A RESPONSE OF NUTRIENT UTILIZATION, DIGESTIBILITY AND DAILY WEIGHT GAIN OF CROSSBRED CATTLE (BLACK ANGUS × ZEBU) FROM 13-15 MONTHS OF AGE TO DIETARY CONCENTRATE SUPPLEMENTION

Nguyen Binh Truong[1,2] and Nguyen Van Thu[3]

[1]Faculty of college Agriculture and Natural Resources, An Giang University, An Giang, Vietnam; [2]Vietnam National University Ho Chi Minh City, Vietnam; [3]College of Agricuture, Can Tho University, Vietnam

Corresponding author: Nguyen Binh Truong; Mobile phone: 0983377424; Email: nbtruong@agu.edu.vn

ABSTRACT

A Latin square design experiment of concentrate supplementation with 5 treatments and 5 cattle (Black Angus × Zebu) of 223±16.7 kg aiming to find the optimum nutrient utilization and daily weight gain (DWG) was conducted. The experiment was carried out at Sau Duc cattle farm, which was located at Vinh Gia commune, Tri Ton district of An Giang province and the laboratory E205 of Department of Animal Science, College of Argiculture of Can Tho University from December 2018 to April 2019. The treatments were 0, 0.5, 1.0, 1.5 and 2.0 kg concentrate supplemented per head per day corresponding to C0, C0.5, C1.0, C1.5 and C2.0 treatments. One experimental period lasted 14 days with 7 days for adaptation and 7 days for sampling. Fresh elephant grass was fed at the fixed level of 5 kg/head/day (in fresh), while rice straw was fed *ad libitum* for all treatments. The results showed that total DM intake was significantly different (P<0.05) among treatments with the higher values for the concentrated suppmentation treatments. The ME intake of C2.0 treatment (52.0 MJ/head/day) was slightly higher (P>0.05) than that of C1.5 treatment (49.2 MJ/head/day) but it was significantly higher (P<0.05) compare to C1.0, C0.5 and C0 treatments (43.4, 39.2 and 34.6 MJ/head/day, respectively). DM and OM digestibility (%) were significantly different (P<0.05) among the treatments with the highest values for the C2.0 treatment. It was also showed that when increasing the level of concentrate supplementation, it improved the CP digestibility from 54.1% to 71.9%. Daily weight gain of experimental cattle was significantly different (P<0.05) among treatments and it was 153, 292, 438, 536 and 557 g/day for the C0, C0.5, C1.0, C1.5 and C2.0 treatments. The feed cost (VND per day) for experimental cattle increased by increasing supplemental levels of concentrate, however the feed cost per kgDWG was lower for the C1.0 and C1.5 treatments (38.4 and 38.2 thousand VND/kg, respectively). The conclusion was that increasing concentrate levels in beef cattle diets from 0 to 2.0 kg was gradually improved nutrient intake, digestibility and daily weight gain. For the beef crossbred cattle (Black Angus × Zebu), concentrate supplementation level from 1.0 to 1.5 kg per day in diets could be properly recommended for farmers' practice in term of feed utilization and economic return.

Keywords: *Ruminants, nutrient utilization, digestion, feed conversion, growth.*

INTRODUCTION

Beef cattle population in An Giang province in 2017 was 85.540 heads. They are mainly raised in Tinh Bien, Tri Ton and Cho Moi district by traditional feedings of grazing or confined systems by natural grasses and crop residues without any supplemtations. Consequently beef performance is usually low. While fattening beef cattle was developed in 3 other districts of Cho Moi, Chau Thanh and Chau Phu (An Giang Sub-Department of Anim. Husbandry and Vet. Med., 2017). The crossbreed beef cattle of An Giang province took 1.47% of total population (Nguyen Binh Truong and Nguyen Van Thu, 2017), they were produced from artificial insemination program from Zebu cattle groups and the improved breeds of Charolais, Angus, Brahman, etc. These crossbreed cattle have better beef

performance compared to the local cattle and they also require better quality diets. Concentrate feeds play a very important role for improving beef production by providing energy, protein, minerals and other micro-nutrients. However studies on concentarte supplementation to improve nutrition and beef performance in An Giang province have been still limited. Therefore the objective of this study was to evaluate the feed and nutrient intakes and digestibility of growing crossbred cattle (Black Angus × Zebu cattle) effected by dietary concentrate levels for further studies and applications.

