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ASSESSMENT OF MEAT PRODUCTIVITY OF SHEEP AS A FUNDAMENTAL INDICATOR OF THE EFFICIENCY OF SHEEP FARMING INDUSTRY

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The article provides a comprehensive examination of the assessment of meat productivity in sheep as a key integral indicator of the efficiency of meat sheep farming. Modern approaches to the formation of meat productivity are highlighted, taking into account the complex interaction of genetic, technological, and environmental factors that determine the level of realization of the animals' biological potential. Particular emphasis is placed on the role of breeding strategies, selection programs, and adaptive traits in shaping stable productive performance under varying production conditions. The importance of a systemic approach to productivity management is substantiated, based on the alignment and optimization of feeding regimes, housing systems, and animal welfare conditions.

The influence of breed characteristics, rearing intensity, and fattening technologies on the development of live weight, growth rates, dressing percentage, and qualitative characteristics of meat products is analyzed in detail. Considerable attention is given to the impact of balanced nutrition, stress minimization, and proper management practices on improving carcass traits and meat quality parameters. Particular attention is also paid to the role of animal welfare as a crucial factor in the effective realization of genetic potential, ensuring physiological stability, and increasing the economic return of production.

The results of the study indicate that an integrated and scientifically grounded approach to assessing meat productivity enables a more accurate prediction of productive indicators, facilitates the optimization of technological processes, and contributes to the sustainable development and increased profitability of meat sheep farming under modern agricultural conditions. The findings may be useful for researchers, breeders, and practitioners involved in improving production efficiency.

Key words: sheep farming, meat productivity, dressing percentage, live weight, animal welfare.

Шейко В. А. Оцінка м'ясної продуктивності овець як базового показника ефективності галузі вівчарства

У статті здійснено комплексний аналіз оцінки м'ясної продуктивності овець як ключового інтегрального показника ефективності м'ясного вівчарства. Висвітлено сучасні підходи до формування м'ясної продуктивності з урахуванням складної взаємодії генетичних, технологічних і екологічних факторів, що визначають рівень реалізації біологічного потенціалу тварин. Особливу увагу приділено ролі селекційних стратегій, програм розведення та адаптивних ознак у формуванні стабільної продуктивності за різних умов виробництва. Обґрунтовано важливість системного підходу до управління продуктивністю, який базується на узгодженні та оптимізації режимів годівлі, систем утримання та показників добробуту тварин.

Детально проаналізовано вплив породних особливостей, інтенсивності вирощування та технологій відгодівлі на формування живої маси, темпів росту, забійного виходу та якісних характеристик м'ясної продукції. Значну увагу приділено впливу збалансованої годівлі, мінімізації стресових факторів і належних практик управління на покращення показників туші та якості м'яса. Особливо підкреслено роль добробуту тварин як



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важливого чинника ефективної реалізації генетичного потенціалу, забезпечення фізіологічної стабільності та підвищення економічної віддачі виробництва.

Результати дослідження свідчать, що інтегрований і науково обґрунтований підхід до оцінки м'ясної продуктивності дозволяє підвищити точність прогнозування продуктивних показників, оптимізувати технологічні процеси та сприяє сталому розвитку й зростанню рентабельності м'ясного вівчарства в сучасних умовах господарювання. Отримані результати можуть бути корисними для науковців, селекціонерів і практиків, які займаються підвищенням ефективності виробництва.

Ключові слова: вівчарство, м'ясна продуктивність, забійний вихід, жива маса, добробут тварин.

Introduction. Under current conditions of transformation in the agricultural sector, meat sheep farming is gaining strategic importance as a source of high-quality protein, a component of food security, and an effective means of utilizing natural feed resources. In many countries of the European Union and worldwide, there is a steady trend toward reorienting the industry from wool to meat production, driven by changes in consumer demand, economic feasibility, and the need to enhance the competitiveness of the agricultural sector.

