ARTICHOKE BRACTS SILAGE IN BEEF CATTLE DIET: MEAT QUALITY DURING DRY AGING

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I. INTRODUCTION

Valuing the agro-industrial byproducts most generated within a given territory holds significance for both economic and environmental reasons [1]. Depending on plant species and tissue types, horticultural and fruit waste exhibit a wide array of properties [2]. Artichoke bracts, for instance, constitute a waste material that can be repurposed for animal feed, thereby transforming them from waste into a resource and reducing food-feed competition. Adding artichoke bracts in beef cattle diet could increase the environmental sustainability and enhance the quality and the stability of meat, although the effects could differ during an aging process. The present study was conducted to assess the quality of beef from cattle fed with artichoke bract silage (BS) during a period of dry aging.

II. MATERIALS AND METHODS

Approval number ethic committee 2256-III/13. For the trial, 48 Holstein×Blue Belgian heifers were randomly assigned to 3 experimental groups: a control group (C) and 2 experimental groups receiving two different percentages of forage substitution with BS (S1: 6% on dry matter; S2: 12% on dry matter) for 60 days before slaughter. C, S1 and S2 diets were isoenergetic and isoproteic. After slaughter, the left loin was removed from each animal and subjected to dry aging for 42 days. At each experimental time (0d, 14d, 21d, 28d, 35d, 42d) a 30mm rib was cut from each loin for the analysis. Color, cooking loss (CL) and water-holding capacity (WHC) were estimated as described by De Palo et al. [3]. Thiobarbituric acid reactive substances (TBARS) and protein carbonyls determinations were performed as reported by De Palo et al. [4]. The ferric reducing antioxidant power (FRAP) assay was used to measure total antioxidant potential according to the method described by Dinardo et al. [5]. Textural properties were assessed using a ZI.0 TN texture analyzer (ZwickRoell GmbH & Co. KG, Ulm, Germany), equipped with 1 kN load-cell and a compression probe of 36 mm diameter, following the method outlined by De Angelis et al. [6] with few modifications. Samples were cooked in a plastic bag in a water bath at 85°C until an internal temperature of 75°C was reached. Shear force was measured on parallelepiped-shaped samples of 3 × 6 × 6 cm, sectioned so that the longitudinal axes was parallel to the orientation of muscle fibers. Each sample was cut three times, and the average of these three values was calculated. The results were expressed in N. Hardness, cohesiveness, springiness and chewiness [6] were evaluated on cubic meat samples of 1 cm per side. For these parameters a double compression cycle was performed at 1 mm s−1 until a recorded deformation of 75%. Three replicates for each sample were considered. The data set was tested for normal distribution and variance homogeneity (Shapiro-Wilk). Then, was subjected to analysis of variance (ANOVA), using the General Linear Model (GLM) software by SAS (2018) (version 9.3, SAS Institute Inc., Cary, NC, USA), according to the following model: $y_{ijk} = \mu + \alpha_i + G_j + T_k + (G \times T)_{jk} + \varepsilon_{ijkl}$, where y_{ijk} represents all parameters as dependent variables; μ is the mean; α_i is the single block random effect, G represents the effect of the j^{th} group, T represents the effect of the k^{th} aging time (k = 1, ..., 6), G × T represents the effect of the binary interaction between the two independent variables (jk = 1,…, 18) and ε_{ijkl} is the error. Subsequently, a Tukey test for repeated measures was carried out to evaluate the differences between the means during the aging time. All means were expressed as square means and mean standard error. The significance level was set to $P < 0.05$.

III. RESULTS AND DISCUSSION

Diet plays a primary role in the physicochemical regulation and metabolic traits of muscular development in livestock animals, thereby contributing significantly to the nutritional quality, organoleptic characteristics, and shelf life of meat [7]. In our results, lightness values of C meat increased from 0d to 21d (35.59 to 38.54), declining thereafter at 42d (35.15) ($P < 0.01$). Moreover, at 42d, these values were consistently lower compared to those of S1 and S2 meat (35.15 *vs.* 37.65 and 37.70) ($P < 0.01$). Lightness is closely associated with the chemical composition of meat, particularly to intramuscular fat concentration and composition, as well as water content [8]. The WHC of S1 meat increased from 0d to 21d (73.98 to 83.28) ($P <0.01$), whereas in S2 meat it increased from 0d to 14d (75.66 to 79.96) ($P <0.01$). Subsequently, WHC values for both meat S1 and S2 remained stable ($P < 0.01$). Although at 21d the WHC of C meat was lower than that of S1 meat (78.28 *vs.* 83.28) ($P < 0.01$), the CL showed lower values in C meat compared to S2 at 28d (31.85 *vs.* 35.66) and to both S1 and S2 at 42d (25.68 *vs.* 29.96 and 30.23) ($P < 0.01$). Regarding oxidative patterns, TBARS revealed statistically significant differences over time only in C meat, increasing from 0d to 14d (0.17 to 0.34) and remaining constant thereafter ($P <0.01$). Protein carbonyls increased from 0d to 35d in S2 meat (1.44 to 2.13) ($P < 0.01$), while FRAP values showed no statistical difference between time points or groups ($P > 0.05$). Shear force values showed the same trend in meat of all three groups, decreasing from 0d to 14d and remaining constant thereafter (from 57.89-48.88 to 25.88-18.96) ($P < 0.01$). None of the texture parameters revealed any differences between aging times or groups ($P > 0.05$).

IV. CONCLUSION

Based on these results, it can be stated that the use of BS in heifers' diet did not compromise the qualitative characteristics of the dry-aged loins. On the contrary, it could enhance WHC and oxidative stability of meat. Dietary utilization of BS could be suitable for developing low-input and low-emission feeding strategies to reduce food-feed competition and mitigate the environmental footprint of meat.

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REFERENCES

1. Vastolo, A.; Calabrò, S.; Cutrignelli, M.I. (2022) A review on the use of agro-industrial CO-products in animals' diets. Italian Journal of Animal Science. 21(1): p. 577-594.
2. Sridhar, A.; (2021) Techniques and modeling of polyphenol extraction from food: a review. Environmental Chemistry Letters. 19(4): p. 3409-3443.
3. De Palo, P. (2016) Is meat quality from Longissimus lumborum samples correlated with other cuts in horse meat? Animal Science Journal. 87(3): p. 428-438.
4. De Palo, P.; (2014) Influence of Gas Mixture on Quality and Shelf Life of Veal Calf Meat. Italian Journal of Animal Science. 13(2): p. 3129.
5. Dinardo, F.R.; (2022) Oral administration of nucleotides in calves: Effects on oxidative status, immune response, and intestinal mucosa development. Journal of Dairy Science. 105(5): p. 4393-4409.
6. De Angelis, D.; (2020) Physicochemical and Sensorial Evaluation of Meat Analogues Produced from Dry-Fractionated Pea and Oat Proteins. Foods, 9, DOI: 10.3390/foods9121754.
7. Salami, S.A., (2019) Sustainability of feeding plant by-products: A review of the implications for ruminant meat production. Animal Feed Science and Technology. 251: p. 37-55.
8. De Palo, P.; (2012) Colour Changes in Meat of Foals as Affected by Slaughtering Age and Post-thawing Time. Asian-Australasian journal of animal sciences. 25(12): p. 1775-1779.