

Department of Bioresource Science and Technology

Fundamental study on the analyzing method of energy revenue and energy expenditure in grazing heifers

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The purpose of this study is to determine heat production (HP), which is one of the useful information for cattle feeding technology, using the regression equation of HP on heart rate (HR). Under different conditions, a regression between the amount of walking exercise and HP, and a regression between feed intake level and HP were studied. Further, to built the advanced grazing technology, it was studied that the analysis of energy revenue and energy expenditure of grazing heifers using estimated HP from HR in the field.

1. HP is important information on the management of animal nutrition and the management of environmental temperature in animal house. HP is usually calculated from the results of respiration test, but it is difficult in grazing animals. There is an estimating method from the regression equation of HP on HR, which is more easy to measure than HP measurement in the field. However, until now, the research using this method has been poorly applied to grazing animals. It is necessary that the effect of walking exercise and feeding level on HP, and the relationship between HR and HP are studied precisely.
2. The relationship between the walking exercise and HP of heifers was examined in changing walking speed. It was shown the clear change in HP by walking speed even in less than 30m/min.
3. The relationships between feed intake level, mean daily gain (DG) and HP were studied. HP and mean body temperature could use as standard of physiological status of heifers. It was also found that from the regression equation of HP on HR, HP was able to be well estimated independent of feeding level.
4. In examination of estimated HP from HR in two different conditions, by changing walking speed and by changing feeding level, the relationship between HP and HP of Holstein heifers was checked. The regression coefficients of equations of HP on HR were not different significantly under both conditions.
5. Using the regression equation of HP on HR, the energy revenue and energy expenditure were studied in gazing condition. Metabolizable energy intake (MEI) was calculated by herbage intake, and net energy for growth (NEg) was calculated from daily gain (DG). The results showed that while DG is plus value, sum of HP and NEg agreed well with MEI. Therefore, it was possible that the analysis of energy revenue and energy expenditure of grazing heifers using estimated HP from HR.
6. In general discussion, the relationships between HR and MEI, resting HR, mean HR and HP

were done. It was impossible the estimation of MEI from HR. There exists a high correlation between mean HR and total HP per day. In analysis of energy revenue and energy expenditure, the accuracy of NEg was discussed. Twenty $\text{kJ/kg}^{0.75}$ day, corresponding DG 0.1 kg, was the limit of estimation, and it may have enough accuracy in heifer production in the field. HP can be estimated by HR measurement, and then it is possible the analysis of energy revenue and energy expenditure in grazing cattle. These developments of managing technology focusing on living information from animals will surely contribute to improvement of grazing animal production.

Key words: energy expenditure, heart rate, heat production, regression equation, walking exercise, feeding level, grazing heifer