71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

BIOACTIVE COMPOUNDS IN RAW AND COOKED BEEF WITH TWO DIFFERENT AGEING PERIODS

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I. INTRODUCTION

Meat is considered a high-quality protein source providing a large amount of essential amino acids, as well as several B vitamins (particularly vitamin B12), micronutrients such as haem iron, zinc, selenium, phosphorus, and long-chain fatty acids [1] [2] [3]. In addition, meat is also a source of bioactive compounds with potential nutraceutical properties whose concentrations may be affected by ageing and cooking [4] [5]. The present study aimed to determine the content of the bioactive compounds: anserine, carnosine, L-carnitine, coenzyme Q10, glutathione, and taurine in raw and cooked beef aged for 5 or 90 days.

II. MATERIALS AND METHODS

Twenty Angus steers finished on pastures were slaughtered (less than 30 months of age and average hot carcass weight of 257.5 ± 11.4 kg) in a commercial meat processing plant according to the Uruguayan legislation. Twenty striploins (*longissimus lumborum* muscle) were removed from each left half carcass, vacuum packaged and transported to the Meat Laboratory of the National Agricultural Research Institute of Uruguay. A 2.54 cm steak was obtained for each treatment within each striploin in a randomized order from the cranial to caudal direction. Experimental treatments were generated from the combination of two meat ageing periods (5 vs. 90 days) and meat status (raw vs. cooked). Steaks were cooked in a preheated clamshell-style grill until the internal temperature at the geometric center reached 71 °C [6]. Samples were homogenized and approximately 15 g of meat were packed in individual whirl-pak bags and freeze at 80°C until analysis. The concentrations of anserine, carnosine, coenzyme Q10, glutathione, L-carnitine, and taurine were determined by HPLC. Data analysis was conducted considering a mixed linear model using the Mixed procedure of SAS (SAS Institute, Cary, NC, USA, version 9.4). A 2 x 2 factorial design was used to evaluate two factors, meat status (raw vs. cooked) and ageing period (5 vs. 90 days). Each striploin was considered as a block (representing each animal) from which samples (steaks) were obtained for each treatment. The model included meat status (raw vs. cooked) and ageing period (5 vs. 90 days) and its interaction as a fixed effect, and the striploin (block) was considered as a random effect.

III. RESULTS AND DISCUSSION

Ageing period across the levels of meat status (raw and cooked) did not affect ($P > 0.05$) anserine concentrations. Greater ($P < 0.05$) concentrations of coenzyme Q10, glutathione, L-carnitine and taurine were observed in beef aged for 90 days than 5 days (Table 1). These greater concentrations could be explained by increases of purge losses during extended ageing [7] where water would be lost to a greater extent than the bioactive compounds augmenting therefore their concentrations. Conversely, carnosine concentration declined after 90 days of ageing which could be associated with its greater loss jointly with water during storage since it is a water-soluble compound. Raw meat showed a higher content ($P < 0.05$) of anserine, carnosine and taurine than cooked meat that could be attributable to losses in cooking juices or compound changes [8]. On the other hand, coenzyme Q10 and L-carnitine presented greater concentrations ($P < 0.05$) in cooked than in raw beef probably due to greater true retentions after cooking or their more effective extraction processes when meat was cooked [4].

Table 1 - Least-squares means ± standard error of bioactive compound concentrations (mg/100g) according to the ageing period (5 or 90 days) and meat status (raw or cooked).

Bioactive compounds	Ageing period			Meat status		
	5 days	90 days	*P*	Raw	Cooked	*P*
Anserine	97.0 ± 2.91	95.0 ± 2.92	0.170	97.7 ± 2.91[a]	94.4 ± 2.92[b]	0.024
Carnosine	508 ± 8.27[a]	472 ± 8.27[b]	<0.001	499 ± 8.27[a]	482 ± 8.27[b]	0.008
Coenzyme Q10	1.92 ± 0.03[b]	2.11 ± 0.03[a]	<0.001	1.94 ± 0.03[b]	2.09 ± 0.03[a]	<0.001
Glutathione	7.34 ± 0.41[b]	11.7 ± 0.42[a]	<0.001	9.23 ± 0.41	9.85 ± 0.42	0.246
L-Carnitine	36.3 ± 0.81[b]	41.4 ± 0.81[a]	<0.001	37.2 ± 0.81[b]	40.5 ± 0.81[a]	0.005
Taurine	25.8 ± 0.65[b]	44.5 ± 0.66[a]	<0.001	37.5 ± 0.65[a]	32.8 ± 0.66[b]	<0.001

[a, b] Least-squares means with different superscripts in the same row and under the same factor differ significantly (P < 0.05).

IV. CONCLUSION

Ageing beef for 90 days increased coenzyme Q10, glutathione, L-carnitine and taurine concentrations suggesting the importance of ageing in the concentrations of some bioactive compounds. Cooking has a differential effect on the concentrations of bioactive compounds mainly associated with their retentions after cooking, thermal stability, and interactions with the meat matrix. Further studies on beef production systems (pasture *vs*. concentrate), meat ageing methods (dry *vs*. wet), ageing periods, and cooking techniques are needed for better understanding of how bioactive compounds concentrations can be affected.

ACKNOWLEDGEMENTS

This project was funded by the Agencia Nacional de Investigación e Innovación (ANII), code: FMV_3_2022_1_172315 and code: POS_NAC_2023_2_177395 for the first author scholarship.

REFERENCES

1. Williams, P.G. (2007) Nutritional composition of red meat. Nutrition & Dietetics, 64 (Suppl 4): S113-S119.
2. McAfee, A.J.; McSorley, E.M.; Cuskelly, G.J.; Moss B.W.; Wallace, J.M.W.; Bonham, M.P.; Fearon, A.M. (2010) Red meat consumption: An overview of the risks and benefits. Meat Science, 84: 1-13.
3. De Smet, S.; Van Hecke, T. (2024) Meat products in human nutrition and health - About hazards and risks. Meat Science, 218:109628.
4. Purchas, R.W.; Rutherfurd, S.M.; Pearce, P.D.; Vather, R.; Wilkinson, B.H.P. (2004) Concentrations in beef and lamb of taurine, carnosine, coenzyme Q10, and creatine. Meat Science, 66(3): 629-637.
5. Jairath, G.; Biswas, A.K.; Mal, G.; Suman, S.P. (2024) Bioactive compounds in meat: their roles in modulating palatability and nutritional value. Meat and Muscle Biology, 8(1): 16992, 1-15.
6. American Meat Science Association (2016). Research Guidelines for Cookery, Sensory Evaluation, and Instrumental Tenderness Measurements of Meat (2. ed. pp. 105), 2016, Champaign, Illinois.
7. Holman, B.W.; Bekhit, A.E.D.A.; Mao, Y.; Zhang, Y.; Hopkins, D.L. (2022) The effect of wet ageing duration (up to 14 weeks) on the quality and shelf-life of grass and grain-fed beef. Meat science, 193: 108928.
8. Purchas, R.W.; Busboom, J.R.; Wilkinson, B.H.P. (2006) Changes in the forms of iron and in concentrations of taurine, carnosine, coenzyme Q10, and creatine in beef longissimus muscle with cooking and simulated stomach and duodenal digestion. Meat Science, 74(3): 443-449.