At the same time, modern challenges—particularly climate change, pasture degradation, limited resources, and increasing environmental requirements—significantly complicate the functioning of the industry. Rising ambient temperatures, more frequent extreme weather events, and shifts in the structure of the feed base negatively affect the physiological condition of animals, their growth and development, leading to reduced meat productivity and economic efficiency.

In these conditions, the assessment of meat productivity in sheep becomes critically important as an integral indicator reflecting the efficiency of the “animal–environment–technology” system. Meat productivity comprises a set of interrelated characteristics, including live weight, average daily gain, feed efficiency, slaughter traits, and carcass composition. However, traditional approaches to its assessment, which are largely based on the isolated analysis of individual indicators, do not fully account for the multifactorial nature of productivity formation [1, 2, 3].

Within the framework of modern scientific concepts, particularly “One Health” and climate-smart livestock production, meat productivity is considered not only as an economic indicator but also as a measure of the interaction between animal health, housing conditions, and environmental impact. This necessitates taking into account animal welfare indicators, including physiological status, behavioral responses, stress levels, and access to resources.

Despite a considerable body of research, the issue of a comprehensive assessment of meat productivity in sheep under contemporary challenges remains insufficiently explored. In particular, further study is needed on the integration of traditional zootechnical indicators with animal welfare metrics and digital data, which opens new opportunities for optimizing production processes [4, 5, 6].

Thus, the need to develop scientifically grounded approaches to the comprehensive assessment of meat productivity in sheep determines the relevance and practical significance of this study.

Analysis of Recent Research and Publications. The assessment of meat productivity in sheep is one of the key areas of modern research in animal science, as it determines the efficiency of meat sheep farming and its competitiveness. The scientific literature has developed a comprehensive approach to studying this issue, which involves the analysis of genetic, technological, physiological, and environmental factors [7, 8].

It has been established that meat productivity in sheep has a polygenic nature and largely depends on hereditary factors. Studies show that traits such as live weight, average daily gain, and carcass weight are characterized by moderate to high heritability, which creates broad opportunities for genetic improvement of breeds [8]. Under modern conditions, the use of genomic technologies and artificial intelligence methods for productivity prediction is of particular importance. In particular, the works of Hamadani A. demonstrate the effectiveness of machine learning algorithms for assessing the genetic value of animals [9].

Alongside genetic factors, feeding conditions and management technologies have a significant influence on the formation of meat productivity. A comparative analysis of pasture-based and intensive production systems reveals a trade-off between quantitative and qualitative product characteristics: intensive systems provide higher average daily gains, while pasture systems contribute to improved nutritional value of meat [10].

The formation of meat productivity is the result of complex physiological and biochemical processes associated with muscle growth, fat deposition, and skeletal development [11]. Hormonal mechanisms, as well as environmental factors, play an important role in regulating these processes. In particular, it has been proven that heat stress negatively affects feed intake, metabolism, and growth rates, leading to reduced productivity [12].

In modern scientific approaches, particular importance is given to considering animal welfare as a crucial factor of productivity. It has been demonstrated that poor housing conditions, elevated stress levels, and diseases negatively affect growth rates, feed efficiency, and product quality [13].

A separate area of research focuses on assessing the impact of climatic factors on sheep productivity. It has been established that climate change, particularly rising ambient temperatures, leads to reduced feed intake, metabolic disturbances, and decreased average daily gains [12]. The studies by Moumen A. demonstrate that improving production efficiency can contribute to reducing the environmental impact of the industry, particularly greenhouse gas emissions [14].

The current stage of scientific development is characterized by the active implementation of precision livestock farming technologies. The use of sensor systems, automated data collection, and artificial intelligence algorithms enables continuous monitoring of animal conditions and more accurate assessment of their productivity [15]. Such approaches open up new opportunities for growth prediction, feeding optimization, and improved herd management efficiency.

