Aging Methods Effect on Meat Quality Attributes from Steers Under Different Finishing Diets

D. Correa[1*], M. del Campo[1], S. Luzardo[1], G. de Souza[1], C. Alvarez[2], M. Font i-Furnols[3], G. Brito[1]

[1] INIA-Programa Nacional de Investigación Producción de Carne y Lana, Ruta 5, km 386, Tacuarembó, Uruguay.

[2] Teagasc-Food Quality and Sensory Science Department, Ashtown, D15KN3K Dublin 15, Ireland

[3]IRTA- Food Technology, Granja Camps i Armet, 17121 Monells (Girona), Spain

Corresponding author email: dcorrea@inia.org.uy

I. INTRODUCTION

Aging is a post-mortem practice for beef tenderization and flavor improvement. Wet and dry aging are the most common processes to age beef. Dry aging in a highly moisture-permeable bag has been widely used in the last decades, producing dry-aged products mainly to reduce microbial contamination, lipid oxidation, and trim loss when compared to the traditional out-of-bag dry-aging technique [1]. On the other hand, finishing diet has been an important factor affecting beef- quality attributes. Meat from grain- and pasture-fed animals presents different physical, organoleptic, and nutritional characteristics [2]. The study evaluates the effects of different and combined aging methods from pasture-fed and grain-fed steers on meat quality attributes.

II. MATERIALS AND METHODS

This study involved 60 paired striploins from British breed steers under 30 months of age, finished (F) on pasture (15) or grain (15). Striploins were assigned to different aging methods (AM) for 40 days, including dry aging in a bag (DAb-40 d), wet aging (WA-40 d), and their combinations (DW: DAb-20 d + WA-20 d and WD: WA-20 d + DAb-20 d). The lean surface color was measured using a Minolta Chroma Meter CR-400. Warner Bratzler Shear Force (WBSF) was evaluated on six cores per steak using a TA-XT Plus texture analyzer (Stable Micro System Ltd., UK). Intramuscular fat content (IMF) was assessed using the lipid extraction method, followed by the analysis of the fatty acid (FA) composition described by Correa et al. [3]. Lipid oxidation was determined using the TBARS method, with the methodology described by Correa et al. [3]. The experimental design was a split-plot and the statistical analysis was performed with a model including the fixed effects of F and AM, their interaction, and the random effect of the carcass using the MIXED procedure (v. 9.4, SAS Institute Inc., Cary, NC, US). The significance level was set at $\alpha = 0.05$.

III. RESULTS AND DISCUSSION

Results are presented in Table 1. Higher L^* values found in WA may be explained by a greater reflectance associated with more moisture. However, a^* and b^* coordinates presented a significant ($P<0.05$) interaction AM * F where the highest ($P<0.05$) values of a^* were in WA regardless of the F, WD from pasture-fed animals, and DAb from grain-fed steers. This result might be attributed to the greater water content from the WA process, so more water on the meat's surface results in lighter red [4]. Also, DAb from grain-fed steers showed greater ($P<0.05$) b^* values than the other treatments. Apaoblaza et al. [5], in agreement with our study, reported lower L^* values on meat from forage-fed animals than grain-fed cattle, which would be associated with an increased myoglobin content (more muscle activity) making them darker. Consistent with other experiments [1], our study showed no differences ($P>0.05$) in WBSF between aging methods, and the values were lower than 3 kgF, below the threshold for consumer acceptance. After the aging period, DW showed a greater IMF than WA meat ($P<0.05$). In agreement with previous studies [2], the composition of FA groups did not differ between AM. However, a significant ($P<0.05$) AM*F interaction was observed for FA composition and the TBARS values. The highest ($P<0.05$) concentrations of saturated fatty acid (SFA), mono-unsaturated fatty acid (MUFA), and TBARS values were found in WD from grain-fed steers. In contrast, polyunsaturated fatty acid (PUFA) and conjugated linoleic acid (CLA) concentrations were greater

(*P*<0.05) in the AM from pasture-fed than from grain-fed steers, except for PUFA in WA and DW. The *n-6:n-3* fatty acids ratio was ≤4 in meat from pasture-fed animals in agreement with the recommended intakes of FAs performed by the Department of Health (1994) of the United Kingdom. The PUFA/SFA ratio was greater in the IMF of meat from pasture-fed than grain-fed steers. The results of the FA in the current study are aligned with previous findings reported [2].

Table 1. Effects (mean ± SEM) of aging method (AM) and finishing diet (F) and their interaction (A*F) on physicochemical traits.

