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Correlations between Carcass Traits and Mineral Concentrations in Angus Beef raised in Iowa

Richard G. Tait Jr.
Iowa State University, rtait@iastate.edu

Qing Duan
Iowa State University

Qi Liu
Iowa State University

Mary Sue Mayes
Iowa State University, mmayes@iastate.edu

Donald C. Beitz
Iowa State University, dcbeitz@iastate.edu

See next page for additional authors

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Abstract

Beef is a nutritious food that is known to have high bioavailability for several minerals such as iron and zinc. Although beef is typically high in these nutrients, there is much animalto-animal variation in mineral contents. The objective of this study is to report the relationship between traditional carcass traits and mineral concentrations within the longissimus dorsi.

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Authors

Richard G. Tait Jr., Qing Duan, Qi Liu, Mary Sue Mayes, Donald C. Beitz, and James M. Reecy

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J R Tait, associate scientist
Qing (Grace) Duan, graduate assistant
Qi Liu, graduate assistant
Mary Sue Mayes, assistant scientist
Don Beitz, distinguished professor
Jim Reecy, professor
Department of Animal Science

Introduction

Beef is a nutritious food that is known to have high bioavailability for several minerals such as iron and zinc. Although beef is typically high in these nutrients, there is much animal-to-animal variation in mineral contents. The objective of this study is to report the relationship between traditional carcass traits and mineral concentrations within the *longissimus dorsi*.

Materials and Methods

Cattle Resource. This project utilized 1,085 bulls (n = 540), steers (n = 236), and heifers (n = 309) born from spring 2002 to spring 2008 in the Iowa State University Angus Selection project as part of our research to investigate the genetic control of healthfulness of beef. These cattle came from 25 contemporary groups (with contemporary group defined as gender within harvest date). Contemporary group size ranged from 12 to 67, with an average size of 43.4. These cattle had carcass traits collected: hot carcass weight (HCW) (n = 1,085); 12th rib subcutaneous fat thickness (12th Fat) (n = 1,085); 12th rib longissimus dorsi area (12th REA) (n = 1,085); estimated percent kidney, pelvic, and heart fat (KPH) (n = 1,085); calculated yield grade (YG) (n = 1,085); marbling score (MARB) (n = 1,084); ether extracted fat (% Fat) (n = 1,050); ultimate (approx. 48 hours post mortem) pH (UltpH) (n = 598); and Warner-Bratzler shear force (WBS) (n = 1,061). Concentrations of minerals {calcium (n = 1,077), copper (n = 986), magnesium (n = 1,079), manganese (n = 982), phosphorus (n = 1,079), potassium (n = 1,068), sodium (n = 1,079), zinc (n = 1,075), total iron (n = 1,072), nonheme iron (n = 980), heme iron (n = 980), and proportion of heme iron (n = 980)} in *longissimus dorsi* were evaluated.

Statistical Analysis. Correlations between carcass traits and mineral concentrations were initially calculated by using actual data (Table 1). However, we know that the gender and management of animals can systematically affect carcass traits (e.g., MARB and 12th Fat are lower in bulls than in steers and heifers). Therefore, we also calculated the deviation of each of these traits from their contemporary group means. The correlations between the deviations from contemporary group means were also calculated (Table 2).

Results and Discussion

The relationships between phenotypes of traits seem to have been influenced by the grouping of animals in harvest date and gender groups. Table 1 shows that the raw correlation data of 54.6 percent (59/108) of the correlations were significantly different from zero ($P < 0.05$). However, when the measures are deviated from their contemporary group mean and then the correlation analysis performed, only 39.8 percent (43/108) of the correlations are significantly different from zero ($P < 0.05$). Carcass traits, which had the largest change in number of significant correlations between analysis methods, were fat related traits. For minerals, manganese and zinc had the largest change in number of significant correlations between the analysis methods.

Overall, the correlations between economically important carcass traits and concentrations of health associated minerals are low (< ± 0.30). This correlation analysis indicates that selection or management for manipulating carcass traits would likely have little effect on mineral concentrations.

