PHYSICAL AND SENSORY CHANGES OF FRESH PORK LOIN DURING AGEING

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ABSTRACT

Pork aging is a controlled process that involves enzymatic and biochemical changes of fresh pork meat over a specific period before consumption. During this aging period, the pork meat is stored under controlled conditions of temperature and humidity. This allows natural enzymes within the meat to break down connective tissue, tenderizing the meat and enhancing its flavour profile. This process leads to improvements in texture, tenderness, and overall eating experience, as collagen degradation mediated by proteolytic enzymes contributes to textural modification, enhancing tenderness and succulence. Furthermore, lipolytic and proteolytic activities contribute to flavour development, imparting a complex sensory profile to aged pork loin. Colour of meat is also affected because myoglobin, a key pigment in meat, undergoes controlled oxidation during aging, leading to the formation of oxymyoglobin and subsequent colour alteration.

Analysing the temporal progression of these transformations reveals dynamic shifts in pH, colour parameters, and weight loss across different aging durations. Within research, it was found that the pH of pork loin increased significantly during the first week of wet aging and remained stable during the second week. With shorter aging periods, a significant increase in the values of all colour indicators (L*, a*, and b* values) was observed compared to the initial values. Weight loss during aging was consistent regardless of the duration, but after thawing, the greatest weight loss was observed in the group with the longest aging period. Contrary to this, the group without aging had the highest weight loss during heat treatment, while the group with the longest aging period had the lowest. As found, heat treatment effects on weight loss underscore the impact of aging on meat structure and water-holding capacity.

By conducting a triangle test, statistically significant differences in sensory properties between groups with and without aging were established. It is worth noting that the change in texture during aging is the primary sensory manifestation. The change in flavour is another important manifestation, but its significance becomes equal to the change in aroma with longer aging durations. These results highlight the profound influence of aging on texture and flavour perception, with aged samples exhibiting superior tenderness and a richer flavour profile compared to fresh counterparts. By elucidating the intricate interplay between aging duration and biochemical processes, this research enhances our understanding of the factors shaping the quality attributes of aged pork loin. Such insights are invaluable for optimizing aging protocols in meat processing and catering to the preferences of discerning consumers.

Keywords: pork loin, pH, weight loss, colour, sensory analysis

INTRODUCTION

The aging of meat involves the breakdown of muscle protein structure predominantly under the influence of endogenous proteases. During this process, cytoskeletal proteins such as titin, nebulin, or desmin are mostly degraded, leading to the softening of the meat structure in post-rigor mortis processes (Devine, 2014; Nowak, 2009). This process leads to improvements in overall eating experience, as collagen degradation mediated by proteolytic enzymes contributes to textural modification, enhancing tenderness and succulence. Furthermore, lipolytic and proteolytic activities contribute to flavour development, imparting a complex sensory profile to aged pork loin. Colour of meat is also affected because myoglobin, a key pigment in meat, undergoes controlled oxidation during aging, leading to the formation of oxymyoglobin and subsequent colour alteration. Despite the known effects of meat aging on tenderness, the impact of pork aging on flavour through the creation of peptides and amino acids is often overlooked in the industry and meat processing (Lee et al., 2016; Ngapo et al., 2012). Supporting this are numerous studies showing that pork aged for 6 to 10 days has better sensory characteristics than meat aged for just one or two days (Channon et al., 2004; Juárez et al., 2011; Lee et al., 2016). Aging is widely applied in beef, while it is almost not conducted in pork and thus the aging process mainly occurs during the distribution of meat to the end consumer. On the other hand, there are increasing consumer complaints about the quality and taste of pork (Ngapo et al., 2012), which presents a challenge for the modern meat industry.

