

NOTES

THE DENSITY OF BOVINE LIMB BONES

The effects of breed-type, sex and age on the density of four bovine limb bones were studied. The density of the four limb bones increased significantly with age, but the effects of breed-type and sex were variable. The results are discussed with reference to the densiometric method of predicting carcass fatness.

There is a clear relationship between the density of a carcass and its fat content (Pearson et al. 1968). However, the fat-free portion of the carcass (mainly muscle and bone) has generally been regarded as having constant density; Jarvis (1971) reported a relative constancy in the density of various bovine muscles. There have been limited data published concerning the density of bovine bones.

This paper reports a study to investigate the effects of breed-type, sex and age on the density of four bovine limb bones (humerus, radius/ulna, tibia and femur). Two hundred and fifty-five left sides of beef from three breed-types of three 'sexes' (bulls, steers and heifers) ranging in age from 8 to 21 mo were studied. The three breed-types were: British beef-type (pure-breds and crossbreds among Hereford, Shorthorn, Angus and Galloway breeds), beef synthetic (mainly three-way crosses of Charolais, Galloway and Angus breeds) and dairy beef-type (animals containing more than 50% of the large dairy breeds e.g. Simmental, Holstein and Brown Swiss). Age was divided into three classes (8-12 mo; 13-17 mo and 18-21 mo). Bones were cleaned of soft tissue and weighed in air. Bone volume was measured by water displacement in a measuring cylinder.

The main effects of age, breed-type and sex were investigated by a least squares analysis of variance; interactions were found to be non-significant in all cases. Differences among main effect means were tested for significance using Duncan's multiple range test corrected for unequal subclass numbers (Steel and Torrie 1968).

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Age, breed-type and sex means for bone density are presented in Table 1. Bone density clearly increased significantly with age for all four limb bones. Breed-type had little effect on bone density except in the case of the femur, which was less dense in the British beef-types. Sex had a variable effect on bone density, but there was a trend for heifers to have the densest bones.

In general, older animals had denser limb bones, a finding which agrees with the results of Fursey (1975). Although no chemical composition data were collected, experiments by Field et al. (1974) indicated that increase in density with age was due to gradual dehydration, presumably as a result of an increase in fat and ash in the bones. Although Fursey (1975) reported differences in limb bone density, between breeds at the same age, the results of this study conducted with much larger sample sizes than those used by Fursey (1975) show little effect of breed-type on bone density. Fursey's study, however, involved cattle of the Jersey breed, a biological type outside the range of cattle used in the present study. Sex did not show a consistent pattern of effect on bone density. Heifers, however, had significantly greater ($P < 0.05$) humerus, tibia and femur densities than steers.

These results have application to the densiometric method of predicting carcass fatness. Bone represents only a small proportion of the carcass and it is unlikely that the small changes in density with age recorded in this study would change the overall relationship between carcass fatness and density. However, some caution must be exercised in interpreting the data, as the

Table 1. Means† of bone density for the four limb bones

Main effects	No.	Humerus	Radius/ulna	Tibia	Femur
Age (mo)					
8-12	47	1.37 <i>a</i>	1.45 <i>a</i>	1.46 <i>a</i>	1.35 <i>a</i>
13-17	138	1.39 <i>a</i>	1.47 <i>a</i>	1.48 <i>a</i>	1.38 <i>a</i>
18-21	70	1.45 <i>b</i>	1.56 <i>b</i>	1.58 <i>b</i>	1.44 <i>b</i>
Breed-type					
British beef-type	119	1.38 <i>a</i>	1.48 <i>a</i>	1.47 <i>a</i>	1.36 <i>a</i>
Beef synthetic	70	1.42 <i>a</i>	1.48 <i>a</i>	1.52 <i>a</i>	1.42 <i>b</i>
Dairy beef-type	66	1.42 <i>a</i>	1.51 <i>a</i>	1.53 <i>a</i>	1.41 <i>b</i>
Sex					
Bull	175	1.40 <i>a</i>	1.49 <i>a</i>	1.49 <i>a</i>	1.39 <i>b</i>
Steer	44	1.37 <i>a</i>	1.48 <i>a</i>	1.49 <i>a</i>	1.35 <i>a</i>
Heifer	36	1.46 <i>b</i>	1.49 <i>a</i>	1.57 <i>b</i>	1.44 <i>c</i>
Residual mean square	248	0.011	0.016	0.022	0.008

†Adjusted least squares means.

a-c Means which do not have the same letters within a source and bone combination differ significantly ($P < 0.05$).

limb bones represent only about 35% of the total side bone. Further studies are needed to examine the effects of age, breed and sex on the density of skeletal bone as a whole.

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