SUMMARY

Keywords: bird slaughter, cold conservation methods, poultry meat quality, nutritional value

Globally, the consumption of poultry meat continues to increase due to its accessibility to all categories of consumers and its nutritional and dietary properties. Moreover, in the last twenty years, semi-prepared or ready-to-use foods have experienced intensive development, meeting the direct demands of consumers and the rapid expansion of the fast-food industry.

Consumers are increasingly concerned about food safety, animal welfare, and environmental issues associated with food production and processing. The European Union places significant emphasis on developing the quality concept of poultry meat by implementing appropriate programs to ensure safe products for all consumer groups, regardless of age.

The concept of "quality" is complex, as defined by AFNOR (French Association for Standardization), which describes it as "the set of properties of a product (or service) that gives it the ability to satisfy direct or implicit needs." This general definition can be applied to meat products and extended in five directions: hygienic, psychosocial, nutritional, technological, and sensory aspects.

Poultry meat can be sold either as carcasses or portioned, and it can be presented in a thermal state, as refrigerated, or frozen. Regardless of presentation, the appearance of the carcass is crucial to consumers, and slaughterhouses assess relevant criteria to ensure payment to farmers. Generally, carcasses with visible defects upon macroscopic examination are declassified or permanently rejected. With the rise of portioned products in the market, the composition of the carcass and particularly the meat production are vital aspects that must be considered by the entire production system.

There are distinct differences between the environmental conditions required for refrigeration processes, whether primary or secondary, and for freezing processes consisting of heat removal/temperature reduction processes. Additionally, these conditions differ from those required for subsequent stages of the cold chain, such as cold storage, transportation, home storage, or retail sale, where the aim is to maintain a fixed temperature of the products.

The primary purpose of cooling poultry meat after slaughter is to lower its temperature and then maintain it at a lower temperature to ensure a high-quality product under optimal safe conditions. Achieving and maintaining the right temperatures can significantly impact product quality, highlighting the importance of maintaining an optimal temperature throughout the cold chain.

Poultry meat is primarily frozen in the form of eviscerated carcasses, but it can also be frozen in sliced portions (breast, thigh, wings, etc.). It can be frozen with or without prior cooling. For the freezing process to be completed, the meat must reach a temperature of -18°C at its thermal center. Freezing with cooled air is a popular freezing method, requiring a relative air humidity of 90-95% and a cold air speed of 4 m/s. This procedure does not appear to alter the taste or flavor of poultry meat. However, older birds that have been frozen tend to be less juicy compared to similarly aged birds that have not been frozen.

In addition, the chromatic parameters of the meat change, with brightness decreasing and color shifting to dark red as freezing temperature decreases and storage time extends. Cellular lysis occurs when the bird's muscles freeze, resulting in fluid loss from the product during thawing and collection through dripping. Rapid freezing is believed to cause fewer cellular disturbances compared to slower freezing, resulting in fewer exudations after thawing. The average freezing rate of muscles and the time-temperature integration of the freezing process can be linked to drop loss measurement.

The doctoral thesis **"Research on the influence of microclimate parameters on cut poultry meat"** was structured into two parts, comprising a total of seven chapters. These chapters integrate a study

of specialized literature related to the addressed problem, own research findings, conclusions, and consulted bibliographic references.

The first three chapters of the thesis include current data from literature and profile research, defining the initial part of the work. Chapter one presents data on global poultry meat consumption, including a historical perspective of the poultry industry and the evolution of poultry meat production. Chapter two describes the main peculiarities of bird slaughter technology, focusing on methods of cold conservation, cooling, freezing, and the main stages vulnerable to poultry carcass contamination. Chapter three focuses on poultry meat quality indicators, their influencing factors, and the relationship between meat quality and consumer perception.

The second part of the thesis comprises four chapters presenting the purpose and organization of the research, methodology for tracking slaughter flow and the variation factor studied (temperature at critical slaughter stages), and the methodology used to evaluate the physico-chemical, textural, technological, and nutritional quality of meat according to the slaughter flow. Chapter four discusses the purpose, objectives, motivation, and applicability of the research, briefly describing the research conduct and organization, with emphasis on the selected organizational framework, study material, and quality analysis methods.

The experimental factor of the research involved working temperature at control points including scalding, cooling, sorting/cutting/packing/deboning, intermediate storage, freezing, and final Storage. The temperature was maintained according to current slaughter technology in the control batch and modified point-by-point within two experimental batches as follows:

- Gradual increases of 2°C per batch at the Scalding Control Point.
- Gradual reduction of 2-3°C per batch at the Sorting / Cutting / Packing / Deboning Control Points.
- 1°C gradual reduction at refrigeration storage control points.
- 2°C gradual decrease at the freezing control point.
- 1-2°C at the Freezing Storage Control Point.

