GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND MEAT COMPOSITION OF NATIVE THAI BEEF CATTLE FED DIETS DIFFERED IN FEEDING LEVELS IN THE TROPICS

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Abstract - The objective of this study was to determine the effects of feeding level on growth performance and carcass characteristics in beef cattle. Eighteen yearling bull native Thai cattle were randomly allocated to one of three feeding levels dietary treatment (1.3xM, 1.7xM and *ad libitum* intake) in a randomized complete block design. Animals were fed dietary treatments in individual pens with free access to drinking water and mineral block for 136 days trials until slaughter. Dry matter and energy intake increased significantly (*P*<0.01) with an increasing feeding levels. Increasing energy density in the diet also resulted in a linear improved (*P*<0.01) in growth performance, carcass quantity, fat deposition in meat component. The results demonstrated that increasing feeding level resulted the increased in growth performance, carcass yields and enhance intramuscular fat deposition because of the improving in feed intake and thus, energy supply and retained in Zebu beef cattle in the tropics.

Key words: *Bos indicus*, carcass yields, feeding

I. INTRODUCTION

The major key reasons for low productivity in the tropical developing countries are animal genetic potential, available feeds and feeding systems that dependent on low quality crop by-products and, thus affected feed intake, digestion and energy supply, thus limit productivity and environmental sustainability [1, 2, 3]. Native Thai beef cattle (*Bos indicus*; humped or Zebu cattle) is small mature body size and growing at slower rate as compared to European breeds, but they have promising on global warming adaptability such as to oppose hot and humid condition, tolerate extreme sunshine, resist parasites and utilize poor quality diets. Tropical feeding systems of beef cattle are normally fed in a system based on pasture or crop residues or both that is often lack both protein and energy. Nutritional feeding guidelines of native cattle have not been well defined because paucity of information on nutrient requirement.

Recently, daily energy requirements for maintenance of beef cattle in the tropics have been established using the indirect calorimetry with head hood respiration method estimated were 435 to 520 KJ/kgBW$^{0.75}$ [1, 2, 3, 4]. However, research on energy utilization and it's affected on production performance and carcass quality in native Thai beef cattle is scarce.

The objective of this experiment was to determine the effects of feeding level on growth performance, carcass yield and rate of empty body fat-protein component gain in native Thai beef cattle.

II. MATERIALS AND METHODS

Eighteen yearling bull native Thai beef cattle, with an initial body weight of 94 ± 16 kg and average 13 months of age were housed individually pens with free access to drinking water and mineral. Animals were blocked by body weight in to 6 blocks. Within each block, the animals were assigned randomly to the three dietary treatments in a randomized complete block design.

Treatments were the level of metabolizable energy intake for maintenance requirement (M= 450 KJ/kgBW$^{0.75}$/d) for Zebu cattle as follows; Treatment 1 = 1.3xM, Treatment 2 = 1.7xM and Treatment 3 = *ad libitum*. Animals were fed a formulated diet (Table 1).

Table 1 Ingredient, analyzed chemical composition and determined energy content of diet (on a dry matter basis) [1]

Items	Experimental diet
Feed 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	93.8
CP	10.0
OM	94.6
EE	4.7
NDF	37.1
ADF	23.9
Energy content, MJ/kg DM	
GE	18.02
DE	11.54
ME	10.43

[1]DM, dry matter; CP, crude protein; OM, organic matter; EE, ether extracts; CF, crude fiber; NFE, nitrogen-free extracts; NDF, neutral detergent fiber; ADF, acid detergent fiber; GE, gross energy; DE, digestible energy; ME, metabolizable energy

Feeding trials was last for 136 days. Animals were fed twice daily at 08.00 and 16.00 h. Daily individual animal feed intake was recorded by weighing the offered and refused quantities. Samples of feed and feed refusal were collected. Animals were weighed every 2 weeks at the same time of the day before feed was offered. The weight of each animal was used as the basis for calculating the daily feed allocation for the next 14 days.

