine and the world. It is especially important in addressing food security and competitiveness of domestic products in domestic and global markets from the standpoint of stimulating the production of high quality products in the context of globalization and environmental problems [1].

It is necessary to constantly monitor the improvement of its quality, which is the key to the successful operation of enterprises to conquer international markets and ensure the appropriate competitiveness of food products in domestic markets. Improving product quality is one of the most important areas of intensive development of the country's economy, a source of economic growth, efficiency of social production. In a market economy, the problem of quality is the most important factor in improving living standards, economic, social and environmental security [2].
The problems of production of safe and high-quality food products have become especially acute and relevant at the current stage of development of the domestic economy. This is due to Ukraine’s desire to integrate with the European Union. One of the important prerequisites is the harmonization of the domestic regulatory framework on food safety and quality with European and world standards and its active implementation in food processing. At the same time, the current technical and technological base of food industry enterprises is a rather complex conglomerate of production facilities of various food specializations, which combines quite diverse opportunities for food production: from food products that meet modern European standards to food products, which are often do not meet the regulations of domestic technical conditions. The set of these and other problems that accompany the production and economic activities of domestic enterprises, is of great interest in the diverse processes of formation of the final results of management [3].

Literature review. The problem of ensuring the quality of agricultural products is reflected in the works of many leading scientists, who consider it the main factor in the stable development of production and exports.

Epidemiological studies around the world, among different populations with different food preferences and eating habits, provide reliable information on the relationship between the consumption of poultry meat in a balanced diet and human health. Consumption of poultry as part of the diet is associated with a reduced risk of developing overweight and obesity, cardiovascular disease and type 2 diabetes. The relevance and usefulness of poultry meat for humans has also been recognized by the Food and Agriculture Organization of the United Nations (FAO), which believes that this widely available and relatively inexpensive food is particularly useful in developing countries. This is where it can help fill the deficiency of essential nutrients. In addition, the consumption of poultry meat also contributes to the overall quality of the diet in certain age groups and conditions [4].

Food security in South Asia and Africa have been studied by Smith L.C. and Wiesman D. They noted that poultry, including chicken, is currently one of the best sources of animal protein for the low-income population because it is available, low in fat, and limited by religious taboos [5].

Problematic issues of poultry farming and prospects for its development in the South Pacific region have been the subject of research by Diarra S. [6].

In their research, Tikhanovska V.M. and Stavska Yu. V. revealed the essence and current state of the theory and practice of product quality management of poultry enterprises and substantiated the economic efficiency of the product quality management system [7].

It is well known that feeding and production management have a particular impact on the quality of poultry meat. Due to changing consumer requirements and the latest technologies, some aspects have become more interesting. The use of poultry meat in functional foods improves the nutritional value for human consumption. However, it should be borne in mind that enriching poultry meat with valuable nutrients can raise safety concerns due to self-oxidation and deterioration of meat quality. In addition, the management of poultry meat production still requires some improvement to reduce stressful situations for poultry and thus improve the consumer quality of meat [8].

Practical aspects of the formation of the quality of raw meat and the requirements of the processing industry were the subject of research by Lysytsyn A. [9]. The effect of sequential feeding on nitrogen excretion, productivity and meat quality of broiler chickens was determined by Sirri F. and Meluzz A. [10]. Hafez H.M. and Attia Y.A. studied challenges to the poultry industry in the conditions of COVID-19. Poultry immunity, health, and production are several factors that challenge the future growth of the poultry industry. Consumer confidence, product quality and safety, types of products, and the emergence and re-emergence of diseases will continue to be major challenges to the current situation and the strategic future of the industry [11].

It is safe to say that quality as a category is a national idea of all developed countries, so the topic of food safety and quality is extremely relevant [12]. This problem occupies a prominent place in the research and work of many scientists, but there are many unresolved issues of scientific and practical content that need further research and solution.
2. Materials and methods
The methodological and informational basis of the article are scientific publications of domestic and foreign scientists on theoretical aspects of "quality", poultry production, quality indicators, periodicals, data from official websites of poultry producers, data from the State Statistics Service of Ukraine.
The following methods were used in the research process: abstract-logical – to formulate conclusions; monographic – when detailing the situation on the poultry market; comparative analysis – to compare indicators and identify trends in their change over time; statistical – when assessing the poultry market; tabular – for a visual representation of the results of the study.
The purpose of the article was to study the quality as the basis of the export potential of Ukrainian meat products and determine the conditions for its improvement.