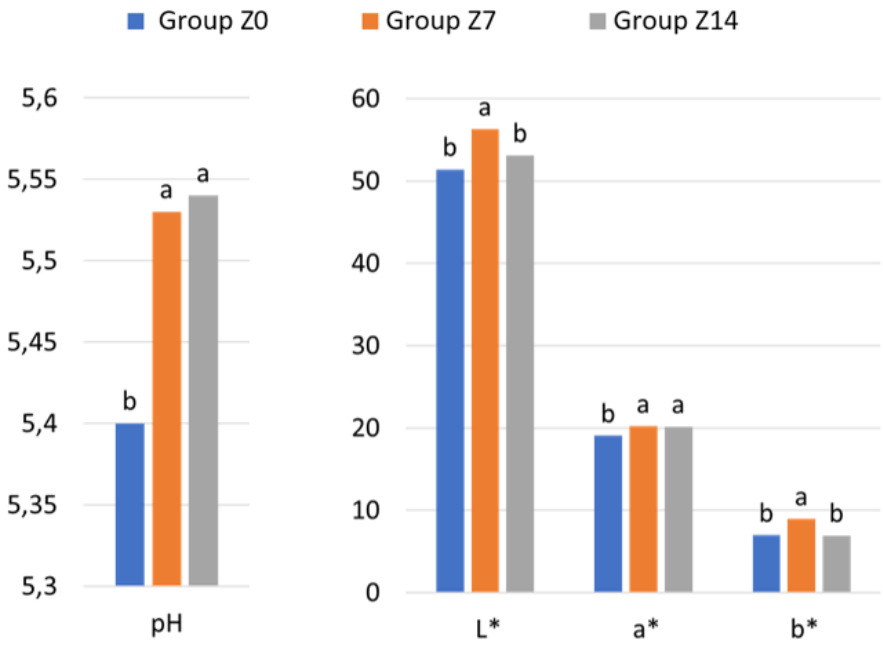
MATERIALS AND METHODS

In this study, pork from castrated male pigs of the German Landrace breed, approximately 12 months old and weighing about 200 kg, was used. Post-slaughter, hot carcass cutting was performed, and the loin (lat. musculus longissimus dorsi) was deboned and cooled to 4°C over 18 hours. Subsequently, loin samples weighing about 1 kg each were randomly divided into three groups: Z0 – control group without aging, Z7 – experimental group aged for 7 days, and Z14 – experimental group aged for 14 days. The samples were weighed on a digital scale (accuracy ± 1 g), pH values were measured using a portable pH meter IQ150 (Texas Instruments, USA) with a BlueLine 21 probe (Shott Instruments, Germany), and colour was assessed using a Chroma Meter CR 410 (Konica Minolta, Japan). After aging, Z0 samples were frozen at -20°C, while Z7 and Z14 samples were refrigerated at +3°C. Following the aging period, samples were reweighed to calculate weight loss, and pH and colour were remeasured. Z7 and Z14 samples were then vacuum-sealed and frozen at -20°C until sensory analysis.

Sensory analysis was conducted after 3 months of storage. Samples were thawed at 4°C for 24 hours, reweighed, and cooked in HDPE bags at 90°C until the centre reached 80°C. After cooling, they were cut into 1x1x1 cm cubes for tasting. A triangle test with 22 trained evaluators was conducted to identify differences in between experimental groups (Lawless and Heymann, 2010). Data were analysed using SAS Studio University Edition 3.71 (SAS Institute, 2018) with GLM procedures and Tukey-Kramer post-hoc tests to assess significant differences between groups ($P<0.05$).

RESULTS AND DISCUSSION

The study investigated pH levels and colour (L*, a*, b*) of pork loin samples before and after aging. Control group (Z0) had a pH of 5.40, increasing significantly to 5.53 and 5.54 after 7 and 14 days of aging respectively ($P<0.05$) as seen on Figure 1a. This pH rise aligns with Juárez et al. (2011) and Lee et al. (2016), who also reported statistically significant pH increases over similar aging periods. The increase in pH is thought to be due to higher amounts of basic amino acids released from protein degradation by meat's endogenous enzymes.



(a) (b)

Figure 1: pH (a) and color values (b) of loin samples of different ageing periods

Colour changes during aging were also statistically significant. Lightness (L*) increased notably in the Z7 group, while the increase in Z14 was less pronounced and not statistically significant. Redness (a*) increased significantly in both Z7 and Z14 groups. Yellowness (b*) was significantly increased in Z7 but it was decreased in Z14. These results suggest that a 7-day aging period affected all colour indicators compared to unaged samples. Over 14 days, only the redness parameter showed significant changes.