Proximate analysis was carried out on the minced samples for dry matter (DM), crude protein (CP), ether extract (EE), ash, neutral detergent fiber and acid detergent fiber were determined according to standard methods. Metabolizable energy intake was calculated as gross energy intake minus feces energy and urine energy, multiplied by 0.93 to correct for fermentation losses.

At the completion of the trial, all animals were slaughtered, warm carcass weight was recorded. The carcass were chilled at 3˚c for 24 h, and then determined of chilled carcass weight, percentage of kidney, pelvic and heart fat and yield grade following the equation from USDA quality grading standards for beef carcass [5]. The carcass was separated into bone and muscle. The weight was computed for the data of muscle per bone ratio, daily carcass gain and daily lean gain. After that, all sub-primal cuts were divided into retail cuts and sampling for meat chemical analysis.

All data were analyzed by ANOVA and differences among treatments means were tested by Duncan's new multiple range test. Contrasts were measured using polynomial orthogonal linear or quadratic comparisons significant.

III. RESULTS AND DISCUSSION

Feed intake, energy intake, growth performance and carcass quality are presented in Table 2. Increasing feeding level resulted in increased intake of dry matter, metabolizable energy intake and energy retained (P<0.01). Also, increasing feeding level resulted in increased (P<0.01) body weight gain and average daily gain. Our findings confirmed that increase in energy intake can improve zebu cattle production performance. The influence of feeding level on changes in energy loss via reduced methane energy gases has been confirmed for *Bos indicus* under humid, tropical conditions [1, 2]. Improving feed quality and amount of feeding at above maintenance may be an important strategy to improved energy utilization and thus, increasing beef productivity and environmental sustainability. However, results of growth performance from this study is less than reported by previous report [1, 2] who found that average daily gain of commercial fattening system in Brahman or native Thai - European crossbred cattle. Differences in breed type, age and slaughter weight and feeding regime may account for growth performance and carcass characteristics difference among these studies.

Increasing feeding level resulted in linear (P<0.01) increased in slaughter weight, hot and chilled carcass weight, muscle per bone ratio,

daily carcass and lean gain, and meat chemical composition (Table 2). The carcass trait as dressing percentage, rib eye area, KPH percentage and yield grade were not significantly (P>0.05) affected by the difference of energy intake. The dressing percentage from our study were range from 51.9% to 53.2%, which was less than the dressing percentage of native Thai purebred from previous report [6] (54.5% to 55.1%) and Thai native crossbred from report of [7] (56.2% to 58.1%).

Also, increasing feeding level resulted in linear (P<0.01) increased in intramuscular fat composition (Table 3). Feeding levels and muscle types (longissimus dorsi, psoas major and semimembranosus muscle) influence meat chemical composition, but there was no interaction between two factors (data not show). Results indicated that amount of energy supply affected partitioning of fat deposition.

IV. CONCLUSION

Feeding amount at above maintenance to *add libitum* to bull caused an appreciable amount of energy supply to be partitioned to carcass yield and fat deposition. Increasing feeding level resulted the greater growth performance, carcass yields and intramuscular fat deposition because of the improving in feed intake and thus, energy supply in Zebu beef cattle in the tropics.

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Table 3 Meat composition of native Thai beef cattle fed diets differed in feeding levels[1]

	Meat (M)[2]					Feeding level(F)				*P-value*	
	SM	RM	LD	PM	GN	1.3xM	1.7xM	*ad lib*	SE	M	F
DM	34.3^{a}	31.2^{c}	32.6^{b}	33.1^{b}	32.5^{b}	32.1^{b}	32.9^{a}	33.3^{a}	0.1	***	***
CP	21.2^{ab}	20.3^{c}	21.4^{ab}	20.3^{a}	21.5^{ab}	21.6^{a}	20.9^{b}	20.6^{b}	0.1	***	**
Ash	4.2^{a}	3.9^{a}	3.9^{a}	3.9^{a}	3.4^{b}	4.1^{a}	3.9^{ab}	3.7^{b}	0.1	**	NS
EE	6.4^{b}	7.9^{a}	6.9^{ab}	6.5^{b}	5.2^{c}	5.9^{b}	6.7^{ab}	6.9^{a}	0.2	***	*