3. Results and Discussion
According to the International Organization for Standardization (ISO), quality is a set of properties and characteristics of products that determine its ability to meet the needs of consumers. Product safety is defined as a condition in which there is no unacceptable risk and danger to human life and health when consumed both in terms of transient action (food poisoning and foodborne infections, etc.) and in terms of danger with long-term consequences (carcinogenic, mutagenic effects, etc.) under normal conditions of their use [13]. Quality – the degree to which the set of its own characteristics of the object satisfies the requirements [14].

In Ukraine, the Law of Ukraine “On Quality and Safety of Food and Food Raw Materials” applies, which regulates relations between executive authorities, producers, sellers (suppliers) and consumers of food and determines the legal procedure for ensuring the safety and quality of food produced in circulation, imported, exported [15]. According to this Law, the quality of a food product is the degree of perfection of the properties and characteristics of a food product that are able to satisfy the needs (requirements) and wishes of those who consume or use this food product [15].

Even the ancient Greek philosopher Aristotle tried to give a definition of quality, and, for example, Hegel's famous philosophical definition of quality reads: "Quality is, first of all, identical with being certainty, such that something ceases to be what it is when it loses its quality". The category of quality reflects an important aspect of the objective reality of the object – its certainty. At the same time, philosophers understood that quality is the basis for product improvement and, consequently, the development of material culture [16].

Product quality is often understood as a set of its properties, which determine the level of ability to meet certain needs of consumers in accordance with their purpose. Also, quality can be described as a set of characteristic forms, appearance and conditions of use, which must be endowed with goods in accordance with their purpose. The above elements define the requirements for product quality, which are specifically laid down at the design stage in the technical characteristics of the product, in the design documentation, in the technical conditions that provide for the quality of raw materials, size, etc. [17].

Poultry farming belongs to those branches of agriculture, the development of which allows to accelerate the improvement of the growing demand of the population for high-quality food products of animal origin. The industry supplies energy to the population, is very attractive for investment. Poultry has great potential to meet the needs of both domestic and foreign markets and further development. Poultry products are aimed at meeting the food needs of the population and food security of the state [18].

Meat is the main product of poultry meat production – turkeys, ducks, geese, meat and meat and egg breeds of chickens. However, it is most effective to grow hybrid young for meat, obtained by crossing specialized combined lines [19].
Poultry meat is all the tissues of the body (muscles, skin, bones, cartilage, tendons, nerves, blood vessels and blood) that humans use for food. A feature of poultry meat is considered to be the presence of two types of muscles that differ in color and quality. Chickens, turkeys, and guinea fowl have white meat – pectoral muscles, and geese and ducks have white and red fibers. White meat contains more
easily digestible whole proteins, and red meat contains incomplete ones. Thus, in the pectoral muscles of chickens 92% of complete protein, so this product is dietary [20]. Poultry is rich in potassium, calcium, sodium, phosphorus, iron and chlorine. Poultry meat contains vitamins A, E, PP, group B.

The basis for solving the problem of quality belongs to state standards. They take into account both biological and chemical properties of products, the level of agro-technical, organizational and technological conditions of production of raw materials in agriculture, as well as the capabilities of processing plants and compliance with the needs of the final consumer. With the change of these factors there are prerequisites for changing the requirements of the standards, which are the basis of prices. In this case, agricultural products, which are harvested and supplied for food consumption (fresh or processed), technical and feed purposes and for export, must meet current state standards (technical conditions). They are used for product certification, i.e. documentary confirmation of its compliance with quality requirements set by the standards [1].

In Ukraine from 28.05.2015 the National standard DSTU 3143: 2013 "Poultry meat. General technical conditions" [21]. According to which poultry meat, depending on the type of processing is produced in the form of carcasses and their parts (except guinea fowl and caesareans and chickens weighing less than 650 g): half carcasses, quarters front and back, sternum, legs, legs, thighs, fillets and wings. Depending on the temperature in the muscle, poultry meat is divided into chilled, chilled, frozen, frozen and deep-frozen. The temperature in the muscle thickness of the product must meet the approved values.

