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GLOBAL QUALITY OF POULTRY MEAT. PECULIARITIES OF POULTRY MEAT

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Abstract

The quality of poultry meat is largely determined by the evolution of production, breeding practices, and genetic management. Globally, the poultry meat industry has experienced remarkable expansion, continuously adapting to market requirements and sustainability standards. The genotype of the chickens plays an essential role in the quality of the meat, with the advanced selection of breeds aimed at improving the food efficiency and organoleptic qualities of the flesh. Breeding systems range from intensive to extensively organic, each of which has a direct impact on animal health and welfare, as well as on the quality of meat. Chicken feeding, adapted to the specific needs of each genotype, improves the nutritional profile of the meat, optimizing the content of essential fatty acids and micronutrients. Handling chickens, from transport to processing, is crucial for minimizing stress and preventing meat quality defects.

Key words*: meat quality, poultry meat, quality characteristics, rearing system.*

INTRODUCTION

Chicken is one of the most consumed sources of animal protein worldwide due to its affordable price, nutritional value, and versatility in preparation (Farrell, 2013).

However, the quality of chicken meat is influenced by many factors, such as genotype, breeding system, feeding, and handling of chickens, which can affect the technological and sensory characteristics of the final product. Poultry meat is the fastest-growing agricultural subsector, especially in developing countries. The global poultry sector is expected to continue to grow, as demand for meat and eggs is driven by population growth, rising incomes, and urbanization.

In this context, the poultry sector faces unprecedented challenges (Mottet & Tempio, 2017).

The production and consumption of poultry meat have increased rapidly worldwide and are expected to continue to increase due to its relatively low price compared to other types of meat, the absence of cultural or religious barriers, and its dietary and nutritional properties, as it has a lower level of fat, cholesterol and sodium content, and consumers a greater preference for white meat (Fletcher, 2002).

The US is considered the world's largest producer of poultry meat, it supplies approximately 17% of global poultry meat production, followed by Brazil and China.

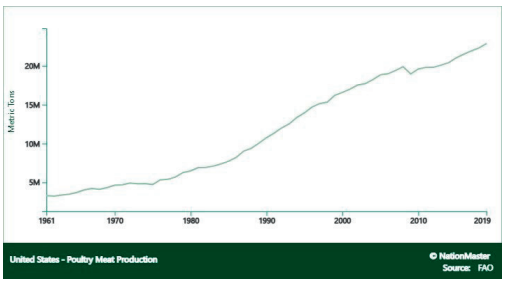

Figure 1. Evolution of poultry meat production internationally (FAO, 1961-2019)

Since 2014, poultry meat production in the United States has increased by 2.3% year-on-year. In 2019, the country was number 1 compared to other countries in poultry meat production at 22.857.595 metric tons. China, Brazil and Russia ranked second, third and fourth in this ranking, respectively. Tajikistan recorded the best average annual growth, with +61.1% per year, while Saint Kitts and Nevis recorded its worst performance at -100% per year.

In 2019, Romania ranked 38th among poultry meat producers in the European Union. Despite the current conditions, our country continues to be a major exporter of poultry meat, by 2020 exporting 42% of the production of fresh and refrigerated unskinned poultry meat.

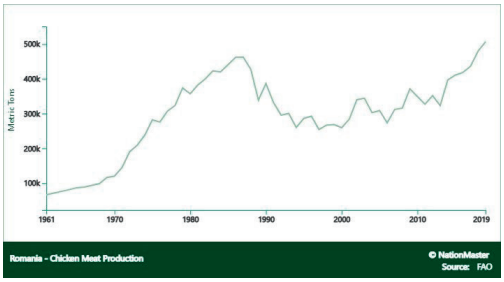

Figure 2. Evolution of chicken meat production in Romania (FAO, 1961-2019)

Since 2014 chicken meat production in Romania has increased by 5% yearly. With 507.106 metric tons in 2019, the country was ranked 38th among other countries in chicken meat production.

Romania is surpassed by Israel, which ranked 37th with 517.106 metric tons, and is followed by Bolivia with 491.098 metric tons. In 2021, around 132.3 million tons of poultry meat were consumed worldwide, making it the most consumed type of meat globally.

Pork was the second most consumed meat in the world, followed by beef and veal (Shahbandeh, 2023). Processed pork also had the highest contamination rates 50% higher than poultry and raw pork.

According to the study by Suler et al., factors contributing to *Salmonella* contamination in meat products included inadequate transport conditions, animal stress during slaughter, poor compliance with hygiene practices, and failures in processing and packaging stages. The predominant types of Salmonella varied with predilection in poultry organs (*S. enteritidis* and *S. enterica*) and raw/processed pork (*S. saintpaul, S. typhimurium, S. tennessee*) (Suler et al., 2019).