MATERIALS AND METHODS

Location and time

The experiment was carried out at Sau Duc cattle farm, which was located at Vinh Gia commune, Tri Ton district of An Giang province and the laboratory E205 of Department of Animal Science, College of Argiculture of Can Tho University from December 2018 to April 2019.

Experimental design and feeds and feeding

Five crossbred (Black Angus × Zebu crossbred) cattle at 13 months of old (223±16.7kg) were arraged a 5x5 Latin square design. Five treatments were different levels of concentrate supplementation in the diet including 0, 0.5, 1.0, 1.5 and 2.0 kg/head/day corresponding to C0, C0.5, C1.0, C1.5 and C2.0 treatments. Elephant grass was fed at a level of 5 kg/head/day, while rice straw was fed *ad libitum.* Feeds were daily offered to the animals 2 times at 7:00 am and 13:00 pm. One experimental period lasted 14 days including 7 days for adaptation and 7 days for sample collection.

Feeds used for feeding cattle, the elephant grass was planted in the cattle farm, rice straw was bought in the rice fields of farmers surrounding the farm. While concentrate feed was occasionally bought from feed company.

Measurements taken

Feeds, nutrient and energy intakes

Feeds and refusals were daily measured for analyses of DM, OM, CP, NDF and ash following procedure of AOAC (1990) and Van Soest et al. (1991). The metabolic energy (ME) was determined according to Bruinenberg (2002).

Apparent nutrient digestibility

Apparent DM, OM, CP and NDF digestibility were employed with the animal feces were daily collected and weighed according McDonald et al. (2002).

Daily weight gain and feed conversion ratio (FCR)

Cattle were weighed for 2 consecutive days in early morning before feedings at the end of each experimental period and the feed conversion ratio was calculated.

Statistical analysis

The data were analyzed by analysis of variance using the ANOVA of General Linear Model (GLM) of Minitab Reference Manual Release 16.1 (Minitab, 2010). Then for the paired comparison of two treatments, Tukey test of of the Minitab was used.

RESULTS AND DISCUSSION

Chemical composition of feeds

Chemical composition of feeds used in this experiment was showed in the Table 1.

Table 1. Chemical composition (%) of feeds using in the experiment

Feeds	DM	OM	CP	NDF	ME, MJ/kgDM
Concentrate	89.6	90.8	15.6	36.5	10.8
Elephant grass	14.5	91.5	8.78	66.1	8.50
Rice straw	89.1	88.8	5.53	70.4	7.96

Table 1 showed that DM and CP values of concentrate were 89.6% and 15.6%, respectively. They were similar than those of findings of Le Thi Thanh Huyen et al. (2017) in an experiment in Son La province being 88.9% and 15.4%, respectively. NDF and CP of rice straw in the experiment were 70.9% and 5.46%, respectively. They were consistent to results found by Van Tien Dung et al. (2011) in Dak Lak province being 80.6 and 5.60%, respectively. While Ho Thanh Tham (2018) stated that CP and NDF of rice straw were 5.20% and 68.9%, respectively. The ME value of concentrate (10.8 MJ/kgDM) in the experiment was higher than that of elephant grass and rice straw (8.50 MJ/kgDM and 7.96 MJ/kgDM, respectively). This findings were similar to the report of Le Duc Ngoan et al. (2016) being 10.9 MJ/kgDM.

Feed and nutrients intake

Feed and nutrients intake of cattle in the experiment were showed in the Table 2.