Regarding meat yield losses, shrinkage during aging (aging loss) was almost identical between Z7 and Z14 at about 6.5%. Thawing loss was significantly higher in Z14, showing double higher more mass loss compared to Z0. In terms of cooking loss, the highest was observed in Z0 (51.2%), significantly reduced in Z14 (26.63%), consistent with findings by Lee et al. (2016) that longer aging periods can significantly decrease cooking loss. It was established that overall loss was lower in aged groups, especially in Z14 group which was significantly different than control group.

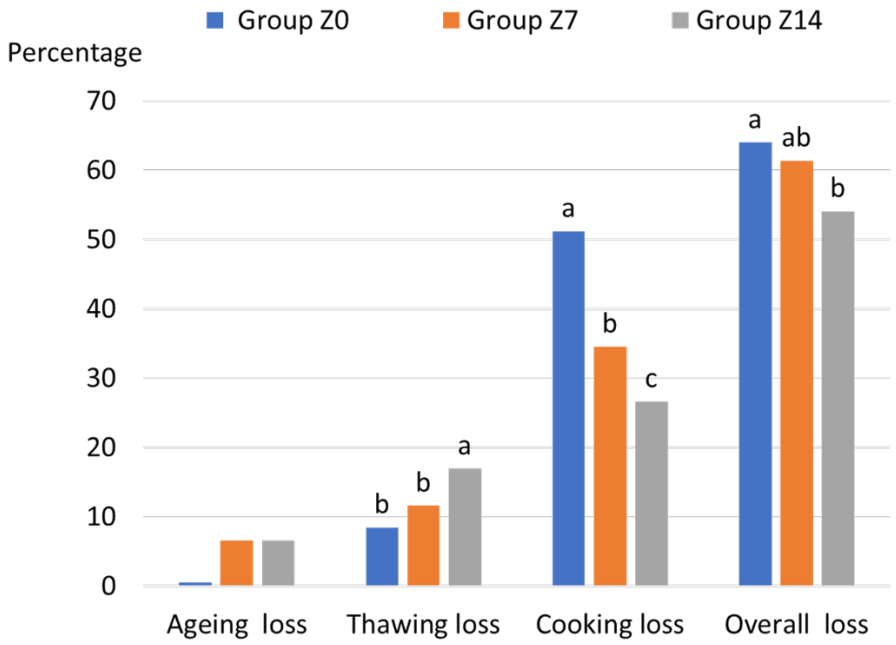


Figure 2: Weight losses of loin samples of different ageing periods

The study also includes a triangle test where evaluators identified significant sensory differences between Z0-Z7 and Z0-Z14 pairs, with higher discrimination for the latter. Over 70% of the perceived differences were in texture, especially between Z0-Z7. Taste was also noted as significantly different in these comparisons, but its prominence declined over longer aging times, becoming comparable to changes in aroma in the Z0-Z14 pair.

These results emphasize that aging affects meat quality significantly, enhancing tenderness and sensory attributes primarily through structural degradation of myofibrillar and cytoskeletal proteins. Longer aging periods not only help in reducing cooking loss but also in maintaining or improving sensory characteristics, especially in texture and aroma.

CONCLUSIONS

Based on the results obtained, it can be highlighted that the pH value of pork loin significantly increases in the first week of aging and remains stable in the second week without further significant increases. Although the aging weight loss was consistent, the highest thawing loss was observed in the group with an aging duration of 14 days, while it was minimal in the non-aged group. Conversely, the highest cooking loss was found in the non-aged group, and the least in the group with the longest aging duration. Sensory analysis revealed statistically significant differences between the groups without aging and those with aging. It is worth noting that the change in texture during aging is the main sensory manifestation. Flavour change is another important manifestation, but its significance tends to equalize with changes in aroma with longer aging durations. Considering the results obtained and the fact that pork meat usually goes through the ageing process during distribution, it is recommended to carry out the aging of pork loin for a minimum of 7 days after slaughter.

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