A STUDY ON MINERAL COMPOSITION OF BEEF

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Introduction

Knowing the mineral content of food is interesting from a nutritional and environmental point of view. Even though the need for studying the mineral content in meat has been long acknowledged (Doornebal and Murray, 1981) the data on this subject are rather lacking and sometimes contradictory. The aim of this investigation is to study the content of some minerals in commonly marketed beef belonging to 2 categories (cow and young bull). Considering the importance of muscle factor for the characteristics of beef (Barge *et al.*, 2001), we analysed the *longissimus dorsi* (LD), the *supraspinatus* (SS) and the *semitendinosus* (SS).

Materials and Methods

In some commercial abattoirs of the Piedmont, from 22 carcasses-10 young bulls (range 12-19 months old) and 12 cows (range 39-120 months old) we collected samples of 3 muscles (LD, ST and SS), which were freeze-dried, digested with nitric acid and analysed in duplicate for Fe, Zn, Ca, Na, K and Mg by an atomic absorption spectrophotometer (3030 Perkin-Elmer). Data were analysed by Anova (SPSS), considering as sources of variation the muscle, the animal category and their interaction. We also studied the correlations (not reported) of each mineral with the age of the animal, with protein content and with lipid content of the meat.

Results and Discussion

Table 1: Minerals: mean value (ppm on dry matter) and coefficient of variation (%).

		Fe		Zn		Ca		Na		K		Mg	
		mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	Mean	cv
Cow	LD	88,3	22,99	166,6	13,80	459,2	10,45	1912,0	19,68	13957,3	11,14	964,7	13,50
	ST	81,8	19,86	129,5	23,25	379,7	11,18	1741,7	16,95	17540,6	6,37	1262,9	4,77
	SS	115,9	16,08	254,1	9,80	424,7	16,39	2752,7	12,92	14471,8	11,06	961,4	14,58
	all	95,5[w]	24,51	181,8	32,36	418,9[z]	14,92	2139,3	26,65	15019,4	15,47	1068,8	17,14
Young bulls	LD	63,1	23,82	160,4	29,19	533,3	15,68	1649,6	18,05	14729,1	7,51	996,8	16,48
	ST	54,1	22,46	126,8	14,65	394,6	6,83	1803,0	15,35	17129,3	11,86	1273,8	5,51
	SS	76,8	9,96	218,4	14,54	481,6	21,75	4425,5	20,29	14469,9	5,91	1047,6	18,09
	all	65,2[z]	22,82	166,8	30,24	467,2[w]	20,36	2528,9	53,76	15467,4	11,97	1106,1	17,17
Muscle	LD	77,7[b]	28,19	163,7[b]	21,70	494,3[a]	15,28	1754,6[b]	19,66	14304,6[b]	9,75	980,7[b]	14,80
	ST	70,8[b]	28,32	128,3[c]	19,48	386,5[b]	9,37	1769,6[b]	15,93	17353,6[a]	9,05	1267,9[a]	5,02
	SS	99,1[a]	24,86	238,0[a]	13,82	449,1[a]	19,78	3496,2[a]	30,41	13925,5[b]	9,94	1000,6[b]	16,61

[a,b,c (w,z)] Means of muscle (of category) within a column with different superscripts are significantly different at $P<.05$.

The 2 factors accounted for more than 50% of the variability (R^2 ranging from 0.53 for Mg to 0.87 for Na); only for Ca the R^2 was equal to 0.40. The data confirmed the great importance of muscle for meat characteristics: this factor significantly influenced all minerals, the size of the differences being not at all negligible. Among the 3 muscles analysed, ST has a low content of iron (as in Von Seggern *et al.*, 2005), zinc and calcium; on the other hand it was the richest in K and Mg. SS was the poorest for K and Ca, but it was definitely the richest not only in sodium, but also in 2 elements as important as iron and zinc. About iron, it is well-known that beef is an important source, either for quantity or for bioavailability; this could have a practical importance, considering that iron deficiency is the most common and widespread nutritional disorder in the world (Biesalski, 2004). Our data confirm that LD was poorer in iron in comparison with less valuable muscle: f.i. *vs diaphragm* (Doornebal and Murray, 1981); *vs triceps brachii* (Purchas and Busboom, 2005). Referring to zinc, Biesalski (2004) underlined that a low intake of this mineral is associated with a weakened immune system; according to Lombardi-Boccia *et al.*, (2005), meat is the richest source of zinc in the Italian total diet. In our study, Zn content in SS was 1.5 times higher than in LD; a figure similar to 163% that can be reckoned from the data of Künhe, (1976). Our results and particularly the low content of ST agree only in part with a statement reported by Doornebal and Murray (1981); it was suggested that Zn would have a higher concentration in those muscles involved in movement.

LD was intermediate between the other muscles for zinc and iron, similar to ST for Na (as in Kotula and Lusby, 1982) and to SS for the K; on the other hand it was the highest for the calcium content.

Recently, Ruusunen and Puolanne (2005) observed that consumers have become more aware of the relationship between sodium and hypertension and review the possibilities to reduce the sodium content in meat products. Our

results indicate that, although we considered only 3 muscles, the variability between muscles is so high (LD sodium content is about half as compared to SS) that the choice of muscles could be a valid way to reduce the sodium intake.
On the contrary, the category only influenced some minerals: cow meat was richer in iron and tended to have more zinc, but was poorer in calcium. It interacted with muscle only in one case: the meat of young bulls contains less Na than cow in LD, whereas it contains more in the other muscles.
Referring to the correlations, we found one positive (significant in 2 out of 3 muscles) between iron and age, as for other authors (Kotula and Lusby, 1982). Age was in negatively related (although not significant in LD) to calcium content, as found in steers (1-6 years) by Kotula and Lusby; whereas in Doornenbal and Murray's cow group (3-12 years) the Ca content increases with age. The protein content was negatively correlated with sodium (not significantly in SS); positively with LD content in K; with Mg content in ST; negatively in zinc content (significant in LD and ST). Sim and Wellington (1976) found a high negative correlation between fat and K content. In our study, the lipid content was negatively correlated to the K content (significant in LD and SS) and Mg content. Lipid and iron content were positively correlated (significant in SS).

Conclusions

Even though obtained from a small number of samples, the present data allow us to highlight that beef normally marketed is a good source of different minerals, contributing to fulfil the RDA (INRAN, 1996) to not a negligible degree. Considering the mean of 3 muscles, 100 g of beef (about 25 g on dry matter) satisfy 11,5% of the needs of iron in adult women, but for SS of cow the figure grows to 29% in comparison to the needs of adult males. About zinc, the percentages for SS of cow was equal to 52.9% of the needs of nursing women, up to 90.7% for the other women, to 63.5% in adult males.
The value of a cut of beef has no relation with its mineral richness: in fact we found the highest content both of iron and zinc in the SS of cow.
Deepening the knowledge of mineral in more muscles of different categories of cattle –and thereby contributing to our knowledge of meat as a varying raw material (Kunhe, 1976)- would allow the upgrading of under utilised cuts and to complete the beef muscling profiling research (Von Seggern *et al.*, 2005). Knowledge of the raw material, together with studies about losses depending on cooking procedures, is the only way to allow consumers to adjust their diet to their specific requirements.

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