MATERIALS AND METHODS

The paper aims to analyze the global quality of poultry meat based on published scientific studies. Articles published in various scientific databases were used for documentation: Elsevier, MDPI, PubMed and Research Gate. This paper, wanted to demonstrate that poultry quality is significantly influenced by advances in production, breeding practices and genetic management.

RESULTS AND DISCUSSIONS

Genotype of chickens

The genotype of chickens is the result of genetic selection, aimed at increasing the productive and economic performance of meat chicks. Thus, hybrid breeds such as Ross 308 or Cobb 500 have been developed, which are characterized by rapid growth, good feed conversion, high body yield, and low-fat content (Hartcher et al., 2020).

However, genetic selection has also had negative effects on the quality of meat, such as reduced water retention, drop loss, and cooking, pale, soft, exudative (PSE) appearance or dark, firm, dry (DFD) (Duclos et al., 2007; Barbut, 2009).

These defects are caused by biochemical and histological changes in muscle tissue, which occur during post-mortem, under the influence of metabolic and oxidative stress to which rapidly growing chickens are subjected (Zhao et al., 2012).

It is therefore necessary to find a balance between productivity and quality, by using breeds adapted to growing conditions and by applying stress reduction measures to chickens (Berri et al., 2001; Bianchi et al., 2006).

A study by Tudorache et al. (2022) highlighted a significant effect of the genotype on growth performance, carcass features, and blood metabolites in slow-growing chickens.

Genotype significantly influences performance parameters such as body weight gain, feed intake, energy intake, feed conversion rate, energy conversion ratio, and production efficiency factor (Tudorache et al., 2022).

Another study by Fanatico et al. (2005) compared the quality of chicken meat from three different genotypes: a rapid commercial hybrid, a slow commercial hybrid, and an inherited breed (Barred Plymouth Rock).

The study found that the genotype had a significant effect on the pH, water retention, color, texture, and lipid content of chicken meat.

The commercial fast-hybrid chicken meat had the lowest pH, the highest cooking loss, the smallest cutting force, and the darkest color, while chicken from the inherited breed had the higher pH, least cooking losses, the largest cutting strength, and the lightest color. Chicken from the slow commercial hybrid had a higher lipid content than the other two genotypes (Fanatico et al., 2005).

Chicken breeding systems

Chicken breeding systems significantly influence the quality of poultry meat, with approaches ranging from intensive systems to extensively ecological ones, each with a direct impact on the final quality of meat. Studies show that non-intensive and organic systems tend to produce meat with superior chemical composition and improved organoleptic characteristics, such as better water retention and better texture, compared to intensive systems, which can promote rapid growth but can adversely affect the quality of meat, through problems such as pale, soft and exudative meat (PSE) and various muscle myopathies (Bošković et al., 2012; Baéza et al. 2021).

The breeding system refers to how chickens are raised and cared for, depending on the space, shelter, light, heat, ventilation, hygiene, and protection they benefit from. The breeding system can be intensive, semi-intensive, or extensive, depending on the degree of freedom and contact with the natural environment of the chickens (Berri et al., 2005).

The intensive system involves breeding chickens in closed, high-density spaces, artificial lighting, controlled temperature, mechanized feeding, and strict prophylaxis.

This system has the advantage of large and fast production, but the disadvantage of low-quality meat due to stress, lack of movement, and exposure to diseases and parasites (Gržinić et al., 2023).

A study conducted by Suler et al. (2021) highlighted species of Listeria that were isolated from various food samples, such as raw pork, raw beef, poultry and bird organs, and processed pork with different contamination rates.

The semi-intensive system involves breeding chickens in open spaces with medium density, natural lighting, variable temperature, mixed feeding, and moderate prophylaxis.

This system has the advantage of balanced production and better quality of meat, due to movement, food diversity, and adaptation to the natural environment (Aksoy et al., 2021).

The extensive system involves breeding chickens in large spaces with low density, natural lighting, variable temperature, natural feeding, and minimal prophylaxis.

This system has the advantage of a higher quality of meat, due to the freedom, food variety, and natural immunity, but the disadvantage of a small and slow production (Bosco et al, 2021).

A study by Castellini et al. (2022) investigated the effect of production technology on the quality of chicken meat.

They compared chicken meat from two different production systems: a conventional system based on intensive growing in narrow spaces and with a high level of stress, and an alternative system, based on extensive growing in open spaces with low levels of stress.

Meat quality parameters such as pH, water retention, color, texture, lipid content, fatty acid composition, and oxidative stress level of chicken were measured.

The results showed that chicken from the alternative system had a higher pH, greater water retention capacity, a lighter color, a softer texture, a lower lipid content, a higher ratio of unsaturated and saturated fatty acids, and a lower level of oxidative stress than chicken coming from the conventional system (Castellini et al., 2002).

