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Original Article

Comparative analysis of maturation processes in animal fat and dry in a cut of beef brisket

Análisis comparativo de procesos de maduración en grasa animal y seco en un corte de pecho de vacuno

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ABSTRACT

Beef aging is a process that involves the interaction of enzymes and chemical transformations that directly influence changes in flavor and texture, which in turn can determine the sensory experience for guests. The purpose of this study was to compare, in terms of texture, the aging of beef brisket cuts through two techniques: with animal fat coating and dry aging, over a period of 21 days, and to determine the acceptability of end consumers. The cuts were stored under controlled temperature and moisture conditions (2 °C and 60 % relative moisture, respectively), with continuous monitoring to ensure food safety. Finally, they were cut into 2 cm thick steaks, fried to medium doneness with salt, and sensorially evaluated by a panel of 27 individuals. The results revealed an acceptance rate of 74.1 % for the meat sample aged with animal fat, surpassing the dry-aged sample (22.3 %) and the control (non-aged sample). It was concluded that aging with animal fat was the most suitable, due to the achieved tenderness and flavor. This is attributed to the promotion of protease activity as the main agents in proteolysis and denaturation due to pH effects on myofibrillar proteins. Additionally, it was highlighted that aging is possible for this beef cut, which is not commonly used in such situations due to its low intramuscular fat content."

Keywords: Beef, aging, meat, protein, proteases

RESUMEN

La maduración de carne es un proceso que involucra la interacción de enzimas y transformaciones químicas que influyen directamente en los cambios de sabor y textura, lo que a su vez puede determinar la experiencia sensorial de los comensales. La finalidad de este estudio fue comparar en términos de textura la maduración de cortes de carne de pecho de vacuno a través de dos técnicas: con recubrimiento en grasa animal y en seco, durante un período de 21 días y determinar la aceptabilidad de consumidores finales. Los cortes fueron almacenados bajo condiciones controladas de temperatura y humedad (2 °C y 60 % de humedad relativa, respectivamente), con monitoreo permanente para

garantizar la seguridad alimentaria. Finalmente, se cortaron en filetes de 2 cm de espesor que fueron preparados en fritura a término medio con sal y se evaluaron sensorialmente con un panel de 27 personas. Los resultados revelaron una aceptación del 74,1 % para la muestra de carne madurada con grasa animal, superando a la muestra madurada en seco (22,3 %) y al blanco (muestra sin madurar). Se concluyó que la maduración con grasa animal fue la más adecuada, debido a la terneza y sabor conseguido. Esto debido al favorecimiento de la actividad de las proteasas como principales agentes en la proteólisis y desnaturalizaciones por pH ejercidas a las proteínas miofibrilares. Además de que, si es posible realizar maduración a este corte de res, que no suele utilizarse en estas situaciones por la baja cantidad de grasa intramuscular presente.
Palabras clave: Vacuno, maduración, carne, proteína, proteasas.

INTRODUCTION

Beef has been consumed around the world for thousands of years, and procedures related to its quality and maturation have become fundamental tools to achieve new flavor profiles and improvements in its sensory properties (Parra-Bracamonte *et al.*, 2020 and Santos *et al.*, 2021). Currently, dry maturation is used to produce cuts of the highest quality (Benech *et al.*, 2021). Unlike its beginnings, where it was used as the main method of preserving meat until 1960, at which time the industry experienced a revolution with wet aging, which became the current standard due to its effectiveness and usefulness for resale by reducing product loss (Álvarez, 2021). Although dry aging is perceived as something special and reserved for specific circumstances (Terjung *et al.*, 2021), this research seeks to carry out, analyze and compare two homemade methods of aging beef with the aim of improving flavor. and texture that fresh meat does not offer. The focus of this research is on the experience of the aging or maturation process of beef from the superficial pectoral muscle, also known as brisket, a low-fat cut with a high content of connective tissue (National Institute of Learning [INA], 2015) and which is not usually used for this type of process, since it corresponds to third category cuts and which are generally used in prolonged cooking. In addition, we seek to analyze how maturation processes affect the sensory characteristics of the muscle due to endogenous enzymatic processes and denaturation of the protein structure (Zhang *et al.*, 2021).

MATERIALS AND METHODS

In the comparative experiment on beef maturation, 1 kg samples of brisket tip (3.5 cm thick) were used, obtained from the Sales Center of the National Agrarian University of La Molina. Initially, dry maturation was carried out, in triplicate. A tray was prepared on which a 1 cm thick layer of granulated salt was placed. A rack was placed on the tray, which supported the meat, in such a way that it was not in direct contact with the salt (Fig. 1a). This setup promoted osmotic dehydration of the meat to concentrate the flavors without salting the cut. Subsequently, it was stored under refrigerated conditions (in a conventional refrigerator), at a temperature of 2 °C and a relative humidity between 60 and 70 %. Manual ventilation of the meat was carried out three times a day and it was

maintained in these conditions for 21 days. This procedure was adapted from that used by Zhang *et al.* (2021). The second cut was covered with animal fat. Three kilograms of beef fat were used, which was melted and cooled until obtaining a consistency semisolid, to later spread it on the meat. The rest of the procedure was exactly the same as that followed with dry ripening (also in triplicate) (Fig. 1b). The remaining samples were frozen in airtight bags (ziploc) to be used later as blank samples. After completing the 21 days, maturation was interrupted. The naturally formed outer layer of the cuts was discarded (Fig. 1c), and the matured meat was also stored in airtight bags that were frozen at -18 °C until cooking.

