2-P17

A STUDY ON BONE FORMATION OF JAPANESE BLACK CATTLE

Toshio Oshida, Tomohiro Kozakai, Masahiko Nakajima, Tomoo Inomata, Hiroshi Kitamura[1] and Seiji Kusuhara[2]

School of Veterinary Medicine, Azabu University, Sagamihara, 229-8501, Japan. [1]Meiji Seika Kaisha, Ltd., Tokyo, 104-0031, Japan. [2]Faculty of Agriculture, Niigata University, Niigata, 950-2181, Japan.

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Background and Objectives

Between Japan and the United States, farm products had been placed as a symbol of trade friction. As for beef, however, its import and export have been perfectly liberalized since April in 1991, according to the mutual consent of both countries. This liberalization attacked the domestic beef consumption directly and the producers have been cornered. Countermeasures for it are; making the price low by improving of productive efficiency, developing and producing animal products with added values e.g. Japanese original marbling beef, and advertising the safeness of domestic beef. Utilization of cheap feed, advancement of breeding efficiency, a cutback in cost by saving of labor or so on can be the items to improve the productive efficiency.

A life of cattle consists of three stages of nursing, raising and fattening. As for beef breed, however, natural nursing with mother's milk is carried out, which causes the start of fattening younger and the boundaries of each stage are not distinct. In general, cattle is nursed until 5 or 6 months old, then raised for 2 or 3 months, and full-time fattening farm-households start its fattening. Dressed carcass, which is the final product of fattening, can be obtained from the carcass of fattened cattle. Quality and quantity of muscle tissue and fat tissue, which are utilized as meat, are varied according to the process of each cattle's growth, and are significant for fattening (Mitsumoto et al: 1989). Besides, there is little information about bone formation. This time, for the purpose of obtaining the basic material for more efficient fattening system, X-ray examination was executed on cattle's bone of fore legs and the suspended time of bone growth was confirmed in this study.

Materials and Methods

(1) Materials

Cattle for experiment: Japanese Black which have been raised in the farm of 300-head scale in Hanamaki-shi, Iwate prefecture. 78 in experimental cattle were sampled at random with 40 steers at the age from 1 month to 27 months and 38 heifers from 1 month to 29 months.

Feeding management: As for feeding, after dividing fattening process into 3 stages, formula feeds with different ratio of ingredients with roughage (hay) were provided to cattle at each stage. Table 1 shows the components.

(2) Methods

Shooting methods and conditions: X-ray examination was executed in the farm for hoof cutting by making cattle stand squeezed. Distal ends of radius and ulna of fore legs were shot. Films used were medical films 25.4×30.5 cm(Konica) and X-ray apparatus was PORTABLE X-RAY UNITMODEL TP-20 (Tanka). Shooting conditions were voltage- 90LV, distance- 40cm and irradiation time- 0.4 seconds.

Measurement items and methods: Each part on Figure 1 was measured. 1) The area of fifth metacarpal bone: Bone contours were traced on the tracing paper placing on the shot X-ray film on the view box. The area was measured by using the planimeter X-PLAN 360d(Ushikata Shokai). 2) Bone density of ulnoradius: Densities of each part shot on X-ray film were measured by DENSITOMETER PDA-85 (Konica). The parts shot were ① ossification center of ulna, ② antero-distal end of radius, ③ distal end of ulna, ④ ossification center of radius, ⑤ fifth metacarpal bone and ⑥ accessory carpal bone.

Principal results and Discussions

(1) The area of fifth metacarpal bone

The area(cm^2) of fifth metacarpal bone significantly increased from 0.45(steers) and 0.17(heifers) at the age of 1 month to 3.30(steers) and 2.55(heifers) at the age of 10 months which are 7.3 times and 15 times each (Figure 2).

(2) Bone density

① Ossification center of ulna: Densities were 2.00(both steers and heifers) at the age of 1 month, 2.03(steers) and 2.07(heifers) of 5 months. When they were 10 months old, however, densities decreased to be 0.46(steers) and 0.45(heifers).

② Antero-distal end of radius: Densities of steers were 1.72 at the age of 1 month, but became 0.27 at 10 months, which means they decreased to its one seventh. Those of heifers decreased from 1.41 (5 months old) to 0.27(10 months old).

③ Distal end of ulna: Densities of steers decreased from 1.95 (1 month old) to its one fifth of 0.42 (10 months old). Those of heifers decreased from 2.00(5 months old) to 0.44(10 months old).

④ Ossification center of radius: Densities of steers decreased sharply from 1.47 (1 month old) to its one fifth of 0.31 (10 months old). As for heifers, also 1.68 (5 months old) became 0.30(10 months old)(figure 3).

⑤ Fifth metacarpal bone: Densities of steers decreased from 2.31(1 month old) to its one third of 0.78(10 months old). Heifers of 5 months old were 2.43, which became 0.70 when 10 months old.

⑥ Accessory carpal bone: Densities of steers of 1 month old were 2.11 and decreased sharply to 0.77 which is one third of it (10 months old). 10-month-old heifers also showed the decrease of density to one third of 2.32 (5 months old).