Table 2. Feed and nutrients intake of catlle by different treatment

Item	Treatment					P	SE
	C0	C0.5	C1.0	C1.5	C2.0		
Feed intake, kgDM/head/day							
Concentrate	0.00^{e}	0.45^{d}	0.90^{c}	1.34^{b}	1.79^{a}	0.000	0.005
Elephant grass	0.73	0.73	0.73	0.73	0.73	-	-
Rice straw	3.70	3.67	3.59	3.70	3.45	0.353	0.097

Item	Treatment					P	SE
	C0	C0.5	C1.0	C1.5	C2.0		
Total nutrient intake, kg/head/day							
DM	4.42^{c}	4.85^{bc}	5.21^{b}	5.77^{a}	5.97^{a}	0.000	0.097
DMI/100 kgBW, %	1.86^{c}	2.05^{bc}	2.20^{b}	2.44^{a}	2.51^{a}	0.000	0.042
DMI/BW$^{0.75}$, gam	73.1^{c}	80.2^{bc}	86.2^{b}	95.6^{a}	98.5^{a}	0.000	1.630
OM	3.94^{c}	4.32^{bc}	4.65^{b}	5.17^{a}	5.34^{a}	0.000	0.087
NDF	3.08^{b}	3.22^{b}	3.33^{ab}	3.57^{a}	3.56^{a}	0.001	0.069
CP	0.269^{e}	0.337^{d}	0.403^{c}	0.480^{b}	0.536^{a}	0.000	0.006
ME, MJ/kgDM	7.82^{e}	8.11^{d}	8.33^{c}	8.50^{b}	8.71^{a}	0.000	0.028
ME, MJ/head/day	34.6^{d}	39.2^{c}	43.4^{b}	49.2^{a}	52.0^{a}	0.000	0.781

C0, C0.5, C1.0, C1.5 and C2.0 were 0, 0.5, 1.0, 1.5 and 2.0 kg concentrate supplementation (head/day), respectively. The numbers with different superscript letters in the same row were significantly different (P<0.05).

The experimental cattle consumed the same weight of elephant grass (0.73 kgDM/day), due to the experimental design. Rice straw intake was slightly different (P>0.05) among the treatments, while concentrate intake gradually increased by the experimental arrangement from 0 to 1.79 kgDM/day. The concentrate intake of the total DM were from 0-30%. Dau Van Hai and Nguyen Thanh Van (2016) and Do Van Quang et al. (2011) reported that DM intake of grass and rice straw reduced by increasing concentrate supplement from 0 to 47%. Total DM intake was significantly different (P<0.05) among treatments with the higher values for the concentrated suppmentation treatments. The DM intake improved by increasing dietary concentrate levels stated by Prado et al. (2015) of Purunã cattle (¼Aberdeen Angus+¼Caracu +¼Charolais+¼Canchim). The DM intake of C2.0 treatment (5.97 kg) was similar to that of 250 kg beef cattle reported by Filho et al. (2016) in Brazil being 5.99 kg with the daily weight gain of 0.75 kg/day. The NDF intake was improved by concentrate supplementation in the experiment up to the C1.5 treatment, while the CP intake was gradually improved (P<0.05) by increasing concentrate in the diets.

The NDF intake was consistent to findings reported by Valero et al. (2015) and similar results were found by Danh Mo (2018). Danh Mo (2018) reported that CP and ME intake were improved by increasing of concentrate supplementation. Similarly in this experiment the ME intake in Table 2 was gradually enhanced by increasing concentrate supplementation from 0 to 2 kg in the diets. The ME intake of C2.0 treatment (52.0 MJ/head/day) was slightly higher (P>0.05) to that of C1.5 treatment (49.2 MJ/head/day) but it was significantly higher (P<0.05)

compare to C1.0, C0.5 and C0 treatments (43.4, 39.2 and 34.6 MJ/head/day, respectively). These findings were consistent to the results of Dau Van Hai and Nguyen Thanh Van (2016) with ME intake were from 26.6 to 49.2 MJ/head/day by increasing dietary concentrate from 0 to 3.1 kg/head/day.

