EFFECT OF DIETARY VITAMIN A RESTRICTION AND SUNFLOWER OIL SUPPLEMENTATION ON ADIPOCYTES ACCRETION BRAHMAN BEEF CATTLE

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Abstract – The objectives of this experiment were to determine the effect of dietary vitamin A restriction and sunflower oil supplementation on adipocytes accretion of Brahman beef cattle. Sixteen Brahman cattle (initial BW = 208.3 ± 3.2 kg) were randomly allotted to one of 4 dietary treatments in 2 × 2 factorial arrangement in completely randomized design (CRD). There were 2 factors (vitamin A and sunflower oil) used in this experiment, the 4 dietary treatments were T1 (diet with no vitamin A and no sunflower oil), T2 (diet with no vitamin A + sunflower oil), T3 (diet with vitamin A but no sunflower oil), and T4 (diet with vitamin A and sunflower oil). Feeding trial lasted for 120 d. At the end of feeding trial, all cattle were slaughtered. The *Longissimus dorsi* muscles (LD) and *Semimembranosus* muscles (SM) were collected to determine meat quality and fatty acid composition. The adipose tissue samples were selected from intramuscular fat, intermuscular fat, subcutaneous fat, and visceral fat to determine adipocyte accretion. It could be concluded that dietary vitamin A and sunflower oil supplement had no effect on fat deposition in Brahman beef cattle.

Key Words – Vitamin A, Adipose tissue, beef

I. INTRODUCTION

In several country, intramuscular fat (marbling) in beef cattle is associated with consumer satisfaction of meat. The international standard of beef carcass quality were determined by the quantities of intramuscular fat and maturity of animal. The nutrition strategies to increase fat deposition in intramuscular fat by feeding high energy density diet were use. However, large amounts of fat are deposited in other sites (i.e. subcutaneous or visceral) and not have an effect to the carcass value. There are limited information about the mechanisms controlling the site of fat deposition within the carcass. Vitamin A and their derivatives has been reported to inhibit adipocyte differentiation in the animal (Sato *et al.* [1]; Kuri-Harcuch, [2]; Felipe *et al*. [3]). Lower serum vitamin A has been showed the relation with increasing of intramuscular fat without any effect on other sites of fat deposition (Oka *et al*. [4]; Oka *et al.* [5]; Gorocica *et al.* [6, 7, 8]; Kruk *et al.* [9]. Moreover, the vitamin A precursor β-carotene, has been reported to reduce the activity of stearoyl CoA Desaturase (SCD) (Alam *et al.* [10]) The SCD enzyme catalyzes the conversion of rumenic acid from vaccenic acid (Ntambi *et al.* [11]) and could be accumulated in beef. Therefore, the objective of this studied was to determine dietary vitamin A restriction and sunflower oil supplementation on adipocytes accretion of Brahman beef cattle.

II. MATERIALS AND METHODS

Animals and Experimental design

Sixteen male Brahman beef cattle (initial BW = 208.3 ± 3.2 kg) were randomly allotted to one of 4 dietary treatments using 2 × 2 factorial arrangement design. Factor A was dietary vitamin A, while factor B was vegetable oil supplement. The vitamin A used in the experiment was either no vitamin A or 2,200 IU/kg of dietary DM. The sunflower oil was either no sunflower oil or 4% of dietary DM supplement. Therefore, dietary treatments in this trial were T1 (diet with no vitamin A and no sunflower oil), T2 (diet with no vitamin A + sunflower oil), T3 (diet with vitamin A but no sunflower oil), and T4 (diet with vitamin A and sunflower oil). The concentrate diets were prepared to provide 14% CP, 1.8% ether extract and energy according the

recommendation of NRC [12]. Rice straw was used as roughage and was fed *ad libitum*.

Adipose tissue analyses

Adipose tissue samples were fixed by perfusion with normal 5% formaldehyde, cut longitudinally into two pieces (2 mm thick). Fixed adipose tissue were dehydrated by using a graded series of ethanol, cleared with a histological clearing agent (Histo-Clear, National Diagnostics, Atlanta, GA), embedded in paraffin, sectioned at 6 µm, and mounted onto glass slides. One section from each of the paraffin-embedded tissues were stained with haematoxylin-eosin solution (Merck, Darmstadt, Germany) and mounted on superfrost Plus slides (Fisher). Images of adipocytes were obtained for counting and diameter measurements at 10X magnification using Magnafire 2.1 C software (Optronics, Goleta, CA) with an Optronics digital camera system attached to Olympus 1× microscope. Two slides were prepared per adipose tissue sample and 3 images from 1 slide were obtained for cellularity analyses as previously described (Pickworth *et al.* [13]). The digital images of adipose tissue were then used for quantitative image analysis using Image-Pro Plus, version 4.5.1 software (Media Cybernetics, Inc., Silver Spring, MD, USA).

