Effects of metabolizable energy intake on growth performance and nutrient digestibility of Thai native cattle

Natthamon Tangjitwattanachai[1*] and Kritapon Sommart[2]

ABSTRAC: This study was aimed to assess the effects of metabolizable energy intake on growth performance and nutrients digestibility in growing Thai native cattle. Eighteen beef cattle were randomly allocated to one of three dietary treatments in a randomized complete block design (RCBD). Animals were fed at 1.3M, 1.7M and *ad libitum* intakes for 136 days (assuming M = 450 KJ/kgBW$^{0.75}$/d). The results showed that feed intake was increases significantly ($P < 0.05$) with increasing metabolizable energy intake. Average daily gain and average body size gain were linear ($P < 0.05$) increased with increasing metabolizable energy intake. Nutrients digestibility were similar among treatments ($P > 0.05$). This recent study was indicated that growth performance can improve by increasing metabolizable energy intake, but metabolizable energy intake were no influence on the nutrients digestibility.
Keywords: Cattle, Digestibility, Growth

Introduction

Energy is main restraint of feed cost for beef production. AFRC (1993) recommended that energy supply is normally the first limiting factor on microbial protein synthesis; because microbial growth is depend on the supply of fermentable carbohydrate (Nocek and Russell, 1988). Lammers and Heinrichs (2000) found that feeding dietary high fractions of protein to energy above NRC recommendations can improved feed efficiency ~6% and average daily gain ~9% in cattle. High-energy diets allowing rapid body weight gain and excess fattening in ruminant. Several studies suggested that increased energy supplements can improve energetic efficiency compared to animals fed at maintenance level (Sejrsen and Purup, 1997; Sauvant and Giger-Reverdin, 2007). In Thailand, Thai native breed represents more than 70% of the country's beef cattle herd (DLD, 2008), but they are smaller mature body size and growing at slower rate as compared to other breeds. Sukho (2008) and Kaewpila (2010) reported that average daily gain of Thai native were increased with increasing metabolizable energy intake, but the nutrients digestibility cattle were not influenced by increasing energy intake. However, the works on metabolizable energy intake on growth performance and nutrient digestibility of Thai native cattle are scantly. Therefore, this study was investigated the effects of metabolizable energy intake on growth performance and nutrient digestibility in Thai native cattle.

[1] Faculty of Veterinary and Animal Sciences, Mahasarakham University, Mahasarakham 44000, Thailand
[2] Department of Animal Sciences, Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002, Thailand
* Corresponding author: nn2520@yahoo.com

Materials and Methods

This experiment was conducted at Khon Kaen University's farm of the faculty of Agricuture, Khon Kaen University. Eighteen growing male Thai native beef cattle, with average initial body weight of 94.30 ± 16.5 kg and 13 months of age were used in this study. Thai native beef cattle were blocked by weight and randomly allocated to one of three dietary treatments in a randomized complete block design (RCBD) with six animals in each group. Treatments were levels of metabolizable energy intake as follows; T1 = 1.3 of maintenance (1.3M), T2 = 1.7 of maintenance (1.7M) and T3 = *ad libitum*. (assuming M = 450 KJ/kgBW$^{0.75}$/d, according to Chaokaur et al.(2007)). Daily total mixed ration of ruzi hay and concentrate was offered throughout the course of feeding trial. The compositions of the diets were present in **Table 1**.

Digestion trial period was consisted of a 14 day adaptation period and 7 day collection period. The animals were switched to metabolic cage for intake, feces and urine samples collection. Samples of feed and feed refusal were collected for prepared to chemical analysis. Total feces and urine were sampling daily in the morning and stored at -18 ˚c. At the end of period, all samples were thawed; mixed thoroughly, sub-sample (1 kg of feces and 500 ml of urine) and stored at -18 ˚c for chemical analysis. The composites of feed, orts, urine and feces were taken for gross energy determination with a SHIMADZU auto-calculating bomb calorimeter according to AOAC (1990). Proximate analysis was carried out on the minced samples for dry matter (DM), Crude protein (CP), Ether extract (EE) and Ash according to the methods of AOAC (1990). Contents of Neutral detergent fiber (NDF) and Acid detergent fiber (ADF) were determined according to the methods of Goering and Van Soest (1970). Energy content of feed was measured by using data from the digestion trial. Gross energy intake was calculated from gross energy content in feed multiplied by average daily feed intake. Metabolizable energy intake data was calculated as gross energy intake minus feces energy and urine energy, multiplied by 0.93 to correct for fermentation losses according to ARC (1980) and Liang and Young (1995). All data were analyzed by ANOVA and differences among treatments means were tested by Duncan's new multiple range test by using PROC GLM of SAS (1999). Polynomial contrasts were used to determine the influence of increasing energy intake on animal performance using PROC GLM of SAS with a $P < 0.05$ significant level.