Apparent digestibility of feed and nutrients

The nutrient digestibility and digested nutrients of experimental cattle were shown in the Table 3.

Table 3. Apparent nutrient digestibility (%) in experimental diets with concentrate supplementation levels

Item	Treatment					P	SE
	C0	C0.5	C1.0	C1.5	C2.0		
Apparent Digestibility, %							
DM	52.3^{b}	51.2^{b}	52.8^{b}	54.9^{ab}	58.5^{a}	0.013	1.22
OM	54.8^{b}	54.6^{b}	56.2^{b}	58.1^{ab}	61.9^{a}	0.003	1.06
NDF	60.7	54.4	56.3	56.8	59.3	0.198	1.87
CP	54.1^{c}	58.9^{bc}	62.7^{b}	66.2^{ab}	71.9^{a}	0.000	1.84

C0, C0.5, C1.0, C1.5 and C2.0 were 0, 0.5, 1.0, 1.5 and 2.0 kg concentrate supplementation (head/day), respectively. The numbers with different superscript letters in the same row were significantly different (P<0.05).

DM and OM digestibility (%) were significantly different (P<0.05) among the treatments with the highest values for the C2.0 treatment. The DM digestibility of C2.0 treatment (58.5%) was significantly higher (P<0.05) than C0, C0.5 and C1.0 (52.3, 51.2 and 52.8%, respectively). It was lower than the values being 62.6-67.2% reported by Valero et al. (2015) for the crossbred cattle (½Angus × ½Nelloro) supplemented 50% concentrate in diet. However, it was similar to findings of Dau Van Hai and Nguyen Thanh Van (2016) supplemented 27% concentrate in beef cattle diet being 58.8%. The DM digestibility of C0 treatment (60.7%) was lower than the values of 64.1% reported by Do Van Quang et al. (2011) with beef cattle fed Guinea grass 1.0% live weight (DM) and rice straw *ad libitum.* NDF digestibility (%) was not significantly ((P>0.05) among the treatments. The CP digestibility was significantly different (P<0.05) among the treatments and it was significantly lower (P<0.05) for the C0 treatment compared to C1.0, C1.50 and C.20 treatments. The results from Table 3 show that when increasing the level of concentrate supplementation in the diet, it improved the CP digestibility from 54.1% to 71.9%. This was consistent to the results reported by Do Van Quang et al. (2011) and Dau Van Hai and Nguyen Thanh Van (2016).

Daily weight gain, feed conversion ratio and feed cost

Table 4. Daily weight gain (DWG), feed conversion ratio (FCR) and feed cost (thousand VND) of experimental diets

Item	Treatment					P	SE
	C0	C0.5	C1.0	C1.5	C2.0		
Initial BW, kg	237	234	234	234	235	0.305	1.03
Final BW, kg	239	238	240	240	243	0.069	0.845
DWG, g	153^{b}	292^{ab}	438^{a}	536^{a}	557^{a}	0.002	58.2
FCR	32.3^{a}	22.8^{ab}	12.3^{b}	15.7^{b}	13.8^{b}	0.005	3.09
Feed cost/d	10.0	13.4	16.8	20.5	23.6	-	-
Feed cost/ kgDWG	65.4	45.9	38.4	38.2	42.4	-	-

C0, C0.5, C1.0, C1.5 and C2.0 were 0, 0.5, 1.0, 1.5 and 2.0 kg concentrate supplementation (head/day), respectively. The numbers with different superscript letters in the same row were significantly different (P<0.05).

