MICRONUTRIENTS OF BEEF MEAT FROM PASTURE AND CONCENTRATED BASED PRODUCTION SYSTEMS

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Abstract –This paper summarizes the content of micronutrients in beef meat coming from the two predominant feeding systems in Uruguay: pasture-based and concentrate-based. Twenty Aberdeen Angus (AA) steers from 26–30 months of age were used. Ten were pasture-grazed and ten were from an intensive feeding system finished 100 days with concentrate. At 36 hours *post mortem* muscle *Longissimus dorsi* (LD) was removed. Meat was vacuum packed and stored at -80 °C prior analysis. Creatine, carnosine, anserine, β-carotene, α-tocopherol, heme iron, minerals and lipid content were quantified. Meat from pastures contained significantly more creatine and carnosine than meat from concentrated based systems, but both contained a similar level of anserine. Also, important differences were found in meat from pastures, for iron and heme iron content, selenium and vitamins, such as carotenoids and tocopherol, whose contents were higher than in meat from concentrated. However, the levels of copper and lipids were significantly higher in meat from concentrated.

Key Words – biopeptides. essentials minerals, nutritional value of meat,

I. INTRODUCTION

Meat, particularly red meat, is a main source of some beneficial peptides such as creatine, carnosine and anserine, which have an antioxidant and protective role in muscles, particularly for athletes and the elderly [1]. Moreover, bovine meat is a major source of essentials minerals such as Fe, Zn, Se, Cu and Mn, antioxidant enzymes activators, and heme iron, a biologically important iron compound. Deficiencies in this mineral causes anemia and it also impairs the cognitive performance of children [2]. For the elderly, dietary deficiencies in vitamins such as carotenes and tocopherol can drive to failure of protective mechanisms [1]. Meat consumption is a good way to prevent all these deficiencies and it contributes to the requirements of children and the elderly [3]. These contents can, however, be affected by the feeding system. In this work, we aim to evaluate the micronutrients content in beef meat from the two predominant feeding systems in Uruguay: pasture-based and concentrate-based.

II. MATERIALS AND METHODS

Ten Aberdeen Angus (AA) steers from 26–30 months of age (live weight 495.8 kg), were reared under Uruguayan characteristic conditions, based on extensive grazing. They were grazed (130 days before slaughtering) consisting in tall fescue (*Festuca arundinacea*), white clover (*Trifolium repens*) and birdsfoot trefoil (*Lotus subbiflorus* cv El Rincón). On the other hand, ten other AA steers (live weight 498.2 kg) were obtained from an intensive feeding system (feedlot) that exports HQB (high quality beef), following the European Comission Regulation (Number 481/2012). The steers were finished 100 days before slaughtering with concentrate. The last consisted of whole plant sorghum silage, wet grain sorghum, corn silage, sunflower pellets, mineral sources, urea and ionophore. All animals were slaughtered on the same day in an official abattoir of Breeders & Packers of Uruguay (BPU-Durazno).

At 36 hours *post mortem* muscle *Longissimus dorsi* (LD) was removed. Meat was vacuum packed and stored at -80 °C prior analysis. Creatine, carnosine and anserine were quantified by HPLC (quaternary HP 1050), UV detection and SILICA HILIC (150 mm, 4.6 mm, 5 µm) column. Identification and quantification of the detected biopeptides was done in comparison to defined standard (Sigma). β-carotene and α-tocopherol were extracted following Zaccari, et al., [ ] and quantified by HPLC.β-carotene content was measured at 450 nm and α-tocopherol at 290nm, with a C30 thermostatized column at 30 ºC. The mobil phase used was ethanol:methanol:THF (75:20:5) HPLC grade, flux 0.5 ml/min, detector UV2000. Calibration curves were performed with β-carotene (Sigma Aldrich C9750), and DL-α-tocopherol standards (Sigma Aldrich T3251) and results were expressed as µg/g tissue. For heme iron, we used the method of Hornsey [4] and for minerals we used the method described in Cabrera et al. [3]. The ferrozine method described by Ahn et al. [5] was used for non heme quantification. Lipids were determined by Folch et al. [6].

II. RESULTS AND DISCUSSION

Beef meat is an important source of nutrients, especially micronutrients whose deficiencies are globally increasing, which is of great concern. Beef is a good way to prevent these deficiencies. In this study we show the content of main micronutrients and the differences observed in relation to the production system in Uruguay. Meat from pastures contains significantly more creatine and carnosine than meat from concentrated based systems, but it contains a similar anserine content (Table 1). The contribution to human diet of a portion of 100 g of beef from pasture or concentrated was 431 mg and 389 mg of creatine, 358 and 316 mg of carnosine and 62 and 58 mg of anserine, respectively. Also, important differences are found in meat from pastures, for iron and heme iron content, selenium and vitamins, such as carotenoids and tocopherol whose content are higher than in meat from concentrated. However, copper and are significantly higher in meat from concentrated.

Table 1 Content of micronutrients in steers fresh *Longissimus dorsi* from pasture and concentrated based system.

Item		Pasture n=10	Concentrated n=10	P
Peptides				
	Creatine, ug/g	4308 ± 167 a	3588 ± 127 b	0.01
	Carnosine, ug/g	3887 ± 68 a	3162 ± 59 b	0.05
	Anserine, ug/g	620 ± 78	577 ± 44	ns
Minerals				
	Fe, ug/g	27.1± 2.0 a	19.3 ± 0.5 b	0.001
	Heme iron, ug/g	25.2 ± 5.6 a	16.5 ± 1.2 b	0.05
	Non heme iron, ug/g	2.54 ± 0.18	2.03 ± 0.16	ns
	Zn, ug/g	41.2 ± 4.2	51.6 ± 5.1	ns
	Se, ug/g	0.62 ± 0.04 a	0.46 ± 0.03 b	0.05
	Cu, ug/g	0.68 ± 0.05 b	1.01 ± 0.08 a	0.01
	Mn, ug/g	0.20 ± 0.01	0.13 ± 0.01	ns
Vitamins				
	β-carotene (ug/g)	1.73 ± 0.18 a	0.27 ± 0.04 b	0.0001
	Luteine (ug/g)	0.342± 0.001	0.339± 0.001	ns
	α-Tocopherol (ug/g)	3.70 ± 0.50 a	1.90 ± 0.30 b	0.05
Lipids	%	1.78 ± 0.15 b	4.52 ± 0.46 a	0.0001

Data are mean ± SEM. a,b, means significant differences between pasture and concentrated by one way-ANOVA and post hoc Tukey-Kramer test ($p<0.05$).

III. CONCLUSION

Bovine meat contributes highly to the intake of micronutrients such as minerals, vitamins and biopeptides in the human diet. However, it is noteworthy that bovine meat produced on pasture is richer in creatine and carnosine, iron, heme iron, Se, β-carotene and α-tocopherol while meat produced with concentrated contains more copper and lipids.

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