RESEARCH ON THE MATURATION OF MEAT FROM THE ILE-DE-FRANCE AND MERINOS DE PALAS BREEDS

Mihai Nelu BAŞTEA[1], Marius-Mihai CIOBANU[1], Cătălin-Mihai CIOBOTARU[1], Diana-Remina MANOLIU[1], Bianca-Georgiana ANCHIDIN[1], Ioana GUCIANU[1], Elena-Iuliana FLOCEA[1], Mugurel MUNTEANU[1], Paul-Corneliu BOIŞTEANU[1]

e-mail: bastea_mihai@yahoo.com

Abstract

This paper aims to conduct a comparative study on the wet aging process and evaluate its effects on the physical parameters of meat from Ile de France and Merinos de Palas sheep breeds. The study focused on two specific anatomical regions, the leg (*Musculus biceps femoris*), and the ribeye (*Musculus longissimus dorsi*), to identify differences and similarities in the evolution of meat quality based on breed and region. The research monitored pH fluctuations during the aging process for both breeds and evaluated their impact on meat quality. The study investigated the processes of oxidation and degradation of pigments and lipids in the meat, as well as methods for maintaining an appealing and stable color, which is essential for consumers' perception of meat freshness and quality. Comparing the physical parameters between the *Ile de France* and *Merinos de Palas* breeds allowed the identification of differences and similarities in the influence of wet aging on the leg and ribeye. The sheep meat industry can benefit from the implementation of an integrated system for monitoring and adjusting aging conditions, which should include pH parameters, sensory qualities, and color evolution. Educating consumers on how these factors affect meat quality, along with promoting sustainable production practices, can help increase appreciation and demand for high-quality sheep meat.

Keywords: sheep meat, Ile de France, Merinos de Palas

Sheep provide a diverse range of resources, including meat, milk, and wool, and have played a vital role in the global agricultural economy since the Neolithic era (Ceccobelli S. *et al*, 2023). The quality of sheep meat is influenced by various factors, including the animal's genotype, rearing, and feeding conditions, age at slaughter, and post-mortem processing methods such as aging (Hopkins D.L., Fogarty N.M., 1998; Safari E. *et al*, 2001). Genetic differences between breeds, such as *Ile de France* and *Merinos de Palas*, can significantly impact meat characteristics, including texture, flavor, and fat content (Young O.A. *et al*, 1997). Sheep meat is valued for its distinctive flavor, which can vary considerably depending on the animal's diet and breed (Priolo A. *et al*, 2001).

Additionally, sheep meat offers a rich nutritional profile, being an excellent source of iron, zinc, and B vitamins, which are essential for human health (Fisher A.V. *et al*, 2000). However, the fat content and fatty acid composition may influence consumers' perception of the meat's quality, affecting both its nutritional value and consumer preferences (Nute G.R. *et al,* 2007).

In addition to fatty acid composition, another important physicochemical characteristic of sheep meat is its myofibrillar and sarcoplasmic protein content, which is critical for meat texture. The enzymatic processes that occur during the aging of sheep meat can modify these proteins, thereby enhancing the tenderness and juiciness of the meat through the breakdown of protein structures and collagen (Hopkins D.L., Fogarty N.M., 1998).

Consumer preferences for sheep meat can vary significantly, influenced by cultural factors, sensory experiences, and awareness of health benefits. The demand for high-quality sheep meat is growing in many markets, as consumers become increasingly interested in food provenance, animal welfare, and sustainable production practices (Sanudo C. *et al*, 2000).

MATERIAL AND METHOD

The material used in the study consisted of loin and leg cuts from two sheep carcasses of the *Ile de France* and *Merinos de Palas* breeds, purchased from a breeders' association in the

[1] "Ion Ionescu de la Brad" University of Life Sciences, Iasi, Romania

Moldova region. The loin and leg cuts are considered premium anatomical sections, with specific guidelines for their anatomical delineation.

The *Ile de France* sheep carcass weighed 39 kg. From this, two unboned legs were obtained, weighing a total of 11.25 kg, which were divided into eight boneless leg cuts, weighing 2.436 kg in total. Additionally, an unboned loin section weighing 7.7 kg was processed, yielding two loin pieces totaling 0.828 kg. The *Merinos de Palas* sheep carcass weighed 22 kg, from which two unboned legs weighing 5.7 kg were extracted, resulting in six boneless leg cuts with a total weight of 1.134 kg. An unboned loin section weighing 4.1 kg produced two loin pieces totaling 0.650 kg.