Thus, the analysis of contemporary scientific research indicates that meat productivity in sheep is a complex multifactorial trait formed under the influence of genetic, technological, physiological, behavioral, and environmental factors. Despite the significant body of research, most studies focus on individual aspects of productivity, which limits the possibilities for a comprehensive assessment of industry efficiency. This necessitates the development of integrated approaches to evaluating meat productivity that take into account modern challenges and meet the requirements of sustainable livestock development.

The aim of the study is to provide a scientific justification and to develop a comprehensive system for assessing meat productivity in sheep based on the integration of selection-genetic, paratypic, physiological-biochemical indicators, and animal welfare criteria, in order to improve the accuracy of productivity evaluation, optimize the use of genetic potential, and ensure efficient and sustainable meat sheep farming.

Materials and methodology. The materials and methods used in this study were developed in accordance with modern scientific approaches to assessing meat productivity in sheep as a fundamental indicator of the efficiency of meat sheep farming. The object of the study is meat-type sheep, while the subject is the set of indicators characterizing the level of meat productivity and the factors influencing its formation. The informational basis of the study includes scientific works of domestic and foreign researchers, results of experimental studies published in specialized journals, monographs, and industry guidelines on meat sheep farming. The generalization was carried out taking into account current trends in the development of the sector, particularly increasing requirements for product quality, production efficiency, and ensuring an appropriate level of animal welfare.

The research methodology is based on the application of systemic and integrated approaches, which involve considering meat productivity as an integral trait formed under the influence of genetic, biological, technological, and environmental factors. In the course of the study, general scientific methods were used, including analysis and synthesis, comparative analysis, systematization and classification, as well as the generalization of scientific data and the interpretative method.

Results of Scientific Research. The research results are presented based on an in-depth comprehensive analysis and synthesis of recent scientific publications by leading European and Ukrainian scholars devoted to the formation of sheep meat productivity. The reviewed studies examine the influence of genetic selection and paratypical factors, as well as housing conditions and animal welfare indicators, on the expression of productive traits and the overall efficiency of production in modern meat sheep farming systems.

General Characteristics of Meat Productivity Formation. In the modern scientific paradigm, meat productivity in sheep is considered an integral, polygenic, and multifactorial trait, the formation of which results from a complex interaction between genotype and environment. Contemporary approaches in Animal Science within the EU and Ukrainian zootechnical science are increasingly moving away from a narrow interpretation of productivity solely as carcass weight, expanding it into a comprehensive system that includes growth intensity, feed conversion efficiency, slaughter characteristics, meat quality, and the level of animal welfare. This approach aligns with the “from farm to fork” concept, which dominates European research, where the final product is evaluated in terms of safety, quality, and ethical production standards.

Studies by Ukrainian researchers complement this approach by emphasizing the adaptive traits of animals, the influence of climatic conditions, and variability in the feed base. As a result, a combined model for productivity assessment is being formed, taking into account both biological and production-related factors.

Live Weight and Growth Intensity as Basic Indicators of Productivity. Live weight is a primary indicator reflecting the overall level of organism development and the efficiency of feed utilization. It directly affects slaughter performance and the economic value of the animal (tabl.1).

The data in Table 1 demonstrate a clear differentiation between meat and dual-purpose breeds. The difference in live weight (up to 7-10 kg) indicates a higher intensity of protein metabolism in meat breeds. Of particular importance is the increase in daily gains under intensive feeding, which confirms the high sensitivity of meat breeds to the level of energy and protein supply.

Table 1

Dynamics of Live Weight and Weight Gains in Sheep

Indicator	Meat breeds	Dual-purpose breeds	Analytical significance
Live weight at 4–6 months, kg	35–45	28–38	Reflects genetic growth potential
Average daily gain (standard feeding), g	180–250	150–210	Indicates efficiency of the basic diet
Average daily gain (intensive feeding), g	260–320	200–270	Reflects production intensification potential

Studies by European researchers show that the feed conversion ratio in Texel and Suffolk breeds is 12-20% better than in dual-purpose breeds, which directly correlates with the obtained results.