These temperature interventions in the technological stages resulted in the formation of the following experimental lots:

- refrigerated carcass: control – LC-CR; L1E-CR; L2E-CR;
- frozen carcass: control – LC-CC; L1E-CC; L2E-CC;
- chilled bone-in cuts: control – LC-TR; L1E-TR; L2E-TR;
- frozen bone-in cuts: control – LC-TC; L1E-TC; L2E-TC;
- chilled boneless cuts: control – LC-TDR; L1E-TDR; L2E-TDR;
- frozen boneless cuts: control – LC-TDC; L1E-TDC; L2E-TDC.

The results of the research, integrated in the last three chapters, present in an objective way the most relevant aspects identified following the monitoring of the microclimate in the slaughter stream, the obtaining of carcasses, the meat cuts with bone and the deboned cut pieces, both refrigerated and frozen, as well as their characterization from the point of view of the physical-chemical, textural, technological and nutritional quality. Finally, on the basis of the results, a statistical interpretation was made correlating the data on the chemical composition, energy value and the peculiarities of the textural profile according to the method of conservation used.

The study revealed significant statistical differences ($P<0.001$) between frozen and refrigerated meat samples, indicating that freezing as a preservation method may adversely affect the proportion of nutrients (proteins and nitrogen-free extractors) in meat. However, for chicken wings, the differences between the two methods were only significant at a probability level of 0.05, suggesting statistically significant differences in the chemical composition of meat samples. The results suggest that freezing may result in a reduction, in 95% of cases, of protein and nitrogen-free extract content in meat compared to chilled meat.

The study suggests greater freezing stability of anatomical regions such as wings, possibly due to the close relationship between muscle tissue and the anatomical base. Additionally, the hydration capacity of these portions may be reduced because the sensory quality of frozen and thawed tissues for consumption is lower than that of refrigerated ones. In the case of the upper thigh, distinctly significant differences ($P < 0.01$) were found for water and dry matter content (probability of change above 99.9% under freezing); insignificant differences were found for ash and total lipid content ($P > 0.05$).

For the lower thigh preserved either by refrigeration or freezing, statistically insignificant differences ($P>0.05$) were recorded for ash content and total lipid content; distinctly significant differences were observed for water and dry matter content ($P<0.01$), and significant differences ($P <0.05$) for total nitrogenous materials and very significant differences ($P<0.001$) for non-nitrogenous extractive substances. The reduced influence of freezing on tissue protein content could be explained by the complex structure of the connective-tendinous stroma.

The study reveals that the cooling method significantly impacts the caloric value of meat, with a 2.26% increase in caloric value favoring the chilled breast region and a 3% decrease in energy per 100 g of frozen breast compared to the same amount of sample preserved by cooling. However, for samples from the lower thigh levels, there is a difference of 2.76% between the caloric values of meat preserved by refrigeration and those preserved by freezing, suggesting that the cooling method can maintain a higher caloric level by approximately 2.7% compared to freezing.

Regarding the results on the textural profile, for samples taken from the breast cuts, the following situations were recorded:

- very significant differences ($p<0.001$) – indicating a 99.99% probability that meat firmness will be influenced by both preservation method (cooling vs. freezing) and the thawing method applied (cold water vs. hot water).
- distinctly significant differences ($p<0.01$) – indicating a 99% probability that meat firmness will be influenced by the thawing method applied (thawing in hot water vs. microwave thawing).
- significant differences ($p<0.05$) – indicating a 95% probability that meat firmness will be influenced by the thawing method applied (cold water thawing vs. microwave thawing).

The study also found significant differences in the resistance of pectoral muscle to degradation during freezing, attributable to a richer conjunctive stroma and more voluminous myocytes. The Warner-Bratzler instrument indicated significant differences in shear force, with a 95% probability of more intense frigidity when using parallel thawing in hot water and microwave.

The research observed dynamic changes in the qualitative parameters of poultry meat influenced by experimental factors such as temperature, cutting, deboning/packaging, and preservation methods. Higher temperatures at scalding points and lower temperatures at sorting, cutting, and storage points had a reducing effect on pH, possibly due to reduced sample contamination. The general trend across all experimental lots was a reduction in water content and the concentration of dry matter, especially organic matter, leading to better nutritional value and increased energy content. Textural properties, measured instrumentally with a texturometer using the shearing method, were also reduced, suggesting better texture and masticability. In particular, the use of freezing and thawing methods with cold or hot water or microwaves led to a decrease in nutrient content and pronounced freezing of the meat.