Energetic efficiency of Thai native beef cattle fed rice straw or Ruzi straw base diet

K. Kongphitee¹, S. Udechachon², M. Otsuka³ and K. Sommart¹*

Abstract: The objective of this study was to determined MEₘᵣ and energy utilization of fattening Thai native beef cattle fed rice straw or Ruzi straw base diet using the open-circuit indirect calorimetry method. Twelve Thai native beef cattle (average body weight 342.25±30.46 kg) were housed in individual pens. Dietary treatments were applied in a randomized complete block design (RCBD) and were block by weight, animals consisted of ad libitum mixed concentrate with Ruzi straw (T₁), ad libitum concentrate with rice straw (T₂) and ad libitum concentrate with rice straw (T₃) (this animal group were fasting and restricted feed). All dietary treatments were total mixed rations containing concentrate with roughage (70:30). A significant linear relationship between metabolizable energy intake (MEI) and energy retention (ER) was obtained; ER = (0.6379 (SE = 16.46) x MEI) - 345.30(SE = 0.03), (R² = 0.955; P<0.001; RSD = 7.81; n = 20). Thus, metabolizable energy requirement for maintenance (MEₘᵣ) of fattening Thai native beef cattle was determined to be 541.31 KJ/kgBW⁰.⁷⁵/d. Efficiency of utilization of ME for maintenance (kᵢₚ) and for growth (kₚ) was determined to be 0.60 and 0.35 respectively. Moreover, results from this study suggest that ME for maintenance of Thai native cattle can used for feeding guideline under tropical condition.

Keywords: Energy requirement, Thai native beef cattle

Introduction

The energy and nutrient requirements for beef cattle recommended by NRC (2000) are widely adopted to formulate diets around the world (Chizzotti et al., 2007). Nevertheless, the energy requirement is based on Bos taurus data. The NRC (2000) indicated that growing Bos indicus cattle required about 10% less metabolizable energy for maintenance (MEₘᵣ) than Bos taurus cattle. In Thailand, the data of WTSR (2008) indicated that growing Thai native cattle required 484 KJ ME/kgBW⁰.⁷⁵/d and Chaokaur et al. (2007) suggested that growing Brahman cattle required 458 KJ ME/kgBW⁰.⁷⁵/d. Because of limited data are available to MEₘᵣ for fattening Thai native beef cattle under tropical condition. This experiment was designed to determined MEₘᵣ and energy utilization of Thai native beef cattle fed rice straw or Ruzi straw base diet using the open-circuit indirect calorimetry method.

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Materials and methods

Twelve Thai native beef cattles (average body weight 342.25 ±30.46 kg) were housed in individual feeding pens. The animals were fed at ad libitum of maintenance requirement (assuming as 484 kJ ME/kgBW^{0.75}/d) (WTSR, 2008). Dietary treatments were applied in a randomized complete block design (RCBD) and were block by weight, animals consisted of ad libitum mixed 70% of concentrate with 30% of Ruzi straw (Ruzi straw as Ruzi pasture after seed harvest) based diet for 90 day (T₁), ad libitum 70% of concentrate with 30% of rice straw based diet for 90 day (T₂) and ad libitum 70% of concentrate with 30% of rice straw based diet for 50 day (T₃) (this animal group were fasting 7 day and restricted feeding 30 day). After treatment period animals were standing in individual head box respiration chamber 3 day for heat production measurements (Suzuki et al., 2008) and 6 day for nutrients digestibility. The weight of feed offered and refused, feces and urine were recorded and sampling daily. Samples were analyzed by AOAC (1990) methods. Heat production was calculated according to Brouwer (1965). Data were subjected to analysis of variance and treatment means were compared using least significant difference (SAS, 1996). Metabolizable energy for maintenance (ME_m) was estimated using linear regression between metabolizable energy intake (MEI) and energy retention (ER) according to ARC (1980). Efficiency of utilization of ME for maintenance (k_m) was estimated by regression the difference between MEI and ER when fed near maintenance and fasting, efficiency of utilization of ME for growth (k_g) was estimated by regression the difference between MEI and ER when fed near maintenance and ad libitum.