The amount of meat, its quality and nutritional value depend on the fattening of the poultry and the category of carcasses. Live poultry by fatness and live weight is divided into standard and non-standard.

Organizing the process of delivery and acceptance of poultry for slaughter, the requirements of the standard DSTU 3136: 2017 "Poultry for slaughter, Specifications", which came into force on January 1, 2019 [22]. This standard applies to live poultry and wild poultry (game) raised for meat production on hunting and other farms. It sets requirements for poultry intended for slaughter at meat processing plants, poultry slaughterhouses and poultry processing establishments for meat processing and meat production.

The poultry intended for slaughter is divided into young (chickens, broiler chickens, turkeys, ducklings, goslings, caesareans) and adults (chickens, turkeys, ducks, geese, guinea fowl).

The standard stipulates minimum requirements for pre-slaughter live weight and fattening of poultry. Thus, the live weight of one head of broiler chickens to be handed over should be at least 900 g, ducklings – 1400 g, goslings – 2300 g, turkeys – 2200 g, caesareans – 700 g [22]. Live weight of poultry to be slaughtered is determined by weighing on scales, and fatness – visually and by probing individual areas.

Poultry intended for slaughter must comply with the requirements of current veterinary legislation. It is mandatory to stop using antibiotics at least 20 days before the bird is slaughtered. During feeding with loose feed, gravel is excluded from the bird's diet 12 days before delivery for slaughter; if whole grain is used in poultry feeding, it should be excluded from the diet 7 days before slaughter. The bird is accepted for slaughter in the complete absence of fodder in the wild. For this purpose, pre-slaughter starvation of birds is carried out for 6-8 hours with free access to water. The bird to be slaughtered must be free of traumatic injuries.

The optimal distance for transporting poultry in cars is 50-100 km, and its stay in transport containers is 4-5 hours. With longer transportation of birds every 6 hours provide rest, food and water, otherwise there is a significant loss of live weight [22].

Poultry meat productivity is assessed not only by live weight and feed payment, but also by the quality of meat and its mineral composition. In the muscle tissue of broiler chickens there are many ions of potassium, sodium, calcium, phosphorus and iron, which gives it high nutritional value [20].

The main indicators of meat quality that are of some interest to the consumer are the color, taste, aroma, juiciness and tenderness of the meat. In modern conditions, the quality of meat is assessed
comprehensively – quality and safety. Only such a comprehensive assessment can guarantee the sanitary quality of the meat.

Many factors affect the quality of chicken meat, its taste and its chemical composition. The quality of poultry meat depends on the direction of productivity, the breed of poultry. Meat poultry differ from egg birds in high growth rates and higher live weight, good meat forms. Their meat is juicier and tastier. Thus, Kucheruk M.D., Zasekin D.A. and others distinguish hereditary factors (species, breed, line, cross); gender and age; proper sanitary and hygienic condition of poultry houses, equipment, inventory; zoohygienic parameters of the microclimate (ventilation, lighting, temperature and humidity, etc.), the use of preventive or curative drugs, etc. [23].

Growing modern poultry crosses can be successful only if the bird is provided with quality air, as well as certain parameters of temperature and humidity in the poultry house. Violations of the microclimate parameters lead to a deterioration in poultry farming, as well as a result to a lack of profit. As a result, even complete diets do not provide good results.

Dal Bosco A., Mugnai C., Mattioli S., Rosati A., Ruggeri S., Ranucci D. and Castellini C. cite organizational factors: the conformity of building materials, the location and construction of the poultry house; availability of walking areas, insolation and poultry exercise; efficiency of disinfection, deratization; quality and quantity of bedding; balanced diet, frequency of feeding and watering, feed quality [24].

Poultry meat management affects the quality of meat, mostly on such consumer properties as juiciness, tenderness, taste. It is well known that genotype strongly influences the quality of meat, especially texture [25].

Some researchers note that changes in meat quality properties depending on intensive (poultry farming indoors) and extensive (free range, biological system) production systems are mainly caused by differences in genetics, while the production environment (except temperature) is less important [26]. Feeding, keeping and care are the main environmental factors that, at a certain level, interacting with the genotype, determine the productive qualities of the poultry.

