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INFLUENCE OF REFRIGERATED STORAGE TEMPERATURE ON THE SHELF LIFE OF LARGE PIECES OF PORK FRESH MEAT CUTS *(Longissimus dorsi)*

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I. INTRODUCTION

The study of storage temperature is a key factor in guaranteeing good microbial quality of fresh meat. Fresh meat is a highly perishable product due to its composition and high water content [1]. There are three main mechanisms that cause meat spoilage after dressing, processing and storage: spoilage due to microbial contamination, protein oxidation and enzymatic spoilage [2]. Several studies have shown that pork fresh meat shelf life can be significantly improved by optimizing the control of the altering and pathogenic microbiology by reducing the cooling time and using the adequate temperature during processing and storage [3,4]. Colour is a very important quality parameter of pork fresh meat. It is one of the most important concerns due to the fact that it is the first thing that consumers will judge at a sensory level. Temperature and pH of the muscle will be key points in determining the final colour of fresh meat [5].

The main objective of the study is to evaluate the influence of refrigerated storage temperature (-1, 0, and 2 °C) on the shelf life of fresh pork loin (Longissimus dorsi), through the analysis of microbiological quality and colour during the storage period.

II. MATERIALS AND METHODS

The study was carried out by preserving the samples under refrigeration at three temperatures: -1, 0 and 2 ± 0.5 ºC in three identical refrigerators. The study was performed in triplicate for each storage temperature. The analyses performed during preservation were: microbial quality and colour. A microbiological study was carried out during shelf life by analyzing total mesophilic aerobes and enterobacteria. The results were expressed in logarithms of colony forming units per g of fresh meat sample (log CFU/g). Colour was measured using a colourimeter (model CR-400), on pieces between 2 and 2.5 cm thick from a standardized area of muscle cut perpendicular to the fiber orientation. The values of L* (lightness), a* and b* (chromatic coordinates) were collected and the total colour difference (ΔE*Lab), which is defined as the sum of the modular differences of L*, a* and b* between two samples, was determined [6]. The experimental data were analyzed using the Statgraphics program (version 5.1 Plus, Statgraphics Technologies; Virginia, United States). The mean values were subjected to the Least Significant Difference (LSD) test with $p<0.05$. The data represented in the graphs and figures are expressed as the mean ± standard deviation (SD).

III. RESULTS AND DISCUSSION

Table 1 shows the results of total mesophilic aerobes and enterobacteria (log CFU/g) during the preservation study at 2, 0 and -1 ºC. The microbiological limits are found to be 5.7 log CFU/g for total mesophilic aerobes and 3.48 log CFU/g for enterobacteriaceae according to ISO 17604:2015. It can be observed that the lower the storage temperature, the longer the shelf life in terms of total mesophilic aerobic microorganisms. Tenderloin preserved at 2 ºC is considered to fall within the quality parameters up to 10 days, at 0 ºC it has a shelf life of up to 15 days and at -1 ºC it is preserved up to 18 days. From day 10 onwards, significant differences start to be found between 2, 0 and -1 ºC of storage temperature within the same day of analysis. It can be observed that loins preserved at low temperatures have shown better results in terms of enterobacterial counts. For 0 and -1 ºC very low counts have been maintained up to day 13 of storage. However, for loins preserved at 2 ºC from day 7 onwards a significant increase begins to occur.

One of the parameters that best reflects the colour is the colour difference (ΔE^*_{Lab}) of the fresh meat during storage. It is considered that the higher the ΔE^*_{Lab}, the greater the difference between the colour of two meat samples [6]. The changes in meat colour during the storage at different temperatures can be seen in Table 2. During storage this value has been increasing for each temperature, being 0 ºC the temperature that produced the most colour changes.

From day 7 onwards significant differences are observed for the colour of fresh meat samples from each temperature.

Table 1. Total mesophilic aerobes and enterobacteria (log CFU /g) along storage at 2 ºC, 0 ºC and -1 ºC (mean value (n=3) ± SD). Different lowercase and capital letters represent significant differences ($p<0.05$) between storage days and between different temperatures, respectively.

Microorganisms	Storage tempera-ture	Storage time (days)						
		0	3	10	13	15	18	21
Total mesophilic aerobes	2ºC	$3,76±0,30^{Ad}$	$3,13±0,00^{Ae}$	$5,40±0,48^{Ac}$	$6,08±0,15^{Ab}$	$8,46 ± 0,02^{Aa}$	-	-
	0ºC	$3,53±0,15^{ABe}$	$3,04±0,55^{Ae}$	$4,57±0,79^{Bd}$	$5,19±0,75^{Bcd}$	$5,29 ± 0,91^{Bc}$	$6,81 ±0,35^{Ab}$	$8,47 ± 0,03^{Aa}$
	-1ºC	$3,41±0,19^{Bd}$	$2,86±0,67^{Ae}$	$3,51±0,00^{Cd}$	$2,82±0,69^{Ce}$	$4,12 ± 0,62^{Cc}$	$5,19 ± 0,74^{Bb}$	$6,83 ± 0,63^{Ba}$
Enterobacteria	2ºC	$1,95±0,79^{Ad}$	$0,95±0,00^{Ae}$	$3,62±0,48^{Ab}$	$3,43±1,34^{Abc}$	$5,56 ± 0,29^{Aa}$	-	-
	0ºC	$1,12±0,41^{Be}$	$1,45±0,55^{Ade}$	$1,90±0,79^{Bd}$	$2,08 ± 0,58^{Bd}$	$3,29 ± 0,15^{Bc}$	$4,72 ± 0,36^{Ab}$	$6,60 ± 0,16^{Aa}$
	-1ºC	$1,55±0,67^{ABcde}$	$1,55±0,67^{Acde}$	$0,95±0,00^{Ce}$	$0,95 ± 0,00^{Ce}$	$2,15 ± 0,64^{Cc}$	$3,48 ± 0,87^{Bb}$	$5,17 ± 0,26^{Ba}$

Table 2. Colour difference (ΔE) during storage (mean value (n=9) ± SD). Different lowercase and capital letters represent significant differences ($p<0.05$) between storage days and different temperatures, respectively.

Storage temperature	Storage time (days)						
	0	3	10	13	15	18	21
2ºC	-	$3,73 ± 0,75^{Ab}$	$4,52 ± 0,73^{Aab}$	$3,64 ± 1,10^{Bb}$	$5,26 ± 1,06^{Aa}$	-	-
0ºC	-	$4,22 ± 1,24^{Ad}$	$5,55 ± 0,91^{Ac}$	$6,38 ± 1,00^{Abc}$	$6,23 ± 0,58^{Abc}$	$6,95 ± 0,65^{Aab}$	$7,73 ± 1,52^{Aa}$
-1ºC	-	$2,47 ± 0,51^{Bde}$	$3,17 ± 1,00^{Bcde}$	$3,65 ± 0,76^{Bbc}$	$3,75 ± 1,06^{Bbc}$	$4,34 ± 0,69^{Bab}$	$4,58 ± 0,84^{Bab}$

IV. CONCLUSION

The results of the study confirmed that preserving meat at lower temperatures (-1 and 0 °C) significantly prolongs its shelf life by reducing microbial growth and minimizing the loss of sensory quality compared to 2 °C. In particular, the -1 °C temperature showed the greatest effectiveness in preserving colour, maintaining the characteristic reddish hue longer and delaying browning associated with spoilage. These results highlight the importance of precise temperature control as a key strategy to optimize the quality and safety of pork fresh meat during storage.

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