Feeding of chickens

The feeding of chickens is an essential factor for their growth and development, but also for the quality of poultry meat (Kralik et al., 2018).

In feeding meat chickens, nutritional strategies aim to optimize their growth and health, taking into account their high requirements for proteins and amino acids. An essential component in the nutrition of chickens is protein, necessary for tissue growth and for the biological functions of the body. In addition, enzymes and hormones, which are essential for the physiology of any living organism, are largely protein compounds (Beski et al., 2015).

The feeding of chickens can be based on concentrated feed, green feed, or natural feed, depending on their source and composition (Alnahhas et al., 2016).

Concentrated feed is the most used in the intensive growing system, as it provides a high energy intake, protein, minerals, and vitamins, which favors rapid growth and meat yield (Bianchi et al., 2005).

Meat chicken feed is often enriched with specialized protein products, both animal and vegetable origin, to support rapid growth and improve growth performance. Also, feeds are formulated to minimize the concentration of anti-nutritional factors and to include immunologically active compounds, to promote the health of the gastrointestinal tract. This is crucial for the early development of the gut and digestive physiology of the chicks, thereby contributing to improving their growth performance and immunity (Beski et al., 2015).

However, concentrated feed can also contain undesirable substances, such as antibiotics, hormones, additives, or pesticides, which can affect the quality and safety of meat.

This paper examines the effect of additives in the feeding of chickens, such as egg yolk, as an alternative to antibiotics. The study indicates that natural additives can improve the quality of meat and reduce the use of drugs that can leave chemical residues (Hussein et al., 2020).

In conclusion, this study provides important data on the use of egg yolk as an additive in poultry feeding, to limit the usage of medicines and improve the quality of meat.

Another study by Khajali & Wideman highlighted that nutritional strategies need to be well balanced to avoid health problems such as pulmonary hypertension, especially at high altitudes where hypoxia can affect the performance of offspring. Low-protein diets are sometimes recommended to reduce oxygen intake and the risk of ascites, but should be managed carefully to avoid compromising the intake of essential amino acids such as arginine.

Another study by Gheorghe et al. (2022) highlighted the importance of dietary manipulation in improving the quality of meat by enriching the diets of animals with bioactive compounds such as PUFA, especially n-3 PUFA which have demonstrated health benefits in alleviating cardiovascular diseases, autoimmune diseases, and certain types of cancer.

Overall, the study recommended the use of ELP30 (a mixture of 30 percent flaxseeds and peas) in broiler diets to improve the nutritional value of meat for consumers, highlighting the positive impact of PUFA-enriched dietary mixtures and probiotics on broiler health and meat quality (Gheorghe et al., 2022).

Green feed is the most used in the semi-intensive breeding system, as it provides a moderate intake of energy, proteins, minerals, and vitamins, which favors balanced growth and meat quality. Green feed can be represented by grass, alfalfa, spinach, and salad which can be served fresh or dried.

Another green feed used in the feeding of meat chickens is represented by sorghum or sorghum-meat, which can be used as partial substitutes for corn and soy flour in the diets of broiler chicks without adversely affecting the chemical composition of the muscle tissue of the broiler or essential amino acids and the concentrations of aromatically related amino acid.

A study conducted by Gheorghe et al. (2021) found that total amino acids, essential amino acids, non-essential amino acids, and the ratio between essential and non-essential amino acids increased in the breast muscle compared to the thigh muscle, indicating differences in the amino-acid deposition between the two types of muscles.

Also, interactions between diets and muscle tissue for specific amino acids were observed, highlighting the influence of the diet on the amino acid composition of the broiler's muscular tissue (Gheorghe et al., 2021).

Natural feed is the most used in the extensive breeding system, as it provides varied energy, protein, minerals, and vitamin intake, which favors slow growth and superior quality of meat (Tufarelli et al., 2018).

Natural feed can be represented by seeds, fruits, vegetables, insects, worms, and slugs that can be found in the natural environment.

The study carried out by Custură et al. (2024) demonstrated that feeding the Barred Plymouth Rock chickens with a low-energy diet, with specific concentrations of nutrients, did not hurt body weight, weight gain, carcass characteristics, or the quality of proteins in the meat. The findings suggest that slow-growing genotypes, Barred Plymouth Rock, can maintain growth performance and meat quality traits even when fed with low-protein and low-energy diets in an organic system.

Another study by Zhang et al. (2010) evaluated the effect of a linoleic acid conjugate feeding treatment (CLA) on the quality of chicken meat. It was given chickens a supplement of CLA (0, 0.5, 1, or 2%) in their diet for 42 days and measured the quality parameters of the meat, such as pH, water retention, color, texture, lipid content, and fatty acid composition.