There are few reports of chronological investigations for the growth of cattle's leg bones especially for heifers. The weight of some parts of leg bones, however, have been known to have high correlation with red meat volume (Fukuhara et al: 1968). This correlation is utilized for the estimation of meat yield. If the number of reports on the investigation for the growth of leg bones becomes increased and the process of bone formation is established, it must be useful for the beef producers who are under the severe condition to raise the productive efficiency.

Besides, Figure 4 is a referential model made from the area transition of fifth metacarpal bone on Figure 2. According to it, the growth becomes equilibrium at the age of 10 months. Figure 5 is a reference of density quoted from the transition of ossification center of radius on Figure 3. The growth becomes equilibrium at the age of 10 months as well.

Table 1. Components of trial feeds (%)

	Former stage	Middle stage	Final stage
Crude protein	over 15.0	14.5	11.5
Crude fat	over 2.0	2.0	2.0
Crude fiber	over 10.0	10.0	10.0
Crude ash	under 10.0	10.0	10.0
Ca	over 0.4	0.4	0.4
P	over 0.4	0.4	0.4
DCP	over 12.0	12.0	8.5
TDN	over 66.0	68.0	68.0

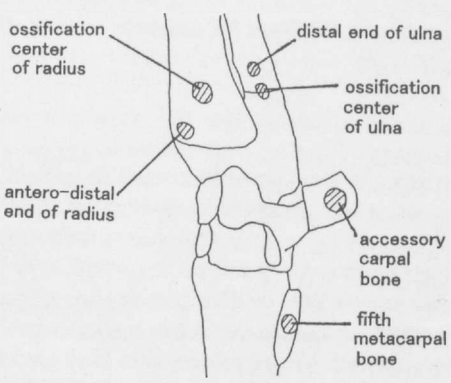

Fig.1. Measurement point of bone aera and bone densities

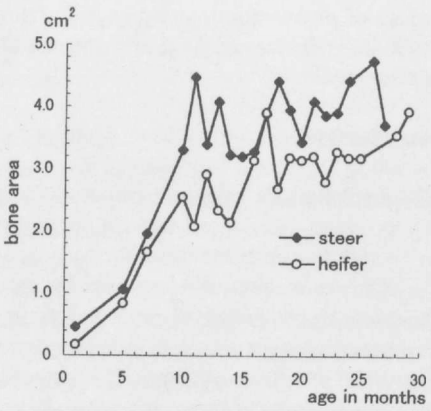

Fig. 2. Changes of bone areas of fifth metacarpal bone

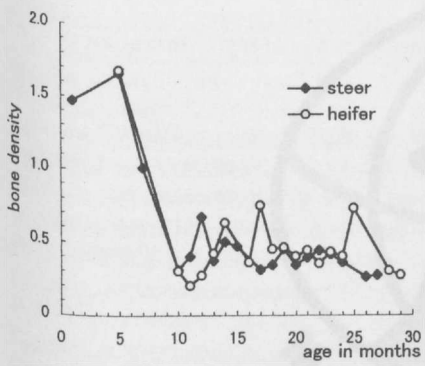

Fig.3. Changes of bone densities of ossification center of radius

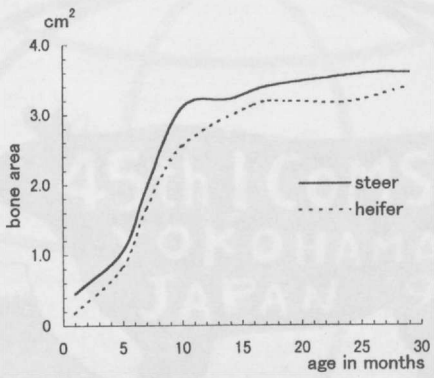

Fig.4. Changes of bone areas of fifth metacarpal bone as model

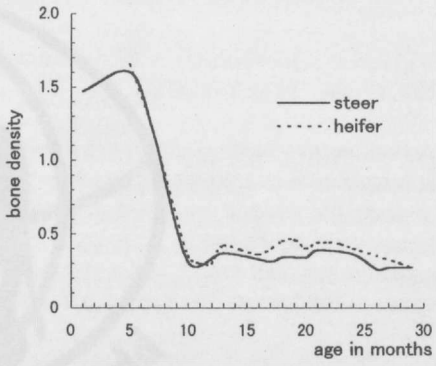

Fig.5. Changes of bone densities of antero-distal end of radius as model

Conclusion

After the examinations on the growth degree of bone from the X-rays of Japanese Black classified by the age, the following results were obtained.

2) Judgement by the area of fifth metacarpal bone: The area increased sharply until the age of 10 months, and after that the change became comparatively gentle.

2) Judgement by the density of each bone: Density of each bone did not decrease after the age of 10 months.

From these results, the growth of Japanese black cattle's bones of fore legs finishes almost at the age of 10 months. Though practically the fattening is started at this time, these results suggest that there is no serious effect for it.

References

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