	Aging (AM)				Finishing (F)		A*F
Traits	DAb	WA	DW	WD	Pasture	Grain	*P-value*
L*	**40.5±0.4b**	**41.8±0.4a**	**40.9±0.4ab**	**41.3±0.4ab**	**40.0±0.4b**	**42.2±0.4a**	*0.350*
a*	**22.2±0.4b**	**24.0±0.4a**	**21.7±0.4b**	**22.3±0.4b**	22.4±0.4	22.7±0.4	***0.011***
b*	**11.8±0.2a**	**11.9±0.2a**	**10.7±0.2b**	**11.1±0.2b**	11.3±0.3	11.4±0.3	***0.029***
WBSF (kgF)	2.6±1.0	2.5±1.0	2.6±1.0	2.5±1.0	2.7±1.2	2.5±1.2	*0.198*
IMF (%)	**3.9±0.2ab**	**3.7±0.2b**	**4.2±0.2a**	**4.1±0.2ab**	**3.7±0.2a**	**4.2±0.2b**	*0.623*
CLA (mg/100g)	19.8±1.6	20.9±1.7	23.4±1.9	24.9±2.0	**28.7±2.4a**	**17.0±1.4b**	***0.008***
SFA (mg/100g)	2043.0±144.0	2019.4±142.3	2186.8±154.1	2205.1±157.7	2071.5±142.8	2153.2±149.0	**0.018**
MUFA (mg/100g)	1780.4±126.6	1732.4±123.1	1961.7±139.4	1970.6±142.1	1686.5±117.5	2047.5±143.1	**0.026**
PUFA (mg/100g)	251.4±14.4	238.2±13.6	238.5±13.7	251.3±14.6	**277.6±11.3a**	**217.3±9.8b**	**0.045**
n6:n3	3.1±0.17	2.9±0.16	3.1±0.17	3.0±0.17	**2.1±0.15b**	**4.5±0.31a**	0.336
PUFA/SFA	0.12±0.007	0.12±0.007	0.11±0.007	0.12±0.007	**0.14±0.01a**	**0.10±0.008b**	0.083
TBARs (mg/kg)	**0.37±0.03ba**	**0.34±0.02b**	**0.43±0.02a**	**0.42±0.03a**	**0.32±0.02b**	**0.47±0.03a**	**0.010**

DAb: Dry aging bag; WA: Wet aging; DW: Dry aging bag 20d + WA 20d; WD: Wet aging 20d + Dry aging bag 20d. WBSF: Warner Braztler Shear Force; IMF: intramuscular fat; CLA: conjugated linoleic acid; SFA: saturated fatty acid; MUFA: mono-unsaturated fatty acid; PUFA: polyunsaturated fatty acid; *n6:n3*: PUFA-n6/PUFA-n3; TBARS: Thiobarbituric acid-reactive substances (mg MDA/kg meat). LS means with different letters in the same row denotes significant differences (*P*<0.05).

IV. CONCLUSION

Although all the aging methods showed at least acceptable performance concerning meat quality, the combination of both aging techniques provides no benefit when compared to a single aging process. The dry bag and wet-aging process alone for meat from grain-fed steers appear to be valuable regarding its technical and nutritional quality. Further research is warranted to identify optimal combinations of dry bag-aging/wet-aging times to develop an in-depth understanding of the safety and quality of extended aging and stepwise aging in fresh beef.

ACKNOWLEDGEMENTS

The authors would like to thank INIA Uruguay for the funding that made this study possible.

REFERENCES

1. Zhang, R.; Yoo, M. J.Y.; Farouk, M. (2020). Oxidative stability, proteolysis, and in vitro digestibility of fresh and long-term frozen stored in-bag dry-aged lean beef. Food Chemistry. https://doi.org/10.1016/j.foodchem.2020.128601.
2. Realini, C.E., Duckett, S.K., Brito, G.W., Dalla Rizza, M., De Mattos, D. 2004. Effect of pasture vs. concentrate feeding with or without antioxidants on carcass characteristics, fatty acid composition, and quality of Uruguayan beef. Meat Science 66: 567–577
3. Correa, D.; del Campo, M.; Luzardo, S.; de Souza, G.; Alvarez, C.; Font i-Furnols, M.; Brito, G. (2024). Aging Methods and Frozen Storage on Meat Quality Attributes of Beef from Different Finishing Diets. Meat and Muscle Biology. https://doi.org/10.22175/mmb.17695
4. Kim, Y. H. B., Frandsen, M., & Rosenvold, K. (2011). Effect of ageing prior to freezing on colour stability of ovine longissimus muscle. Meat Science, 88, 332–337.
5. Apaoblaza, A., Gerrard, S.D., Matarneh, S.K., Wicks, J.C., Kirkpatrick, L., England, E.M., Scheffler, T.L., Duckett, S.K., Shi, H., Silva, S.L., Grant, A.L. & Gerrard, D.E. (2020). Muscle from grass- and grain-fed cattle differs energetically. Meat Science 161, 107996.