Changes in Bovine Muscle Tissue and Whole Body Potassium From Birth to Weaning Age

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Story in Brief

Eight Angus and eight Charolais calves were used to study changes in muscle tissue and whole body potassium, in calves of different growth rates, during their pre-weaning life phase. Results showed that as the calves matured, muscle tissue potassium increased while whole body potassium decreased in concentration. In comparing the two breeds it was noted that the Angus calves had a higher content of muscle tissue potassium at Periods 1, 2 and 3 pre-weaning, but the Charolais calves were higher at the 4th test period. The Angus calves showed a net increase of 8.03 percent in muscle tissue potassium during the test, whereas the Charolais calves displayed a 35.98 percent net increase. Assuming muscle tissue potassium to be an indicator of "chemical maturity", results suggest that the Angus calves matured much earlier in life than did the Charolais.

Conversely, the Charolais calves were higher in whole body potassium at Periods 1, 2 and 3 and lower at Period 4 pre-weaning, than the Angus. It would appear that whole body potassium content, determined by ^{40}K count, is influenced by animal scale and surface area and that if ^{40}K count is to be used to estimate fat-free lean in live cattle, the ^{40}K count could be adjusted for animal scale and body mass.

Introduction

Although several research articles have been published in the past showing changes in various cation concentrations in muscle tissue with chronological age, these works have been accomplished on species other than the bovine. For instance Dickerson (1960) reported an increase in the concentration of muscle tissue potassium in fowl pectoral muscle with increasing age. Dickerson and Widdowson (1960) showed an increase in muscle tissue potassium of piglets at 6 weeks of age versus newborn pigs. However, Martin *et al.* (1968) reported a decrease in both chemical and whole body potassium concentration in pigs of 23 kg., 46 kg., and 91 kg. live weight.

This study was initiated to investigate the change in muscle tissue potassium and whole body potassium, determined by ^{40}K count, in steer calves from an "early maturing" breed and a "late maturing" breed.

Materials and Methods

Experimental animals utilized in this study were eight grade Angus and eight Charolais (7/8 Charolais x 1/8 Angus) steer calves. Whole body and muscle tissue potassium were determined at four periods during the preweaning life phase of the calves, beginning when the calves were about one month of age and at 56 day intervals thereafter.

Whole body poatssium was determined by means of the ^{40}K counter at the Oklahoma State University Live Animal Evaluation Center. Total ^{40}K count was expressed as gm K/kg. live weight.

Muscle tissue potassium was determined from live animal muscle biopsy samples (Guenther, 1972) obtained at each of the four test periods. The biopsy samples were frozen in liquid nitrogen and stored at —20°C until analyzed via atomic absorption spectroscopy. Muscle tissue potassium was expressed as mg K/gm wet tissue.

Results and Discussion

Results from the muscle tissue and whole body potassium analyses are presented in Table 1. These data indicated that as the calves matured during their pre-weaning life phase, muscle tissue potassium increased, while whole body potassium decreased in concentration.

The comparative changes in muscle tissue potassium between the Angus and Charolais calves are illustrated in Figure 1. It is apparent that the Angus calves were higher in muscle tissue potassium at Periods 1, 2, and 3 while the Charolais calves were higher at period 4. If tissue potassium is used as an indicator of "chemical maturity", these data suggest that the Angus calves were more mature (chemically) than the

Table 1. Mean Values for Potassium Concentration by Chemical Determination[1] and ^{40}K Count[2]

Variable	Breed	Period			
		1[3]	2[4]	3[4]	4[4]
Muscle Tissue Potassium[5]	Angus	32.61	32.79	34.60	35.23
	Charolais	27.71	28.61	30.41	37.68
Whole Body Potassium[6]	Angus	12.50	10.05	8.92	9.45
	Charolais	13.30	14.51	9.72	8.79

[1] Determined by atomic absorption spectroscopy
[2] Determined by ^{40}K whole body counter (calf counter)
[3] Average age for Angus = 41 day; Charolais = 32 days
[4] Increments of 56 days between Periods
[5] Expressed in mg potassium per gm wet tissue
[6] Expressed in gm potassium per kg live weight