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Table 1. Correlations between economically important carcass traits and mineral concentrations.[a]

Traits	HCW	12th Fat	12th REA	KPH	YG	MARB	% Fat	UltpH	WBS
Calcium	-0.01	**-0.14**	**0.12**	**0.14**	**-0.15**	**-0.07**	-0.00	-0.05	**-0.29**
Copper	0.00	**-0.12**	-0.03	-0.06	-0.05	**-0.12**	**-0.10**	-0.01	**-0.17**
Magnesium	**-0.08**	-0.01	**-0.10**	**-0.15**	-0.01	**-0.09**	**-0.20**	**0.22**	**0.17**
Manganese	-0.06	**0.16**	**-0.11**	0.02	**0.14**	**0.13**	**0.10**	0.01	**0.08**
Phosphorus	0.03	**-0.11**	0.03	**-0.08**	**-0.08**	**-0.14**	**-0.18**	**0.21**	-0.01
Potassium	**-0.12**	-0.05	**-0.11**	**-0.09**	-0.03	**-0.12**	**-0.23**	-0.03	-0.01
Sodium	**-0.17**	-0.06	**-0.12**	-0.06	-0.04	-0.02	**-0.08**	**0.12**	0.01
Zinc	**0.14**	**-0.06**	**0.18**	0.03	**-0.09**	**-0.16**	**-0.17**	**0.12**	**-0.10**
Total iron	0.05	0.00	0.05	0.04	-0.00	-0.05	**-0.07**	0.07	0.04
Nonheme iron	**0.10**	**-0.12**	0.03	0.06	-0.02	**-0.09**	**-0.10**	-0.03	**-0.07**
Heme iron	-0.05	**0.12**	0.01	-0.01	0.03	0.03	0.04	0.04	**0.08**
Proportion of Heme iron	**-0.09**	**0.13**	-0.02	-0.03	0.03	**0.07**	**0.08**	0.04	**0.07**

[a]Correlations in bold are significantly (P < 0.05) different from zero.

Table 2. Correlations between deviations from contemporary group mean for economically important carcass traits and mineral concentrations.[a]

Traits	HCW	12th Fat	12th REA	KPH	YG	MARB	% Fat	UltpH	WBS
Calcium	**-0.07**	**-0.10**	-0.02	-0.01	**-0.08**	**-0.07**	-0.04	0.00	-0.05
Copper	0.01	-0.02	0.01	-0.04	-0.02	-0.01	-0.01	-0.00	-0.04
Magnesium	**-0.07**	**-0.11**	-0.00	0.02	**-0.09**	**-0.18**	**-0.24**	**0.28**	-0.01
Manganese	0.02	0.05	0.06	0.03	-0.00	-0.05	-0.06	0.07	0.01
Phosphorus	-0.01	-0.05	0.01	0.02	-0.03	**-0.10**	**-0.16**	**0.16**	0.01
Potassium	-0.03	**-0.06**	0.02	-0.00	**-0.07**	**-0.13**	**-0.20**	**0.15**	-0.02
Sodium	**-0.10**	**-0.14**	**-0.07**	0.01	**-0.07**	**-0.06**	**-0.06**	**0.27**	**-0.09**
Zinc	**0.08**	0.05	**0.09**	0.01	0.01	-0.04	-0.04	0.03	**0.06**
Total iron	0.03	0.03	0.01	0.04	0.03	**-0.07**	**-0.06**	0.05	**0.07**
Nonheme iron	**-0.09**	-0.04	**-0.08**	-0.01	-0.01	-0.01	-0.01	**-0.20**	**0.14**
Heme iron	**0.11**	0.06	**0.08**	0.04	0.04	-0.06	-0.06	**0.16**	-0.06
Proportion of Heme iron	**0.11**	0.06	**0.08**	0.04	0.04	-0.02	-0.03	**0.22**	**-0.11**

[a]Correlations in bold are significantly (P < 0.05) different from zero.