The beef cuts were thawed, only salt was added and they were prepared on a frying pan with vegetable oil, with a temperature in the center of the cut of 60 °C and for a time of 3 minutes on each side.

Immediately afterwards they were stored in an airtight container and transported to the site where the sensory test was carried out.

Finally, a sensory test was carried out on a sample of 27 people, who were gastronomy students, with knowledge of the subject having taken courses that involve the use of beef. A station was set up in which the meat samples were tasted, which were coded so that they would not be identified before being tested, and a glass of water was provided to the panel members to maintain the neutrality of flavors between sample and sample. Immediately afterwards, a sensory evaluation instrument (5-point hedonic scale) was applied to evaluate

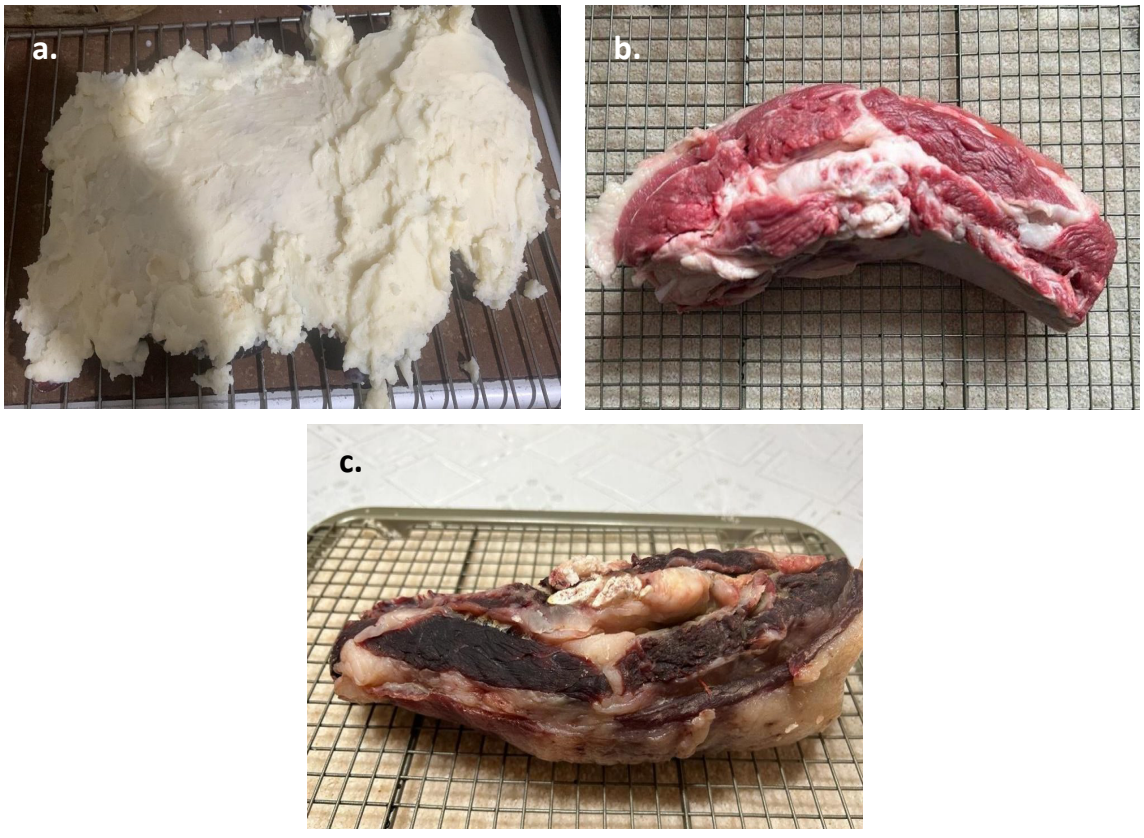

Figure 1. Dry maturation of beef (a) coated with animal fat (b) cut after maturation (c)