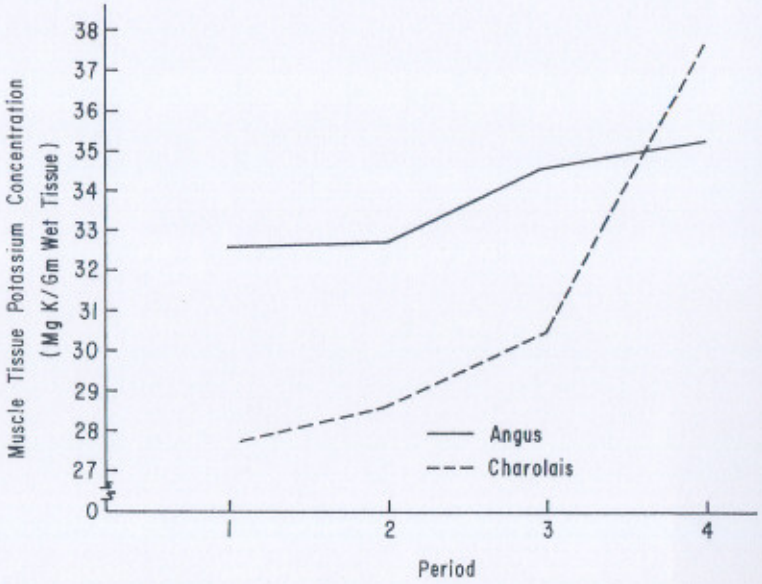

Figure 1. Concentration of Chemical Potassium in Muscle Tissue by Period

Charolais. This may best be evidenced by the increase in concentration within the Angus calves of only 8.03 percent, whereas the Charolais calves increased by 35.98 percent over the same span of life. This would indicate that the slower maturing (Charolais) breed is less chemically mature at birth than the faster maturing (Angus) breed.

Figure 2 illustrates the changes in whole body potassium between the two breeds during pre-weaning life. The smaller scale, more compact Angus calves were lower in whole body potassium than the larger scale, "growthy", Charolais calves. The Angus calves showed a decrease from 12.50 gm to 9.45 gm while the Charolais decreased from 13.30 gm to 8.79 gm during this phase of life. The Charolais calves were higher in whole body potassium at Periods 1, 2 and 3 and lower at Period 4 than the Angus calves.

Although the exact reasons for and signifance of the above findings must await further study, it would appear that whole body potassium content, as determined by ^{40}K count, is definitely influenced by the scale and surface area of the animal being counted. Consequently any prediction equation developed to estimate fat-free lean in the live bovine from ^{40}K count might have to include a "correction factor" to reflect differ-

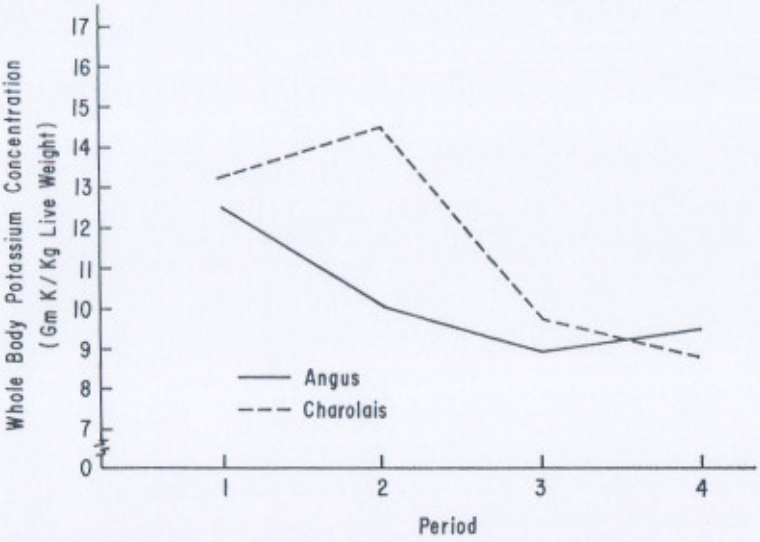

Figure 2. Concentration of Detectable Whole Body Potassium by Period

ences in animal scale and body mass, as this could improve the accuracy of any such estimate.

Literature Cited

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