Genotype Effect of κ -Casein on Milk Performance in Japanese Black Cows

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The genotypes of 30 Japanese Black cows at the κ -casein loci were determined using the PCR method to examine their effect on calf growth which showed the milk performance of the dam.

Materials and Methods

Animals : Thirty Japanese Black cows derived from an experimental herd maintained at Chugoku National Agricultural Experiment Station were used in this study. These cows produced 74 calves, whose weight was used to calculate a daily gain from birth to 60 days of age. Cows were fed 20 kg of silage, 2 kg of hay and 2 kg of concentrate per day⁸⁾. Calves were fed hay *ad libitum* and a pelleted creep ration of not more than 2 kg per day. They were weighed within 24 hours postpartum, and thereafter weighed twice a month up to six months of age.

Determination of κ -casein genotypes : Ge-

nomonic DNA was prepared from the blood of 30 dams. The PCR reaction was performed using 250 ng of genomic DNA as a template²⁾, 200 μ M of each dNTP. 1 unit of Tth DNA polymerase (TOYOBO) with reaction buffer and 20 pmole of each primer. The PCR for 35 cycles was applied : denaturation at 93°C for 1 min, annealing at 55°C for 1 min, extension at 72°C for 1 min. Synthetic oligonucleotides were used as primers¹⁾ : Primer 1 (sense primer), 5' CGCTGTG-AGAAAGATGAAAGATTTC 3' ; Primer 2 (anti-sense primer), 5' AGATTCAAGGAGTATACCA-ATTGTTG 3'. Primer 1 was a terminal sequence of exon 4 and primer 2 was 26 nucleotides in intron 4. Therefore, the DNA fragment containing exon 4 was amplified by PCR. After amplification, 780 bp of PCR products were digested with Hind III^{3,6)} and Pst I⁷⁾, and were analyzed by agarose gel electrophoresis. This procedure for determining κ -casein genotypes is almost identical to that used by

黒毛和種における κ -カゼイン遺伝子型と泌乳性について : 山本智子・島田和宏*・高橋政義*・田畑利幸・竹之内直樹*・大島一修*・吉川昭雄・中山 収・小杉山基昭 (茨城大学農学部, 茨城県阿見町 300-03 * 農林水産省中国農業試験場, 大田市 694)

CHIKUNI *et al.*²⁾

Statistical methods: The data obtained in this study were analyzed by least-squares procedures⁴⁾. The calf daily gain from birth to 60 days was analyzed according to the model including the fixed effects of κ -casein genotypes, calving season, calf sex and parity of cow and the random effect of cow within κ -casein genotypes. The effects found to be unimportant ($P > 0.20$) were deleted from the final model.

Results and Discussion

PCR products had a 780 bp sequence. Three genotypes (AA, AB, BB) were determined according to the PCR of the above-mentioned regions and restriction digestion of PCR products with Hind III and Pst I (TOYOBO). After the digestion of PCR products with Hind III, the digested fragments were observed by electrophoresis. We observed, in κ -casein genotype AA, one band at the 780 bp sequence; in genotype AB, three bands at 780, 413 and 367 bp sequences; and in genotype BB, two bands at 413 and 367 bp sequences. Three genotypes could also be determined by Pst I digestions. All these results are coincident with the results of CHIKUNI *et al.*²⁾ The distribution of κ -casein genotypes in this experiment was as follows, AA, 17 cows (56.7%); AB, 12 cows (40.0%); BB,

1 cow (3.3%). The gene frequency of A was 0.77 and B was 0.23, respectively. The distribution of κ -casein genotypes and gene frequency in this experiment were almost the same as those reported by CHIKUNI *et al.*²⁾ and RANDO *et al.*⁷⁾ We obtained data for only one BB sample, therefore, the least-square analysis of variance was done without BB data. The least-square means and standard error for daily gains from birth to 60 days old are presented in Table 1. The main effect of the parity number was significant ($P = 0.0134$). This shows that the calf of an AA genotype dam tends to have a higher value in daily gain from birth to 60 days than that of an AB genotype dam ($P = 0.0596$). SHIMADA *et al.*⁸⁾ mentioned that the milk performance of Japanese Black cows could be estimated by the calf daily gain from birth to 60 days of age. Therefore, our results suggest that AA cows produce more milk than AB cows. We thought that the relation between κ -casein genotypes and milk performance appeared clearly in beef cattle. In Holstein cows, KOMATSU *et al.*⁵⁾ reported that κ -casein AB cows produced more milk than AA cows. This result was different from our current study, though the reason was not discovered. We must do further research on the relation between κ -casein genotypes and milk performance in other breeds.

Table 1. Least-squares means and standard errors for calf daily gain from birth to 60 days (kg/day)

Effect	No.	Least-squares mean	Standard error
Overall mean	74	.7730	.0280
κ -casein genotypes			
AA	39	.8109 ^a	.0349
AB	35	.7352 ^b	.0380
Parity			
1	21	.6558	.0418
2	17	.8282	.0403
3-4	19	.7880	.0370
5-7	13	.7975	.0420
8-9	4	.7956	.0662

^{a, b}: The probability of the means with different superscripts with main effects was $P < 0.0596$.

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