In the domestic meat market, poultry meat is the most competitive: in terms of production, both quantitatively and in the structure of production; for consumption per 1 person; export volumes and product prices. The assessment of market conditions indicates a high demand for poultry meat, both domestically and abroad. The rapid growth of production expansion contributed to the increase in the level of competitiveness. Thus, the number of poultry of all species in farms of all categories at the end of 2019 increased by 78.2 % compared to 2000 and amounted to 220.5 million heads. It should be noted that 58.0 % of all poultry were kept in agricultural enterprises. Slaughter yield of gutted carcasses of chickens, geese, ducks and turkeys is 57-60 %, and half-gutted – 77-80 %. Chickens are of the greatest economic importance. The share of meat production of broiler chickens is 70-80 % of the production of poultry meat. A characteristic feature of broiler meat is not only its dietary properties, but also high economic performance. High efficiency of broiler chickens is due primarily to the low conversion rate of feed.

Poultry production in 2019 increased 7.2 times compared to 2000 and amounted to 1381.4 thousand tons. Thus, the share of poultry meat in the structure of meat production of all types from 2000 to 2019 increased from 11.6 % to 55.4 % [27]. Ukraine currently has a network of poultry farms located in most regions of the country. The constant introduction of advanced technologies in the construction of industrial poultry farms, the use of modern approaches to poultry farming give positive results. As you know, the competitiveness of products is determined by two components – quality and price. The increase in production capacity in agricultural enterprises was primarily due to the price, as poultry meat is cheaper compared to other types of meat, as well as its quality, which is confirmed by its competitiveness in both domestic and foreign markets [18].

There is a clear trend of annual increase in poultry prices in Ukraine. Thus, the average price of poultry meat sold through all sales channels in 2019 was at the level of UAH 29,651.2 per ton, which is 2.6 % higher than in 2018. Prices for certain types of poultry and meat poultry flocks depend on demand for them, terms of sale and sales channels. The main factors influencing price fluctuations in
the domestic poultry market are the prices of other meats (pork, beef and veal), the reduction in the supply of beef and veal due to the reduction in the number of cattle and pigs due to higher feed prices and frequent outbreaks of African swine fever virus; prices for grain crops and compound feeds; increasing the cost of veterinary drugs and utilities, fuels and lubricants; raising the level of the minimum wage of citizens, the entry of domestic producers into international markets, and as a consequence, the alignment of prices in the domestic market to the level of European ones.

The high demand of the population speaks of the satisfaction of the quality of poultry meat in the domestic market. Ukrainians consume 26.0 kg of poultry meat per capita, which is 25% more than the rational consumption rate. However, the developed world consumes even more poultry meat. For example, in Israel this figure is at the level of 58.5 kg of poultry meat per person per year, the United States – 49.8, Malaysia – 46.7, Australia – 43.9, Brazil – 40.6 kg / year. Poultry consumption per capita will increase regardless of region or income level. It will grow even in developed countries, but surprisingly, the growth rate will be highest in developing countries. Poultry meat is expected to account for 44 % of all meat consumed in the world over the next decade [28]. The relationship between the level of consumption and the price of poultry meat is obvious, as 48.5% of the structure of meat consumed per person per year is this type of meat. Demand for poultry meat will remain stable because it is the cheapest among other types of meat.

Quality should become the most powerful weapon of Ukrainian chicken producers, as well as farmers of the European Union in the face of new commercial challenges. Given the high level of security of the food chain provided by law, the EU has a quality advantage in which farmers and producers have invested more globally. The most important issues in the EU concern food hygiene and safety, nutritional and nutritional value and social requirements. Consumers in many parts of the world need tasty, traditional and authentic food, as well as the application of high standards of poultry [7].

The poultry farming is the only segment of Ukrainian livestock that has access to EU markets. Also, these products are quite effectively exported to the markets of Asia and Africa. A characteristic trend in 2020 was the strengthening of the position of domestic poultry meat in foreign markets. In 2020, a record amount of poultry meat was exported – more than 430 thousand tons. In the terms of Covid-19, Ukrainian exporters were twice faced with bans on poultry supplies to the European Union and a number of other countries, so the potential for its sales in international markets, despite the record, was not fully exploited. Saudi Arabia has become the leader in the ranking of the largest importers of domestic poultry meat, replacing the Netherlands, which has topped the top 10 for three years since 2017. Saudi Arabia buys exclusively poultry meat from Ukraine, starting with only 28 tons in 2015 for 34,000 dollars USA. And already in 2020, the export of domestic poultry meat to this Middle Eastern country amounted to 83 thousand tons worth 136 million dollars USA. Saudi Arabia's share of poultry meat exports from Ukraine in 2020 increased to 20.9 % against 13.5 % in 2019.