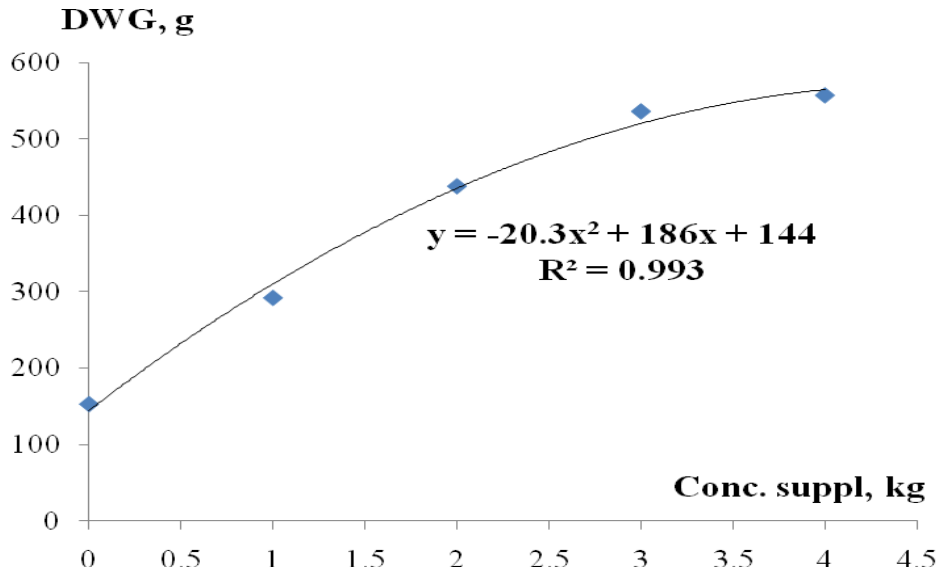

Fig. 1. The relationship of concentrate supplementation and DWG of cattle

Daily weight gain (DWG) of experimental cattle was significantly different (P<0.05) among treatments and it was 153, 292, 438, 536 and 557 g/day for the C0, C0.5, C1.0, C1.5 and C2.0 treatments. This was explained by the gradual improvement of ME and CP intakes of the cattle (Table 2). It was similar to that concluded by Kongphitee et al. (2018) with the DWG of beef cattle was improved from 391 to 569 g by increasing ME intake from 40.2 to 51.9 MJ/day. The daily ME intake of cattle of the C1.5 treatment being 49.3 MJ/head appeared the

DWG of 536 g. Kearl (1982) stated that DWG of beef cattle got 500 g/day by ME intake of 45.1 MJ/head/day. Dao Duc Vu et al. (2017) also found that daily weight gain of crossbred cattle (Red Angus x Brahman) at 12-18 months of age was 498 g/day. The relationship between concentrate supplementation levels and the DWG was closed with the $y=-20.3x^2 + 186x + 144$ and $R^2=0.993$ (Fig. 1). The FCR was significantly ($P<0.05$) improved for the C1, C1.5 and C2 treatments compared to the C0 treatment. The feed cost (VND per day) for experimental cattle increased by increasing supplemental levels of concentrate, however the feed cost per kgDWG was lower for the C1.0 and C1.5 treatments (38.4 and 38.2 thousand VND/kg, respectively), while the highest cost was for the C0 treatment (65.4 thousand VND/kg). Consistently, in a survey of An Giang province, Nguyen Binh Truong and Nguyen Van Thu (2019) concluded that concentrate supplementation for beef cattle with the optimum economic return was 15.6-16.1% of the diet practiced by cattle keepers (Nguyen Binh Truong and Nguyen Van Thu, 2019).

CONCLUSION

It was concluded that increasing concentrate levels in beef cattle diets from 0 to 2.0 kg was gradually improved nutrient intake, digestibility and daily weight gain. For the beef crossbred cattle (Black Angus × Zebu) with the average body weight of 223 kg, concentrate supplementation level from 1.0 to 1.5 kg per day in diets could be properly recommended for farmers' practice in term of feed utilization and economic return.

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