[1]M=maintenance requirements (450 KJ ME/kgBW$^{0.75}$/d); SE, standard error; $^{a-c}$ Within a row, means without a common superscript letter differ *(P<0.05)*; * = P<0.05, ** = P<0.01, *** = P<0.001, NS = non-significant; DM, dry matter; CP, crude protein; EE, ether extracts; SM=semimembranosus RM=general red meat, LD=longissimus dorsi, PM=praos major and GN=gastrocnemius

Table 2 Daily feed intake, daily energy intake, growth performance and carcass yields of native Thai beef cattle fed diets differed in feeding levels[1].

Item	Feeding levels				*P* value	
	1.3xM	1.7xM	*ad lib*	SE	L	Q
No. of animal	6	6	6	-	-	-
Daily feed intake, kg DM	2.0[b]	2.5[a]	2.8[a]	0.1	**	NS
Daily energy intake						
GE intake, KJ/kgBW$^{0.75}$	1063.9[b]	1202.7[a]	1279.6[a]	29.2	**	NS
DE intake, KJ/kgBW$^{0.75}$	675.4[b]	795.1[a]	829.6[a]	26.0	**	NS
ME intake, KJ/kgBW$^{0.75}$	590.8[c]	713.5[b]	768.9[a]	17.1	***	NS
Growth performance						
Initial weight, kg	92.9	95.2	94.7	2.5	NS	NS
Final weight, kg	134.4[b]	151.7[ab]	164.7[a]	6.2	**	NS
Average daily gain, g/d	0.31[c]	0.42[b]	0.52[a]	0.3	***	NS
Carcass yields						
Slaughter weight, kg	131.1[b]	147.8[ab]	163.6[a]	6.8	*	NS
Hot carcass weight, kg	69.4[b]	79.1[ab]	88.6[a]	3.5	**	NS
Chilled carcass weight, kg	68.0[b]	76.5[ab]	87.0[a]	3.5	*	NS
Dressing, %	51.9	51.7	53.2	1.1	NS	NS
Rib eye area, cm^2	56.0	66.4	62.9	0.8	NS	NS
Rib fat , mm	1.8	2.7	2.6	0.1	NS	NS
KPH[2], %	3.5	4.0	4.2	0.7	NS	NS
Yield grade[3]	2.2	2.5	2.2	0.2	NS	NS
Muscle, kg	55.5[b]	65.2[a]	70.9[a]	2.7	**	NS
Bone, kg	13.8	14.7	15.6	0.5	NS	NS
Muscle, % of carcass	79.9[b]	82.5[a]	79.9[b]	0.6	**	NS
Bone , % of carcass	20.1[a]	18.6[ab]	17.9[b]	0.5	**	NS
Muscle per bone ratio	4.0[b]	4.5[a]	4.5[a]	0.1	*	NS
Daily carcass gain, kg/d	0.5[b]	0.6[ab]	0.6 [a]	0.1	**	NS
Daily lean gain, kg/d	0.4[b]	0.5[a]	0.5[a]	0.1	**	NS

[1]M = maintenance requirements (450 KJ ME/kgBW$^{0.75}$/d); SE, standard error; [2] Probability of a significant effect of levels or of a linear (L), quadratic (Q); [a-c]Within a row, means without a common superscript letter differ *(P<0.05)*; * = *P*<0.05, ** = *P*<0.01, *** = *P*<0.001, NS = non-significant.

[2]KPH = Kidney, pelvic and heart fat;

[3]Yield grade determined according to [5]