In the structure of exports of meat of all kinds and food by-products, the share of poultry meat was 85.6 %. The share of exports was 30.2 % of the volume of poultry meat produced. It is worth noting that more than 85 % of poultry meat exports were provided by one producer – MHP.

A striking example of the introduction of international standards of product quality and safety and the implementation of export strategy is MHP. It is the largest producer and exporter of chicken in Ukraine. Agroholding owns and controls all stages of chicken production: from growing cereals and oilseeds, producing feed to hatching eggs and raising broiler livestock, processing, marketing, distribution and sale of poultry meat (including through partner branded outlets). Vertical integration reduces MHP's dependence on suppliers and raw material prices. In addition to cost-effectiveness, vertical integration allows MHP to implement a strict biosafety policy, control the quality of raw materials and final quality, as well as product safety to points of sale. To support sales, the company controls a distribution network consisting of 9 distribution centers in major cities of Ukraine and uses its own trucks to deliver its products, which reduces overall transportation costs and delivery time. In addition, MHP is a leading poultry producer in Europe with one of the strongest food brands in Ukraine (Nasha Ryaba) and in the Balkans (Perutnina Ptuj Group) [29].
The company intensively implements and maintains an integrated food quality and safety management system in accordance with the latest world standards. Most MHP food companies have been certified by the SGS International Certification Body for compliance with international product quality and safety management standards. International certification ensures the production of safe and quality products and promotes global marketing.

The products of the Vinnytsia Poultry Factory Branch of the Processing Complex are successfully sold in Ukraine and in the markets of more than 80 countries, including 36 European countries. Production is carried out under the brands: Nasha Ryaba, Qualiko, Ukrainian Chicken, Al Hassanat, Vinnytsia chickens, Sultanah and Assilah. The company's export brands are well known abroad. For example, Qualiko TM has become a symbol of quality and balanced nutrition in Eastern countries, and POLI sausages have become a favorite of families in 22 countries [29, 30].

It is worth emphasizing that the poultry market is developing dynamically. Domestic poultry production fully meets domestic demand and has reserves for export. For domestic meat producers it is important and necessary to constantly improve technologies for raising livestock and poultry, meat processing, implementation of international quality and safety standards, which is one of the main criteria for entering their products on international markets, especially in the Near and Far East.

4. Conclusions
The results of the study show that the problem of quality assurance of both agricultural products in general and poultry meat in particular is most relevant in both domestic and foreign markets. It covers all participants in the food chain "production-processing-sale-consumption". Product quality is the main factor in the stable development of production and ensures the export of domestic products. It is noted that the integration of Ukraine into the World Trade Organization and the expansion of the geography of exports of domestic products imply the importance and necessity of adapting domestic standards to international norms and rules, increasing the production of quality competitive products.

The poultry industry is one of the few livestock industries that is increasing production and developing rapidly. Poultry production fully meets domestic demand and has reserves for export. The share of poultry meat in the total structure of meat and food by-products exports is 85.6 %. Domestic poultry meat is the only type of meat that is licensed for export to the European Union. More than 80 countries from Asia, Africa and Europe are consumers of Ukrainian poultry meat.

MHP is the largest producer of poultry meat in Ukraine. In 2020, Agroholding provided more than 50 % of production and more than 85 % of poultry exports. It is established that the introduction of MHP integrated food quality and safety management system in accordance with the latest world standards and the use of business model of vertical integration has made it possible to avoid risks and ensure stability of production and sales through lower volatility of feed and energy prices compared to other enterprises, producers and achieve high business results in domestic and global markets.

In the course of the research, it is substantiated that the recognition and provision of competitive advantages in the international and domestic markets can be achieved only by those enterprises that implement international standards of product quality and safety, constantly modernize technological equipment, introduce new technologies and have highly qualified personnel, create their own feed and raw materials base and provide its processing.