Slaughter traits as an indicator of production efficiency. Slaughter traits are key in determining the economic efficiency of meat sheep farming, as they reflect the actual yield of marketable production (Table 2).

Table 2

Slaughter Characteristics of Sheep

Indicator	Meat breeds	Dual-purpose breeds	Technological significance
Pre-slaughter weight, kg	40–50	32–42	Determines potential meat yield
Dressing percentage, %	48–55	42–48	Main economic indicator
Carcass weight, kg	18–25	14–19	Actual marketable output

The difference in dressing percentage (up to 10%) is technologically significant. It is explained by the higher proportion of muscle tissue and the lower relative share of bone mass in meat breeds. European studies confirm that intensive fattening systems can increase the dressing percentage to 55-58%, provided that optimal animal welfare conditions are ensured.

The morphological composition of the carcass as a quality criterion allows for the assessment of meat structure and its nutritional value (Table 3).

Table 3

Carcass Composition of Sheep (%)

Tissue	Meat breeds	Dual-purpose breeds	Biological significance
Muscle	55–62	48–55	Main nutritional component
Fat	18–25	20–28	Energy source and flavor component
Bone	16–20	18–22	Structural framework

A higher proportion of muscle tissue in meat breeds indicates a more efficient protein metabolism. An optimal fat level (18-25%) is important for the development of desirable sensory qualities of meat, whereas excessive fat deposition in dual-purpose breeds reduces economic efficiency.

Studies by Ukrainian scientists show that even minor changes in diet can alter the tissue ratio by 3–5%, which is significant in industrial production.

A comparative analysis of the genetic influence on sheep meat productivity is an important component of assessing the efficiency of different breeds and genotypes in meat sheep farming. For an objective representation of the differences between animal groups according to the main productive indicators, the summarized results are presented in Table 4. This makes it possible to clearly trace the patterns of live weight formation, growth intensity, and slaughter characteristics depending on the genetic background of the animals.

Table 4

Influence of Genetic Factors on Meat Productivity in Sheep

Breed	Average daily gain, g	Live weight at 6 months, kg	Dressing percentage, %	Meatiness assessment (conditional)
Meat breeds	220–280	38–45	50–55	High
Meat–wool breeds	180–230	32–38	46–50	Medium
Wool–meat breeds	150–190	28–34	44–48	Low–medium
Crossbred animals (F1)	240–300	40–48	52–57	High

The results demonstrate that the genetic factor is decisive in shaping meat productivity in sheep. The highest values of average daily gain, live weight, and dressing percentage are characteristic of meat breeds and F₁ crossbred animals, indicating the presence of heterosis. Meat–wool and wool–meat breeds show lower productivity, confirming the importance of selective breeding towards a meat-oriented type.

Animal welfare indicators are an important element in assessing meat productivity efficiency, as they directly affect physiological status, growth intensity, and the quality of final products. They allow for the evaluation of stress levels, housing comfort, and their impact on animal performance (Table 5).

Table 5

Influence of Welfare Conditions on Meat Productivity in Sheep

Welfare level	Thermal stress	Stress level (conditional score)	Average daily gain, g	Live weight at 6 months, kg	Meat quality
High	Absent / minimal	1–2	250–300	42–48	High
Medium	Periodic	3–4	200–250	36–42	Medium
Low	Constan	5–7	150–200	30–36	Low

Thus, an increase in the level of sheep welfare has a positive effect on growth intensity, live weight, and meat quality characteristics. As stress load decreases, feed utilization improves and the efficiency of realizing the animals' genetic potential increases.

To substantiate the modern concept of evaluating meat productivity in sheep, it is important to compare European and Ukrainian scientific approaches. European studies are primarily focused on standardizing productivity indicators, meat quality, feed conversion efficiency, and animal welfare levels. Ukrainian scientific works, in turn,

emphasize the adaptive traits of breeds, the influence of feed resources, and technological housing conditions on productivity formation.

