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THE IMPACT OF DRY AGEING AND CULINARY METHODS ON BEEF TEXTURE

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I. INTRODUCTION

Dry aging transforms beef through controlled enzymatic and environmental modifications, resulting in enhanced tenderness, intensified flavor, and unique textural attributes. It involves storing beef subprimals, typically large cuts like the ribeye or strip loin, in a carefully regulated environment characterized by low temperature (typically between 2-4°C), controlled humidity (around 85%), and sufficient airflow [1]. The extended aging period, ranging from a few weeks to several months, allows endogenous enzymes present in the muscle tissue, such as calpains and cathepsins, to break down complex proteins into smaller peptides and amino acids, contributing to increased tenderness and the development of savory, umami-rich flavors [2]. The duration of the dry aging process is a critical determinant of the final product's quality and flavor complexity, with extended aging periods generally resulting in more pronounced flavor development. However, the optimal aging time is contingent upon various factors, including the initial quality of the beef, the specific environmental conditions employed, and the desired flavor profile [3]. Otherwise, high-heat environment promotes the denaturation of myofibrillar and connective tissue proteins, causing muscle fibers to contract and water to be expelled, potentially resulting in a drier texture if not carefully controlled [4]. In contrast, sous vide, which translates to "under vacuum," involves precisely controlled water bath cooking at relatively low temperatures, typically ranging from 50°C to 85°C [5]. This method facilitates uniform heat distribution throughout the meat, minimizing temperature gradients and enabling precise control over the final internal temperature and thus, the degree of protein denaturation [6]. The idea of this research is to examine the effects of dry ageing duration (21 and 42 days) and subsequent culinary methods (grill and sous vide) on the textural profile analysis of beef.

II. MATERIALS AND METHODS

Beef for ageing were collected from a local abattoir (steers and heifers approx. 18 months and 580 kg carcass weight) following 24 h post-mortem. Ribeye steaks (*m. spinalis dorsi, m. longissimus dorsi* and *m. complexus*, n = 6) from the same animal were randomly assigned to in-bag dry-ageing method and two different ageing periods: 21 and 42 days. In-bag dry-ageing was carried out in a water permeable ageing bag (TUBLIN® 10, 50 µm thick, polyamide mix with water vapor transmission rate 920 g/50 µ/m2/24 h at 7 ◦C, 50% RH, and oxygen transmission rate 660 g/m2/24 h at 7 ◦C, 50% RH, TUB-EX ApS, Denmark) at 2 ± 0.5 ◦C, 0.5 m.s-1 air velocity and relative humidity of 75 ± 5%. After the end of ageing, meat was subject to two different culinary methods: (I) conventional (searing+grilling) and (II) unconventional (sous-vide). For the first method, the steaks were subjected to searing on both sides for 30 seconds, followed by grilling until an internal temperature of 72 °C was achieved (corresponding to approximately 15 minutes of grilling). Rapid searing was employed as a conventional meat preparation technique intended to facilitate crust formation, while maintaining a consistent grilling temperature throughout the process. The internal temperature of the steaks was continuously monitored using a digital thermometer (Trotec GmbH, Model BT20, Germany). The applied grilling conditions were selected in accordance with the procedure described by Ngapo, Riendeau [7]. For the second culinary method, the steaks were vacuum-packaged using a chamber packaging machine MVS 35× (Minipack-Torre SpA, Dalmine, Italy) in multilayer PA/PE/PE bags with a thickness of 85 µm. The vacuum-packaged samples were subsequently subjected to sous-vide cooking in a water bath (Gorenje, model SVI6B, Slovenia) at a constant temperature of 62 °C. Cooking was continued for 45 minutes following the attainment of an internal core temperature of 61 °C, as described by Jeong, O [8]. The internal temperature of the steaks was continuously monitored using a calibrated digital thermometer (TFA Dostmann GmbH, Germany). The specimens were compressed parallel to the muscle fiber orientation to 50% of their original height under the following test conditions: pre-test speed of 180 mm/min, test speed of 60 mm/min, and post-test speed of 180 mm/min. A cylindrical aluminum probe (P/25; 25 mm diameter) was employed, and the samples were prepared in a rectangular shape. A 10-second interval was applied between the two compression cycles. Instrumental texture parameters, including hardness, springiness, cohesiveness, and adhesivnes, were determined using the Exponent software (Stable Micro Systems, UK) integrated with the texture analyzer.

III. RESULTS AND DISCUSSION

Hardness values were significantly higher in freshly grilled samples (Grill "0"d) compared to the other groups. Dry ageing time led to a reduction in hardness for both grilling and sous-vide samples, with the lowest values recorded after 42 days of ageing. Adhesiveness was more negative (indicating higher adhesiveness) in grilled samples aged for 21 and 42 days, while sous-vide samples showed lower adhesiveness values overall, with the least negative values after 42 days of ageing. Springiness values varied slightly among the samples, with no clear trend related to the ageing duration, although the sous-vide fresh ribeye samples exhibited the highest springiness value. Cohesiveness was significantly higher in grilled samples aged for 21 and 42 days compared to freshly grilled samples. In contrast, sous-vide samples showed lower cohesiveness values overall, with significant increases only after 42 days of dry ageing. Overall, grilling resulted in higher initial hardness and cohesiveness, while sous-vide cooking provided more stable textural properties over storage time, with lower adhesiveness and moderate changes in springiness and cohesiveness.

Table 1 – Differences in the values of textural profile analysis parameters.

	Hardness (g)	Adhesiveness (g.sec)	Springiness	Cohesiveness
Grill "0"d	4159.83 ± 923.93^{a}	-0.34 ± 0.26	0.45 ± 0.03	0.36 ± 0.01^{a}
Grill "21"d	2608.84 ± 921^{b}	-2.44 ± 1.54	0.55 ± 0.05	0.49 ± 0.03^{b}
Grill "42"d	2467.09 ± 645.93^{b}	-2.82 ± 1.27	0.57 ± 0.19	0.48 ± 0.15^{b}
Sous-vide "0"d	3595.38 ± 1363.99^{a}	-1.3 ± 0.77	0.54 ± 0.08^{a}	0.39 ± 0.03^{a}
Sous-vide "21"d	2760.16 ± 665.46^{b}	-1.04 ± 0.55	0.46 ± 0.03^{b}	0.36 ± 0.02^{a}
Sous-vide "42"d	2496.38 ± 635.01^{b}	-0.68 ± 0.62	0.50 ± 0.04^{a,b}	0.45 ± 0.03^{b}

*Indicate significant differences ($p<0.05$) between values in the same column.

IV. CONCLUSION

Dry ageing of beef in plastic bags for 3 weeks and sous-vide cooking significantly improved its textural profile. Additional extension of dry ageing does not seem to significantly improve textural characteristics of ribeye beef steaks. Further research is needed to explain the reasons for the observed trend.

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