<table>
<thead>
<tr>
<th>Items</th>
<th>Dietary treatment</th>
<th>SE</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number animal, head</td>
<td>T₁</td>
<td>T₂</td>
<td>T₃</td>
</tr>
<tr>
<td>Average body weight, kg</td>
<td>349.50</td>
<td>347.50</td>
<td>338.08</td>
</tr>
<tr>
<td>Average daily gain, kg/h/d</td>
<td>0.50</td>
<td>0.50</td>
<td>0.58</td>
</tr>
<tr>
<td>Feed intake, kg/h/d</td>
<td>4.03</td>
<td>4.07</td>
<td>4.82</td>
</tr>
<tr>
<td>Energy partition, kJ/kgBW^{0.75}/d</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GE intake</td>
<td>900.63</td>
<td>904.48</td>
<td>1197.79</td>
</tr>
<tr>
<td>DE intake</td>
<td>576.14</td>
<td>611.12</td>
<td>805.71</td>
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<tr>
<td>ME intake</td>
<td>487.11</td>
<td>527.70</td>
<td>701.37</td>
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<tr>
<td>Feces excretion</td>
<td>324.49</td>
<td>293.36</td>
<td>392.08</td>
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<tr>
<td>Urine excretion</td>
<td>15.21</td>
<td>11.58</td>
<td>14.29</td>
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<td>Methane production</td>
<td>73.82</td>
<td>71.84</td>
<td>90.05</td>
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<td>Heat production</td>
<td>519.89</td>
<td>518.13</td>
<td>618.69</td>
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<tr>
<td>Energy retention</td>
<td>-32.79</td>
<td>9.58</td>
<td>82.68</td>
</tr>
</tbody>
</table>

<sup>a, b</sup>: Least square means with different superscripts among treatments significantly differ (P<0.05).

<sup>1</sup>: SE, standard errors; GE, gross energy; DE, digestible energy; ME, metabolizable energy.
Results and discussions

The energy balance including the results of the metabolism trial in Thai native beef cattle are shown in Table 1. The GE, DE and ME intake and heat production on the basis of metabolic body size was higher in T3 (P<0.01) than T1 and T2, but there was not significantly difference between T1 and T2.

Energy excretion into feces, urine, methane and energy retention were not significantly difference (P>0.05) among the treatments. The results indicated that heat production increased as ME intake increased. Especially, animals fed T3 was higher efficiency of feed utilization than T1 and T2, because compensatory growth was the ability of animals to exhibit after feed restriction (Hornick et al., 1998)

A significant linear relationship between metabolizable energy intake (MEI) and energy retention (ER) were obtained; ER = (0.6379 (SE = 16.46) x MEI) - 345.30 (SE = 0.03) (R² = 0.955; P<0.001; RSD = 7.81; n = 20). Thus, metabolizable energy requirement for maintenance (ME_m) was determined to be 541.31 KJ/kgBW^{0.75}/d (see also in figure 1). In these present study the ME_m was similar to NRC (1976) report for British breeds (540 KJ/kgBW^{0.75}/d). However, these values were higher than the values was reported by Chokaur et al. (2007) for growing Brahman cattle, Nitipot et al. (2008) and Tangjitwattanachai (2010) for growing Thai native cattle (458, 509 and 532 KJ/kgBW^{0.75}/d, respectively).

Efficiency of utilization of ME for maintenance (k_m) and for growth (k_g) were determined to be 0.60 and 0.35 respectively. In these results k_m were similar to growing Brahman cattle reported by Chokaur et al. (2008) (k_m = 0.58) and growing Thai native cattle reported by Nitipot et al. (2008) (k_m = 0.62). The results k_g were similar to Ferrell and Jenkins (1998) for growing Boran cattle (k_g = 0.32). Nevertheless, these values were lower than the values reported by Tangjitwattanachai (2010) for growing Thai native cattle (k_g = 0.53).

**Figure 1** The relationship between metabolizable energy intake and energy retention.
Conclusions

The result of study indicated that metabolizable energy requirement for maintenance of fattening Thai native beef cattle with offer poor quality roughage based diets under tropical condition was determined to be 541.31 KJ/kgBW^{0.75}/d. Efficiency of utilization of ME for maintenance ($k_m$) and for growth ($k_g$) were determined to be 0.60 and 0.35 respectively.

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References