For Wet-Aging, the cuts were vacuum-sealed in special packaging bags. The materials used in this study included: sheep loin, sheep leg cuts, vacuum packaging bags, a vacuum-sealing machine, storage trays, and a refrigeration unit with appropriate storage parameters. Special care was taken to ensure that all sample preparation steps were carried out in the shortest possible time to minimize exposure of the meat to ambient temperature after purchase. Packaging and refrigeration at 3/4°C were performed immediately after division and weighing.

The instrumental color characteristics of the product were measured using a Chroma Meter CR-410 colorimeter from Konica Minolta Inc., Japan, based on the CIELAB color space. These characteristics were reported as L*, a*, and b* values. The primary color parameters—L* (lightness), a* (red-green coordinate), and b* (yellow-blue coordinate)—were evaluated according to the CIELAB [CIE (Commission Internationale de l'Éclairage)] system. Measurements were taken across the sample area, with the final values representing the average of readings from five evenly distributed points on the sample. For section analysis, a Hunter Minolta CM-2600d colorimeter was used, with a 2° observation angle and an 8 mm measurement aperture, illuminating a 50 mm diameter surface, following the protocol outlined by Manoliu *et al* (2023).

The pH value was determined by calibrating the device using two buffer solutions (standard solutions) with known pH values: an acidic solution with a pH of 4.01 and a neutral solution with a pH of 7.01. After calibration, the pH meter probe was rinsed with distilled water, inserted into the meat, and the pH value was recorded once the device stabilized. After each reading, the pH meter probe was cleaned by immersion in distilled water, and any excess water was removed by wiping it with a paper towel. Generally, the normal pH of fresh sheep meat immediately after slaughter (initial pH) is around 6.5-7.0. After a 24-hour post-slaughter period, the pH decreases to approximately 5.5-5.8, due to the post-mortem glycolysis process that produces lactic acid.

RESULTS AND DISCUSSIONS

In *table 1*, according to the pH analysis, there are no significant differences between the Merinos de Palace and Ile de France species in terms of pH values monitored during Wet-Aging in the Musculus longissimus dorsi anatomic zone. Though a trend appears in terms of the impact of maturation days, the differences are not significant.

Table 1

pH analysis in the antomic zone *Musculus Longissimus Dorsi*: Means ± Standard Deviation for Palace Merinos and Ile de France during Wet-Aging

Day of Aging	MP_1	IF_2
0	5.50±0.007	5.65±0.092
3	5.93±0.213	5.78±0.014
6	5.61±0.403	5.84±0.091
9	5.96±0.219	5.75±0.090
p-value		
Day of Aging	0.07	
Type of Species	0.94	

Values are given as means ± SE with five repeated determinations; MP_1 -*Merinos de Palas*; IF_2 -*Ile de France*

According to the results obtained from the pH analysis, presented in *table 1*, no significant differences were found between the two sheep breeds studied, *Merinos de Palace* and *Ile de France*, in terms of pH values recorded during the wet-aging process in the anatomical area *Musculus longissimus dorsi*. There is a general trend suggesting an influence of maturation duration on pH, this variation does not reach the threshold of statistical significance ($p > 0.05$). This finding suggests that the wet maturation process affects comparably the pH characteristics of muscle for both breeds, and the differences observed over time can be attributed to other factors but not to the sheep breed (Puie A. *et al,* 2018). Data in *table 2* shows that the day of maturation has a significant effect on pH values. This suggests that as maturation time progresses, the pH of the treated muscle undergoes significant changes. For example, for both breeds, pH increased from day 0 to day 9. This development is related to the natural processes that occur during meat maturation, such as protein breakdown and accumulation of metabolic products, which can alter the acid-base balance (Kim Y.H.B. *et al*, 2017).

The increase in pH during maturation is common in meat studies due to the release of compounds such as ammonia or other protein degradation products, which tend to alkalinize the environment (Bulgaru V. *et al*, 2022). Breed type has no significant effect on pH. In other words, regardless of whether the sheep belong to the

Merinos de Palace or *Ile de France* breed, there are no statistically relevant differences in mean pH values.

Table 2

pH analysis in the antomic area *Musculus biceps femoris*: Means ± Standard Deviation for Palace Merinos and Ile de France Merinos during Wet-Aging

Day of Aging	MP_1	IF_2
0	*5.41±0.135*	5.57±0.191
3	5.46±0.209	5.71±0.249
6	5.48±0.206	5.56±0.173
9	5.73±0.205	5.75±0.015
p-value		
Day of Aging	0.05 *	
Type of Species	0.80	

Values are given as means ± SE with five repeated determinations; MP_1 -*Merinos de Palas*; IF_2 -*Ile de France*.