The results of the addition of CLA in chicken feeding significantly reduced the pH, cooking loss, cutting force, and intense yellow color of the chicken meat, but increased the water retention capacity, the redness index, and lipid content of chicken.

Also, CLA treatment changed the fatty acid composition of chicken meat, reducing the ratio of unsaturated and saturated fatty acids (Zhang et al., 2010).

Manipulation of chickens

Chicken handling refers to how chickens are treated and transported, throughout their breeding period up to the time before slaughter. The handling of chickens has a direct impact on the quality of the meat, as it can induce stress, injury, bleeding, or even death thereby altering the technological and sensory characteristics of the finished product (Delezie et al., 2007).

The handling of chickens should be as gentle, calm, and quick as possible, to minimize the negative effects on the quality of the meat. Catching chicks should be done manually, with hands, by grabbing the chest and wings, and avoiding shaking, throwing, or hitting them (Jones, 1992).

Chickens must be loaded in suitable cages or containers with sufficient space, adequate ventilation in summer, and a suitable temperature in winter. Chickens must be transported in adapted vehicles with suspension, air conditioning, and monitoring systems. The landing of chickens must be done with caution, avoiding falling, overturning, or hitting cages which usually lead to chicken injury (Nowak & Połtowicz, 2009).

Nishimura et al. analyzed the effect of pre-sacrifice transport and handling on the quality of chicken meat. The chickens were subjected to different transport conditions (duration, temperature, density) and handling conditions (catch method, waiting time, slaughter method), and the meat quality parameters such as pH, water retention, color, texture, lipid content, and stress level of the chicken meat. The results showed that the transportation and pre-sacrifice handling harmed the quality of chicken meat, causing a decrease in pH, an increase in cooking loss, a closure of color, a hardening of texture, a rise in lipid content, and an increased level of stress in the chickens.

Another study by Cockram et al. brought important conclusions about improving the well-being of meat chickens by modifying a mechanized discharge system. The study compared two versions of a swivel discharge system for poultry transport containers, using qualitative and quantitative techniques, including closed-circuit video recording.

The waiting and so-called fasting of the chickens must be done in shaded, cool, and airy spaces, without noise, light, or strong odors together with the withdrawal of food and water to reduce pollution of carcasses and to ensure healthy meat hygiene (Xue et al., 2021).

The sacrifice of the chickens must be done as quickly and humanly as possible, by electrical or mechanical insensitization, followed by neck cutting and the achievement of complete bleeding (Salwani et al., 2015).

Electric shooting in the water bath is still the most commonly used method for chickens regardless of the breeding system used, but controlled atmospheric shooting methods are becoming more and more common, especially at larger slaughterhouses (McNeal et al., 2003).

At the same time, it must be borne in mind that in all methods of astonishment to ensure a reliable and profound process quality the brain mechanisms associated with the induction and maintenance of unconsciousness are carried out appropriately, to avoid unnecessary suffering of the chicken (Berg & Raj, 2015).

CONCLUSIONS

The quality of chicken meat is determined by several factors, which can be controlled or modified by various interventions at the level of genotype, chicken feeding, production technology, transport, and pre-sacrifice handling. These interventions can have positive or negative effects on the sensory, nutritional, technological, and microbiological quality of

chicken meat which may also vary depending on the preferences and expectations of consumers. Therefore, it is important to know and monitor these factors, to ensure the optimal quality of chicken meat.

The study highlighted that the alternative extensive breeding system for chicken production resulted in higher meat quality compared to conventional intensive systems, with better pH levels, water retention, color, texture, and lipid content.

Growing conditions also have a significant impact on the quality of chicken meat. The intensive breeding system favors the rapid growth and yield of meat, but can adversely affect the organoleptic and physico-chemical quality of the meat. This is because chickens raised in the intensive system are subjected to metabolic and oxidative stress, which causes biochemical and histological changes in muscle tissue.

The semi-intensive and extensive breeding system favors the balanced growth and superior quality of chicken meat. This is because chickens raised in these systems have more room for movement, more diverse feeding, and better adaptation to the natural environment. The genotype also plays a significant role in determining growth performance, carcass characteristics, and blood metabolites in slow-growing chickens, highlighting the importance of selecting the right genotypes for desired meat quality results.

Using natural feed in extensive breeding systems can provide a wide range of nutrients, promoting slow growth and superior meat quality in poultry. This approach ensures that chickens maintain growth performance and meat quality even when fed with low-protein and low-energy diets in an organic system.

In conclusion, the research highlights the importance of balancing productivity and quality in poultry production by selecting suitable breeds, implementing stress reduction measures, and optimizing dietary strategies to improve meat quality and overall performance.

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