Results and Discussions

Growth performance

The positive effect of metabolizable energy intake on average daily gain and average body dimension (height, length and heart girth) resulted in linear relationship with metabolizable energy intake increasing from 590.83 to 775.16 KJ/kgBW$^{0.75}$/d. The highest average daily gain from this study was 521.20 g/d or 13.48 g/kgBW$^{0.75}$/d, it was obtained in cattle fed *ad libitum*. The highest of average body height, length and heart girth were 0.09, 0.13 and 0.16 cm/d, respectively. The growth performance data are shown in **Table 2**.

Table 1 The chemical composition of experimental diet (DM basis).

Item	Experimental diet
Ingredient, %	
Ruzi grass hay	30.0
Cassava chip	32.0
Rice bran	22.5
Coconut meal	4.0
Palm kernel cake	10.0
Urea	1.0
Chemical composition , %	
DM	93.80
CP	10.03
OM	94.68
EE	4.70
NDF	37.13
ADF	23.98
Energy content, MJ/kg DM	
GE	18.02
DE	11.54
ME	10.43

Table 2 Average daily gain and average body size gain of Thai native cattle fed diets containing various metabolizable energy intake.

	Levels of metabolizable energy				Polynomial contrast [1] P-value	
Item	1.3 M	1.7 M	*ad lib*	SEM	L	Q
Feed intake, kgDM/d	1.97 ^{b}	2.54 ^{a}	2.84 ^{a}	0.11	0.009	0.96
Energy partition						
GE intake, KJ/kgBW $^{0.75}$ /d	1063.91^{b}	1202.72^{a}	1279.63^{a}	29.17	0.01	0.46
ME intake, KJ/kgBW $^{0.75}$/d	590.83^{c}	713.53^{b}	775.16^{a}	17.15	0.001	0.21
Body weight						
average daily gain, g/d	307.52^{c}	416.27^{b}	521.20^{a}	33.18	0.01	0.96
average daily gain, g/kgBW $^{0.75}$/d	8.83^{c}	11.26^{b}	13.48^{a}	0.64	0.001	0.89
Body dimension						
average height gain, cm/d	0.07^{b}	0.07^{ab}	0.09^{a}	0.01	0.001	0.83
average length gain, cm/d	0.07^{b}	0.10^{ab}	0.13^{a}	0.01	0.001	0.84
average hearth girth gain, cm/d	0.11^{b}	0.15^{a}	0.16^{a}	0.01	0.001	0.35

[1] Probability of a significant effect of levels or of a linear (L) or quadratic (Q)

$^{a-c}$ Within a row, means without a common superscript letter differ ($P < 0.05$)

Table 3 Nutrients digestibility of Thai native cattle fed diets containing various metabolizable energy intake.

Item	Levels of metabolizable energy			SEM	Polynomial contrast [1] P-value	
	1.3 M	1.7 M	*ad lib*		L	Q
Nutrients digestibility, %						
DM	70.63	73.52	70.82	2.17	0.95	0.31
OM	71.50	72.58	67.34	2.21	0.20	0.26
CP	62.66	65.44	58.61	3.10	0.36	0.22
EE	80.56	80.17	80.09	2.04	0.87	0.94
NDF	58.31	58.69	51.54	3.25	0.16	0.35
ADF	49.03	50.07	39.76	3.87	0.11	0.24

[1] Probability of a significant effect of levels or of a linear (L) or quadratic (Q)

The results from this study were in good agreement with Foldager and Krohn (1994) and Bar-Peled et al. (1997), who demonstrated that a high energy level can be increased average daily gain of steer and heifer. Similarly, Sugimoto et al. (2004) also reported that increased total digestible nutrient intake resulted in increased average daily gain and withers height gain in steers. These findings indicated that increase in energy intake can improve animal performance, as many other researchers have noted (Bowman and Sanson, 1996; Caton and Dhuyvetter, 1997).

Nutrient digestibility

Apparent digestibility of all nutrients were not ($P > 0.05$) affected by increasing metabolizable energy intake. Nutrient digestibilities in Thai native cattle are shown in **Table 3**.

The result from this study are in good agreement with report of Reed et al. (2007) and Walsh et al. (2008), who found that the digestibility of organic matter, crude protein and neutral detergent fiber were not affected by increasing energy intake. Moreover, this study supports the report of Shellito et al. (2006), who found that total tract digestion of dry matter, organic matter and nitrogen cannot be improved by increasing intake level. This study was indicated that increased feeding and energy level intake cannot improve nutrients digestibility. However, it is unclear if changes in apparent digestibility are accompanied by changes in metabolizable energy intake or in efficiency of metabolizable energy use by the animal (Clark et al., 2007).

Conclusions

A positive linear effect was found for average daily gain and body size gain as the metabolizable energy intake increased. Nutrient digestibility were no influenced ($P > 0.05$) by metabolizable energy intake. This study demonstrated that increase in energy intake can improve growth performance in Thai native cattle.

Acknowledgments

The authors thank Khon Kaen University, Mahasarakham University and Japan International Research Center for Agricultural Sciences (JIRCAS) for support this research project.

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