Doctoral Thesis

Association with Temperament, Behavior and Polymorphisms in Cattle

(Summary)

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（ウシにおける気質、行動及び遺伝子多型との関係）

Understanding the temperament of live-stocks plays an important role in improving productivity and welfare during managing. For instance, when the feeding condition was inappropriate, the feed intake of live-stocks will decrease. Temperament of an animal can be defined as the behavioral responses of an animal to handling by humans, which includes its excitatory or inhibitory reactions, levels of motor activity, persistent habits, emotionality or alertness. Because understanding the certain behaviour is considered to be useful to animals, it is necessary to study the relation between behaviors and genetic genes of animals. Due to above investigations were not operated on cattle, therefore, some genetic polymorphisms will be studied to understand behavioral traits and temperament of cattle correctly. The present dissertation describes four studies that were designed to evaluate the association with temperament, polymorphisms and production in cattle; (1) sex, age or genetic differences related to play behaviors, (2) the facial hair whorl position and raising environment on temperament of cattle, (3-4) association with behavioral traits, temperament and genetic polymorphisms in cattle.

First study was designed to investigate age, sex, and genetic differences of Japanese Black calves in relation to frequency of play behaviors (galloping, leaping, turning, bucking, head butting objects, and head shaking) and examined how these relationships might affect growth during the suckling stage. Locomotor play behaviors (galloping, leaping, turning, and bucking) and head butting objects gradually declined with the age for both sexes, but the frequency of head butting was significantly higher in males than females. The author found significant interaction effects (age × *MAOA* polymorphism) in play behaviors (except head shaking) and the frequencies of locomotor play in calves without the wild-type allele were significantly higher than those in younger calves (2 and 6 weeks of age). Weight gain was significantly correlated with the frequency of locomotor play in females, but not in males. This study suggests that play in Japanese Black calves gradually declines as they mature and that play may be controlled by variations in the *MAOA* gene. In addition, the frequency of locomotor play may be an indicator of health in female calves.

Second study was designed to determine if there is a relationship between hair whorl position and temperament using questionnaire in Chinese yellow cattle. In addition, the effect of raising environment is investigated. The overall distribution of facial hair whorl was: 20.5% high, 58.2% middle, 13.1% low, 6.6%

double and 1.6% no hair whorl. The scores of grassland were significatly higher than those of village in terms of “Retentive memory”, “Sensitivity” and “Timidity” while lower in “Docility” and “Fortitude”. Also, the score of village for “Nervousness” tended to be lower than one of grassland. As for the whorl position difference, the scores of high position tended to be higher than those of middle plus low positons in terms of “Adaptability” and “Obedience”. On the other hand, there was a tendency that score of high position was lower than other in “Excitability”. Significant interaction between area and whorl position was observed in “Friendliness to cattle”, and significant area effect were also detected. In addition, a tendency in interaction (area × whorl position) was detected in “Curiosity”. These data suggest that hair whorl location may be effective to predict temperament in cattle, but that there are some temperaments to change under the influence of environment and/or handlings.

Third study was designed to look for associations between the SNPs in these three genes (MAOA, CRH and LEP), involved in the interconnected HPA axis and/or appetite pathways, with various measurements of behavioral temperament in Japanese Black cattle. The aim of the present chapter was to investigate the associations between the SNP of MAOA, CRH or LEP with various measurements of behavioral temperament in Japanese Black cattle. As for the variation of MAOA, there was a significant difference between wild and mutation-types in tast A ($P < 0.05$), but not B and C. Additionally, the score of mutation-type tended to be lower than one of wild-type ($P < 0.1$). On the other hand, scores in all tests were not significantly different between genotypes of both CRH and LEP ($P > 0.1$). These data suggest that some SNPs affect behavioral response in Japanese Black cattle.

Last study was designed to estimate the effect of LEP, NPY, CAST and DGAT loci on temperament traits in the Japanese Black population. Since the results for the possible use of the mentioned polymorphisms in selection to improve temperament traits are few in number and rather contradictory, it has been decided to carry out studies in the existing Japanese Black population with the aim to provide additional data to this particular subject. The scores of “Nervousness” and “Timidity” in mutant homozygous genotype of *LEPE2FB* was significatly lower than ones in wild homozygous genotype. In “Fortitude”, the score in heterozygous genotyped cattle was lower than other. The scores in mutant homozygous genotype of *LEPE2JW* were significatly higher than those in wild homozygous genotype in terms of “Nervousness”, “Excitability”, “Inconsistent emotionality”, “Sensitivity” and “Timidity” while lower in “Obedience”, “Fortitude” and “Friendliness to cattle”. The scores of “Curiosity” and “Frindliness to cattle” in mutant homozygous genotype of *NPY* was significatly lower than ones in wild homozygous genotype. In “Fortitude”, the score in heterozygous genotype was lower than one in wild homozygous genotype. The scores of “Adaptability” and “Docility” in wild homozygous genotype of

DGAT was significatly higher than ones in mutant homozygous genotype. The scores in mutant homozygous genotype of *CAST282* were significatly higher than those in wild homozygous genotype in terms of "Inconsistent emotionality" while lower in "Fortitude". In "Adaptability", the score in mutant homozygous genotype was lower than in wild homozygous and heterozygous genotypes. The score of "Fearfulness" in heterozygous genotyped cattle was lower than others. The score for "Inconsistent emotionality" in mutant homozygous genotype of *CAST2959* was higher than ones in other genotypes. In "Sensitivity", the score in heterozygous genotype was lower than one in mutant homozygous genotype. These data suggest that SNPs affect temperament in Japanese Black cattle. It may be possible in the future to select for temperament alongside production.

In conclusion, these data suggest that Some SNPs affect temperament and/or behavioral traits in Japanese Black cattle. It may be possible in the future to select for temperament alongside production and welfare.