

学 位 論 文 要 旨

氏名 井尻 萌

題 目 : Studies on stress by heat and transport in swine.
(豚の暑熱・輸送ストレスに関する研究)

論文要旨 :

As global demand for food increases, intensive livestock production is becoming more common, which is known to cause various stress-related health problems in animals. This not only directly affects livestock productivity, but in recent years, with the growing interest in animal welfare, it is desirable to develop a method of feeding livestock with less stress on them. On the other hand, although various biomarkers have been proposed to evaluate stress in livestock, there is no gold standard procedure, indicating the difficulty of stress assessment in livestock. In this dissertation, I focused on the effects of stress during swine feeding and management.

In Chapter 1, the effects of seasonal heat stress in Kagoshima Berkshire pigs reared in the subtropical region were investigated by comparing the biomarker changes in the summer and winter seasons. Pigs were allocated to summer- and winter-finishing cohorts, 12 each. The evaluations included assessment of carcass traits and internal organs' normality carried out at the time of slaughter, and measurement of biomarkers in whole blood: derivatives of reactive oxygen metabolites (d-ROMs) and biological antioxidant potential (BAP) as markers of oxidative stress, and serum amyloid A (SAA) and albumin/globulin (A/G) ratio as markers of acute and chronic inflammation, respectively. During the summer, the feeding environment in Kagoshima exceeded the thermal neutral zone for pigs, suggesting that the pigs were exposed to chronic heat stress. In winter, on the other hand, the pigs were within the thermal neutral zone throughout the rearing period. In addition, the summer-finished pigs reared under subtropical field conditions showed lower carcass quality than the winter-finished pigs, indicating a potential adverse effect of summer temperatures on the swine industry. Marginal changes were observed in d-ROMs and the A/G ratio between the summer- and winter-finishing cohorts. The results demonstrated that d-ROMs and the A/G ratio could be used as sensitive markers for heat stress under field conditions.

In Chapter 2, the effects of transport stress were examined using experimental microminipigs, and the stress-reducing effects of acupuncture via ear acupuncture points were evaluated. The effects of transport and acupuncture treatment on pigs were examined using blood stress marker. Six animals were equally divided into two groups (Control and Treatment). In the treatment group, before transportation (6 h; vehicle and plane), short, ultrathin circular transdermal needles were applied to locations corresponding to the acupoints on the apical area of both ears.

Peripheral blood samples were collected from the cranial vena cava 2 days before and immediately after transportation. Blood stress markers, biochemistry indicators, and oxidative stress levels were examined. Transport stress induced an increase in blood cortisol, SAA, glucose, non-esterified fatty acid, and d-ROMs and decreased the BAP/d-ROMs ratio yet did not affect BAP. Acupuncture suppressed the increases in SAA and d-ROMs values and the decrease in BAP/d-ROMs ratio. As a follow-up study, diarrhea incidences after transportation in the control and treatment groups were also investigated. The total diarrhea incidence was 25% in the control group, whereas diarrhea was not observed in the treatment group. These results suggest that acupuncture treatment suppresses hypothalamic–pituitary–adrenal function and, as a result, reduces transport stress without affecting the suppression of the central catecholaminergic system. Therefore, acupuncture treatment for transport stress was considered to have the potential to improve animal welfare. In summary, this dissertation verifies the effects of heat and transport stress on pigs and demonstrates the effectiveness of acupuncture as a method of reducing these effects. These should contribute to the development of livestock stress research and the establishment of strategies to manage stress in pigs.

Stress in the actual feeding environment did not necessarily show obvious changes in stress markers, but it was suggested to affect health status and meat quality. Furthermore, d-ROMs and BAP, indicators of oxidative stress, are sensitive markers and may be useful in assessing stress in livestock. The development of simpler and easier stress assessment methods is essential for livestock stress research and further study is desirable. In addition, the effects of acupuncture shown in this study provide a new perspective on stress management in livestock. Recently, functional saccharide named 1,5-anhydro-d-fructose (1,5-AF) was reported to increase endogenous oxytocin secretion in mice, suggesting that it may be effective in reducing stress in humans and animals. Since it has been suggested that 1,5-AF may be effective with oral administration, 1,5-AF is expected to be easily applied to livestock, including pigs. Stress reduction methods such as acupuncture and the administration of functional substances such as 1,5-AF are revolutionary in that they can contribute to stress reduction without requiring changes in equipment or husbandry methods.

(和文2,000字又は英文800語程度)