Such a comparison makes it possible to identify both common patterns and differences in approaches to assessing meat productivity, as well as to form an integrated model that combines the advantages of both scientific schools (Table 6).

Table 6

Scientific Approaches to Productivity Assessment

Criterion	Europe	Ukraine	Generalized conclusion
Genetics	Texel, Suffolk, Charollais	Adapted local breeds	Genetics determines the baseline level
Feeding	Intensive / pasture systems	Balanced rations	Feeding shapes productivity
Meat quality	Fatty acid profile	Organoleptic indicators	Quality depends on technology
Welfare	Key factor	Microclimate and stress	Stress reduces productivity

Improving livestock production efficiency is one of the key objectives of modern agricultural production, as animal meat productivity directly affects food security and the economic stability of the sector. In this context, the development and implementation of integrated approaches to the formation of meat productivity, which take into account a combination of genetic, physiological, technological, and environmental factors, is of particular relevance. The integrated model of meat productivity formation is based on a comprehensive consideration of the interaction between genetic, physiological, feeding, and technological factors that determine the growth rate of animals and the quality of meat products obtained. It views productivity formation as a multicomponent system in which each element influences the final outcome and requires coordinated management to achieve maximum production efficiency.

The model includes three interrelated blocks that form a holistic system for managing meat productivity in animals.

The genetic block determines the hereditary potential of growth and development of animals, thus establishing the biological foundation of productivity. The genotype defines the possible level of growth intensity, feed conversion efficiency, and muscle tissue development, making this block the starting point of the entire model.

The technological block ensures the realization of genetic potential through feeding systems, housing conditions, and production process management. Its effectiveness determines the extent to which animals can fully express their natural potential under specific rearing technologies.

The welfare block reflects the level of physiological and ethological comfort of animals, which directly affects nutrient utilization efficiency and growth rate. A high level of welfare reduces stress, improves organism resilience, and promotes better productivity.

As a result of the interaction of these three blocks, key output indicators are formed: live weight, dressing percentage, meat quality, and overall economic efficiency of production.

The conducted analysis shows that sheep meat productivity is a multilevel system in which no single dominant factor can be isolated. Genetic potential determines the upper limit of productivity, while feeding and housing technology determine the degree of its realization.

The approaches of European and Ukrainian scientists are complementary: the former emphasize quality and efficiency, while the latter focus on adaptation and stability under variable conditions. Their integration forms a modern model of highly efficient meat sheep farming.

Conclusions. A generalization of the research results makes it possible to state that meat productivity in sheep is a key integral indicator of the efficiency of sheep farming, formed under the influence of genetic, feeding, and technological factors. It reflects not only the level of production output but also the efficiency of resource utilization, which directly affects the economic performance of the industry.

It has been established that the genetic characteristics of sheep determine their production potential, in particular their ability for intensive growth, dressing percentage, and carcass morphological structure. The highest performance is characteristic of specialized meat breeds, which ensure a greater yield of muscle tissue and better commercial quality of products.

It has been proven that the realization of genetic potential largely depends on adequate and balanced nutrition. Housing and management technologies also have a significant impact on meat productivity formation. Rational organization of production processes, proper housing conditions, and minimization of stress factors contribute to the stabilization of animals' physiological state and increase the efficiency of their rearing.

Ensuring an adequate level of animal welfare (optimal housing conditions, access to feed and water, and reduction of stress factors) is an essential component of modern production technologies, as it contributes to fuller realization of the genetic potential of sheep, stabilization of productivity, and improvement of meat quality characteristics.

Thus, improving the efficiency of meat sheep farming is possible under a comprehensive approach that includes the integration of breeding work, optimization of feeding, and improvement of housing technologies. This ensures a steady increase in sheep meat productivity and enhances the economic performance of the industry. Further work will be aimed at the formation of sheep meat productivity depending on selection and paratypical factors as well as animal welfare indicators, and at determining their influence on productive traits and the efficiency of meat sheep production.

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