Although small variations in pH between breeds are observable, they are not large enough to be considered significant. This may indicate that physiologically both breeds behave similarly in terms of changes in muscle pH during maturation. The fact that there is no major breed effect on pH may suggest that the biochemical processes influencing pH are similar in these two breeds (Murariu O.C. *et al*, 2023).

The results presented in *table 3* suggest that species type has a significant impact on color parameters evidenced by a p-value of 2.01738E-07, which indicates notable differences between the two types of species studied, *Ile de France* and *Merinos de Palas*. These differences are reflected in the means of the color parameters L*, a* and b*.

Table 3

Impact of Wet-Aging Time and Species on Color Parameters in *Musculus Longissimus Dorsi*

Type of Species	Aging time	L*	a*	b*
IF_2	0	38.71±0.799	21.27±0.402	6.85±0.486
IF_2	3	37.71±0.841	20.91±0.423	6.08±0.202
IF_2	6	39.41±1.777	20.19±1.208	6.45±0.690
IF_2	9	39.52±1.062	21.19±1.83	7.02±0.754
MP_1	0	41.00±0.867	19.92±0.935	7.73±0.754
MP_1	3	40.15±1.169	20.85±1.257	7.01±0.390
MP_1	6	40.91±0.83	20.235±0.589	7.66±0.451
MP_1	9	40.72±0.511	19.64±0.513	7±0.815
***p*-value**				
Day of Aging	0.483			
Type of Species	2.01738E-07			

Data are presented as means±standard deviation at a significance level of $p < 0.05$. MP_1 -*Merinos de Palas*; IF_2 -*Ile de France*.

The *p* value of 0.483 indicates that aging time does not have a significant influence on color parameters. This suggests that, during the observation period of 0, 3, 6 and 9 days, the changes in color characteristics are not sufficient to demonstrate a noticeable impact of aging. This finding may suggest a stability of coloration during this ripening period, which is a positive aspect as consumers may have consistent expectations regarding the visual appearance of the product. Color stability can contribute to consumer confidence in the product, as consistent color is often associated with quality. *Table 4* gives a look at the color characteristics (L*, a*, b*) of two species, *Ile de France* and *Merinos de Palas*, as a function of aging time 0, 3, 6 and 9 days. Values are presented as means ± standard deviation, with superscripts to indicate statistically significant differences.

Table 4

Impact of Wet-Aging Time and Species on Color Parameters in *Musculus Biceps femoris*

Type of Species	Aging time	L*	a*	b*
IF_2	0	40.13±1.469	22.18±0.537	7.21±1.089
IF_2	3	37.82±1.606	20.69±0.489	5.41±0.508
IF_2	6	41.02±1.808	19.98±1.196	7.07±1.954
IF_2	9	39.09±0.671	21.8±1.023	6.92±1.377
MP_1	0	39.22±2.647	16.34±0.311	6.05±0.576
MP_1	3	37.88±0.395	20.31±1.167	5.13±0.948
MP_1	6	39.21±0.734	20.28±0.901	6.22±1.421
MP_1	9	38.67±1.182	20.067±1.479	5.51±1.472
***p*-value**				
Day of Aging	0.066			
Type of Species	2.91E-18			

Data are presented as means±standard deviation at a significance level of $p < 0.05$. ; MP_1 -*Merinos de Palas*; IF_2 -*Ile de France*.

This value is greater than 0.05, which suggests that there is no significant influence of aging time on color parameters. This means that the color variations observed during aging are not sufficient to be considered statistically significant. The results suggest that species type has a significant

impact on color parameters, with significantly different values between *Ile de France* and *Merinos de Palas*. This could influence consumer preferences and overall perception of product quality. These findings may guide production and marketing decisions, indicating that attention should be focused on the choice of ingredients and processes that affect the species type to maximize the visual appeal of the final product.

CONCLUSIONS

The results of the pH analysis indicate that there are no significant differences between the *Merinos de Palas* and *Ile de France* breeds in the pH values recorded in Musculus longissimus dorsi and *Musculus biceps femori*s during wet maturation. Although a trend of pH variation with maturation duration is observed, it does not reach the threshold of statistical significance ($p > 0.05$), suggesting that both breeds show similar biochemical behavior during maturation. This stability in pH between the breeds studied suggests that any differences observed during maturation may be determined by external factors rather than by the breed of animal.

The study demonstrated that maturation time did not significantly influence meat color parameters during the observation period of 0, 3, 6 and 9 days. This suggests a stability of the color characteristics (L*, a*, b*) for both breeds studied, *Ile de France* and *Merinos de Palas*, during the maturation process. This stability is a positive aspect as consistent color is perceived by consumers as an indicator of quality. Consequently, the product can maintain a consistent visual appearance, which can contribute to consumer confidence and satisfaction.

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