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Introduction

Extensive research has been conducted on objectively assessing the palatability characteristics, particularly tenderness, of carcass meat. A patent (#4,009,390) by Satterlee et al. (1977) claimed that the ratio of iron (Fe) to zinc (Zn) in beef was highly correlated to its tenderness and that it is also easy to calculate a Fe/Zn ratio accurately with spectrophotometric methods.

An increase in the crosslinking between strands of collagen decreases the solubility of collagen, and also decreases the tenderness of the meat. High moist heat is required to improve tenderness of meat with extensive crosslinking of collagen. Increases in crosslinking of collagen is generally associated with increases in maturity. Collagen crosslinking has been shown to be impaired in zinc-deficient rats, which tends to suggest that a low concentration of zinc in muscle would prevent collagen crosslinking. Also, zinc concentration was significantly correlated to skeletal maturity, fat thickness, ribeye area, panel-detectable connective tissue, and tenderness. The objective of this study was to relate the zinc and iron content of meat from animals varying in sex and age to the textural properties of meat.

Procedure

Bulls (40) and steers (45) were slaughtered at either 12, 15, or 18 mo of age. Carcasses were chilled for 24 hr, and the ribeye muscle was removed from the left side, vacuum packaged, and frozen. Subsequently, steaks were analyzed for shear force requirements and zinc (Zn) and iron (Fe) analyzed.

Results

Mean values for textural properties and mineral content of meat from bulls and steers stratified by age and sex are shown in Table 1. Shear force values tended to decrease between 12 and 15 mo of age in both bulls and steers, which would suggest an increase in tenderness of meat. Overall, age groups were not significantly different in textural properties of meat from bulls *vs* steers.

The Zn content of meat from animals 12 to 18 mo of age did not differ significantly, but meat from bulls contained 19.3% more Zn than meat from steers. The Fe content steadily increased in meat as the age of the animals increased. In addition, meat from bulls, overall, contained 7.1% more Fe than meat from steers. The Fe/Zn ratio markedly increased between 12 and 15 mo of age by 15.6% and was 14.0% lower in meat from bulls than in meat from steers.

There appears to be an interesting relationship between the textural properties (shear force) of meat and the Zn content and Fe/Zn ratios. As the shear force requirements decreased (more tender), the Zn content decreased and the Fe/Zn ratios increased. A plausible explanation for the increase in tenderness with a decrease in Zn content may lie with relationship of Zn to collagen crosslinking.

Further research is needed to determine if supplemental Zn fed to animals will affect muscle Zn levels and if Zn prevents intramuscular collagen crosslinking.

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[2]The full report of this work was published in J. Food Quality 7:91-96, 1984.

Table 1—Mean values for textural properties and mineral content of meat from bulls and steers stratified by age and sex

Sex	Age (mo)	n	Mineral content: Shear force (lb)	Zn (µg/gm)	Fe (µg/gm)	Fe/Zn
Bull	12	12	11.5	35.21	13.65	0.390
Steer	12	12	11.4	32.42	13.83	0.429
Avg	12	24	11.5	33.81	13.75	0.410
Bull	15	13	6.4	36.31	15.77	0.437
Steer	15	15	8.8	27.67	14.30	0.529
Avg	15	28	8.2	31.68	14.98	0.486
Bull	18	15	10.7	37.00	16.67	0.452
Steer	18	18	8.5	28.44	14.58	0.520
Avg	18	33	9.5	32.33	15.44	0.489
Avg Bull		40	9.5	36.24	15.38	0.429
Avg Steer		45	9.7	29.24	14.29	0.499