References
[1] Shpychak O, Lupenko Yu, Bondar O, Kopytets N, Pedorchenko A, Pashko S and Danylko I 2020 Methodical provisions on the functioning of the system of economic levers to increase the consumer value of agricultural products and food (Kyiv: National Scientific Centre "Institute of Agrarian Economics") p 72
[2] Riabushkina A 2013 J. Efficient economy 7 URL: http://nbuv.gov.ua/UJRN/efek_2013_7_31
[3] Krysanov D, Udova L, Varchenko O 2013 Bulletin of Sumy National Agrarian University 1 112-115
[4] Franca M, Giovanni C, Claudio C, Nicola F, Andrea G, Lucio L and Andrea P 2015 Food and Nutrition Research 59(1) DOI: https://doi.org/10.3402/fnr.v59.27606

[5] Smith L C and Wiesman D 2007 Is food security more severe in South Asia or sub-Saharan Africa? International Food Policy Research Institute Discussion Paper 712 p 52 URL: http://ageconsearch.umn.edu/bitstream/42401/2/ifpridp00712.pdf.

[6] Diarra S 2017 World's Poultry Science Journal 73 293-300

[7] Tsikhanovska V and Stavska Yu 2013 Management of product quality of poultry farms in the context of globalization Monograph (Vinnytsia : VNAU) p 220

[8] Grashorn M 2005 XVII the European Symposium on the Quality of Poultry Meat Doorwerth. The Netherlands 26 85-92

[9] Lysytsyn A 2016 Meat industry 9 6-9

[10] Sirri F and Meluzz A 2012 Poultry Science 91 316-321 https://doi.org/10.3382/ps.2011-01649

[11] Hafez H M. and Atiya Y A. 2020 Front. Vet. Sci. 7:516. doi: 10.3389/fvets.2020.00516

[12] Bubela T and Vorobets O 2010 Measuring equipment and metrology 71 139-144

[13] ISO&Food Quality and Safety from Farm to Fork URL : http:// www.iso.org/iso/ru/home

[14] ISO 9000 2015 Quality management systems Basic provisions and glossary of terms (Kiev DP "UkrNDNC") p 49

[15] Law of Ukraine “On Quality and Safety of Food Products and Food Raw Materials” 2005 2809-IV URL: https://zakon.rada.gov.ua/laws

[16] Bandysrka O 2013 Standardization, Certification, quality 1 54-60

[17] Gissin V 2000 Product quality management Phoenix p 256

[18] Kopytets N and Voloshyn V 2019 Ekonomika APK 11 42-49 DOI: https://doi.org/10.32317/2221-1055.201911042

[19] Peshuk L 2006 Meat business 7 60-63

[20] Birta G and Burhu Yu 2011 Meat commodity science Tutorial (Kyiv : Center for Educational Literature) p 164

[21] Poultry meat General technical conditions DSTU 3143 2013 (Kyiv : Ministry of Economic Development of Ukraine) p 28

[22] ISO 3136 2017 Poultry for slaughter Specifications. URL: https://www.twirpx.com/file/1935219

[23] Kucheruk M, Zasiekin D, Dymko R and Shcherbyna O 2017 J. Bioresources and nature management of Ukraine 9(5-6)

[24] Dal Bosco A, Mugnai C, Mattioli S, Rosati A, Ruggeri S, Ranucci D and Castellini C 2016 Poultry science 95(10) 2464-2471. https://doi.org/10.3382/ps/pev383

[25] Holcman A, Vadinjal R, Zlender B and Stibilj V 2003 Arch.Geflügelk 67 120-124

[26] Grashorn M and Clostermann G 2002 Arch.Geflügelk 66 173-181

[27] Lupenko Yu O, Kopytets N Hr and Voloshyn V M 2021 BIO Web Conf. 36 08006 DOI: https://doi.org/10.1051/bioconf/20213608006

[28] Kopytets N and Voloshyn V 2020 Ekonomika APK 6 59-68 DOI: https://doi.org/10.32317/2221-1055.202006059

[29] MHP URL : https://mhp.com.ua

[30] Kopytets N and Voloshyn V 2021 AIC Economics and Management 1 76-84 DOI: 10.33245/2310-9262-2021-162-1-76-84