COMPARISONS OF ENERGY UTILIZATION BETWEEN JAPANESE BLACK AND HOLSTEIN STEERS

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Introduction

Japanese Black (JB) and Holstein (H) steers are important in Japanese meat production. However, the knowledge of energy requirements of JB is still poor compared to that obtained on European breeds. Hasizume et al. (1962) reported that JB cows showed lower basal metabolism than H cows. Moreover mature weight of JB is smaller than that of H. Therefore it is considered that energy requirements of H steers could not be directly applicable to these of JB steers.

The object of the present study is to assess the differences in the efficiency of metabolizable energy (ME) utilization for growth and ME requirements for maintenance between JB and H steers at the same body weight.

Materials and Methods

Six JB steers (16 months-old, 373 kg) and 6 H steers (14.6 months-old, 387 kg) were used. Both breeds were offered the experimental ration at 3 different levels [maintenance(M), 1.5xM, 2xM]. The experimental ration consisted of 30% Italian ryegrass hay wafer [second cut, crude protein (CP) 8.4%, organic cell wall(OCW) 58.5% in a dry matter] and 70% concentrate (CP 14.2%, OCW 18.7%).

Energy balance trials were carried out using open circuit respiration chambers (Iwasaki et al., 1982).

On the last day of each trial, rumen fluid samples were collected at 0 hr and at 3 hr after feeding. VFA, NH_3-N, pH and numbers of protozoa in the rumen fluid were measured.

Results and Discussion

Results of energy and nitrogen balance trials

TABLE 1. RESULTS OF ENERGY BALANCE TRIALS

Breed	Holstein			Japanese Black		
Feeding level	1xM*	1.5xM	2xM	1xM	1.5xM	2xM
Energy balance (kcal/kgBW$^{0.75}$)						
GE intake	200.2	294.0	378.0	190.2	279.0	378.6
DE intake	150.2	214.8	263.6	141.0	192.7	256.7
ME intake	125.1	181.7	229.6	118.8	166.3	221.3
Excretion						
Feces	50.1	79.2	114.4	49.2	86.3	122.0
Urine*	6.7	7.8	8.2	5.7	6.2	7.7
Methane	18.5	25.3	25.9	16.6	20.3	27.6
Heat production**	131.3	148.7	179.3	111.5	126.0	160.6
Retention	−6.2	33.0	50.3	7.3	40.3	60.8
as fat*[F]	−10.9	24.9	38.0	2.5	31.3	49.6
as protein[P]	4.7	8.2	12.3	4.8	9.0	11.2

M : Maintenance feeding level.
[F]Deposit energy as fat was calculated as (energy retention-deposit energy as protein).
[P]Deposit energy as protein was calculated from nitrogen retention (nitrogen retention x 6.25 x 5.7 kcal/g).
*The effect of breed was significant at 5% level.
**The effect of breed was significant at 1% level.

were shown in table 1. Energy excretion in feces of JB steers was more and energy excretion as methane was less than that of H steers (no significance). There were significant difference between breeds in energy excretion in urine ($p < 0.05$). Heat production of JB steers was lower than that of H steers significantly ($p < 0.01$). Deposit energy as protein was not different between breeds but deposit energy as fat of JB steers was more than that of H steers ($p < 0.05$).

The regression equations relating retention energy (Y, kcal/kgBW$^{0.75}$) to ME intake (X, kcal/kgBW$^{0.75}$) were as follows.

JB steers : $y = -51.9 + 0.523\ x$
H steers : $y = -71.4 + 0.543\ x$

Efficiency of ME utilization for growth was 52.2% for JB steers and 54.3% for H steers, though there was no difference between breeds. ME requirements for maintenance were 100 kcal/kgBW$^{0.75}$ for JB steers and 131 kcal/kgBW$^{0.75}$ for H steers.

pH in rumen fluid of JB steers showed lower value and total VFA and NH_3-N of JB steers were higher than that of H steers at 3 hr after feeding, but not significant. The molar proportion of acetic acid propionic acid and butyric acid were 67%, 17% and 13% for JB steers and 71%, 14% and 12% for H steers at 0 hr and 63%, 19% and 15% for JB steers and 65%, 18% and 14% for H steers at 3 hr, respectively.

Vermorel et al. (1976) observed different maintenance requirements and the similar efficiency of ME for growth between Friesian and Charolais at 16 months of age. Our results agreed with their observation, however the breed difference of the maintenance requirement in our study was larger than that of Vermorel et al. (1976). The breed differences in rumen fermentation pattern were significant but small. Therefore other factor, for instance hormonal factor, contributed to the breed differences in energy requirements for maintenance. More detailed experiments are necessary to clarify the breed differences in energy utilization between JB and H steers.

(Key Words: Energy Utilization, Steer, Growth)

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