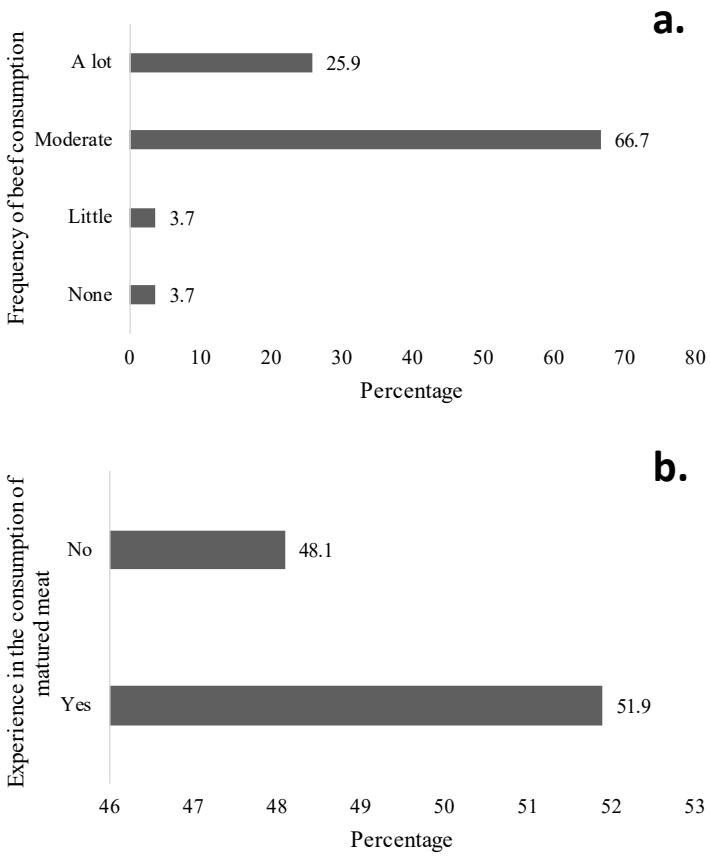

Figure 2. Results of general queries. Frequency of beef consumption (a) and experience in the consumption of matured meat (b)

the acceptability of the maturation of the meat cuts.

RESULTS AND DISCUSSION

In the sensory evaluation, general questions were asked, in order to know certain aspects that could affect the sensory evaluation of the meat.

We asked if the participants consumed beef regularly. It was found that 66.7 % of the participants consume it moderately, which allows us to infer that they are people who have a critical perspective and enjoy beef in their daily lives. Figure 2 shows the results obtained from the general queries.

In addition, it was asked if the respondents had ever tried aged meat, resulting in 51.9 % having done so and, therefore, they were able to offer informed and objective opinions about the qualities and flavors of this type of meat. The results are shown in Table 1. Additionally, there were 18.5 % who liked it moderately to very much. While 11.1 % disliked it moderately.

More varied results were obtained for dry-aged meat, with a trend of 29.6 % of participants liking it moderately and 22.2 % liking it extremely. This shows that, although the results were a little more divided, the trend leaned towards the taste of the participant, obtaining 51.8 % of those who liked it versus those who did not like it, which reached 26 %. The others remained in a position of indifference.

The sample matured in animal fat made more than half (51.9 %) choose that they liked it moderately. Furthermore, 22.2

% expressed both a greater preference and also a neutral attitude towards this type of meat, highlighting the diversity of tastes. It is notable to see that no participants expressed a strong dislike for fat-aged meat, suggesting a largely positive reception.

The results and feedback received in the sensory evaluation report a slightly higher acidity in the case of meat matured in fat. It possibly manifested itself as a result of the heating to which the fat used as a coating was subjected, which could have promoted greater lipid oxidation (Ribeiro *et al.*, 2021a). Although the fats were oxidized to some extent, this change was not reflected in the final product, which was found to be in perfect condition.

Regarding the sensory analysis, the results indicate a moderate preference on the part of the majority of participants towards meat matured in fat, suggesting that the organoleptic characteristics of this sample were appreciated. These findings support the effectiveness and acceptance of this homemade technique as an effective means of improving beef quality. This is initially linked to proteolysis, where enzymes break down collagen, improving the tenderness and softness of the meat.

Table 1.

Sensory evaluation results

Scale	Acceptability (%)		
	Blank	Dry maturation	Maturation in animal fat
I like it very much	7.4	22.2	22.2
I like it moderately	11.1	29.6	51.9
I neither like it nor dislike it	70.4	22.2	22.2
I dislike it moderately	11.1	22.2	3.7
I really dislike it	0	3.8	0
TOTAL	100	100	100

Furthermore, Maillard reactions, which generate aromatic and flavor compounds, played an essential role in the acceptance of this ripening method (Gálvez *et al.*, 2006). The loss of water and denaturation of proteins also resulted in a nicer, juicier texture.

Likewise, there was a greater presence of lactic acid bacteria in meat matured in fat. This is evidenced by the presence of syneresis, a milky liquid released by the bacteria *Lactobacillus curvatus*, which, despite being low, is indicative of the transformation of sugars into lactic acid. This observation is compared to studies on ripening in a permeable bag, which also revealed a greater presence of lactic acid bacteria (Berger *et al.*, 2018), causing additional denaturation due to the decrease in the pH of the sample (Ribeiro *et al.*, 2021b), which was reflected in greater perceived tenderness.

CONCLUSIONS

The maturation of leaner third-grade meat cuts was very positive with both methods, where a more pleasant texture was obtained, due to the softer textures and more intense flavors. The maturation process with animal fat was the one that had the greatest acceptance in the sensory evaluation.

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