Statistical analyses

All data were statistically analyzed as 2×2 factorial arrangement in completely randomize design (CRD) using the General Linear Model (GLM) procedures of SAS (SAS Inst. Inc., Cary, NC). Significant differences between treatments were determined using Duncan's New Mutiple Range Test (DMRT) according Steel *et al.* [14].

III. RESULTS AND DISCUSSION

Adipose tissues from four sites of fat deposition and data from adipose tissues image analyzed were presented in Table 1. Adipose cellularlities were not different by level of vitamin A and sunflower oil supplementation (P>0.05). Cattle fed with supplemental sunflower oil diet tended to have more (P=0.07) the percentage of adipocytes (cells>100<200 µm) than the cattle fed with no sunflower oil supplemented. The resulted of this study agreed with Pickworth *et al.* [13] who reported that the adipose cellularlities were not affect by the level of vitamin A in the diets. Robelin [15] and Schoonmaker *et al.* [16] reported that a new adipocyte differtiation occurs when the adipocyes were reach 90 µm of diameter.

Table 1 Effect of vitamin A restriction and sunflower oil supplementation on adipocytes accretion of Brahman cattle

Item	T1	T2	T3	T4	SEM	P-value		
						VA	SF	VA*SF
Intramuscular fat								
Cell number/mm^2	87.7	88.6	83.2	80.4	6.12	0.32	0.84	0.54
Mean diameter, µm	124.2	127.2	119.3	126.2	3.21	0.17	0.87	0.41
Cells ≤ 100 µm, % of total cells	20.0	24.1	23.3	27.7	4.65	0.63	0.17	0.54
Cells > 100 <200 µm, % of total cells	68.5	63.1	66.2	62.5	3.21	0.43	0.54	0.47
Cells ≥ 100 µm, % of total cells	11.5	12.8	10.5	9.8	4.98	0.33	0.41	0.57
Intermuscular fat								
Cell number/mm^2	65.4	61.2	63.1	64.3	1.32	0.36	0.85	0.84
Mean diameter, µm	162.1	158.9	166.3	167.2	2.45	0.15	0.09	0.36
Cells ≤ 100 µm, % of total cells	16.8	18.1	17.4	16.2	3.51	0.17	0.34	0.56
Cells > 100 <200 µm, % of total cells	54.2	53.4	54.5	55.6	1.14	0.12	0.33	0.45
Cells ≥ 100 µm, % of total cells	29.0	28.5	28.1	28.2	0.09	0.36	0.14	0.74
Subcutaneous fat								
Cell number/mm^2	63.2	64.1	64.2	63.1	1.32	0.22	0.31	0.46
Mean diameter, µm	178.9	177.7	177.2	179.1	1.17	0.47	0.13	0.41
Cells ≤ 100 µm, % of total cells	8.26	10.2	11.16	9.94	0.08	0.36	0.15	0.86
Cells > 100 <200 µm, % of total cells	60.22	63.12	64.98	61.87	1.41	0.17	0.48	0.88

Cells ≥ 100 µm, % of total cells	31.52	26.68	23.86	28.19	2.32	0.36	0.74	0.64
Visceral fat								
Cell number/mm^2	59.7	56.2	57.4	58.7	1.12	0.12	0.34	0.48
Mean diameter, µm	187.6	193.2	179.5	184.9	3.41	0.45	0.33	0.74
Cells ≤ 100 µm, % of total cells	6.25	9.32	10.42	8.77	0.98	0.17	0.41	0.44
Cells > 100 <200 µm, % of total cells	74.25	71.16	73.19	71.18	0.06	0.18	0.07	0.66
Cells ≥ 100 µm, % of total cells	19.50	17.52	16.39	20.05	1.48	0.33	0.54	0.87

Note: T1 = diet with no vitamin A and no sunflower oil, T2 = diet with no vitamin A + sunflower oil, T3 = diet with vitamin A but no sunflower oil, T4 = diet with vitamin A and sunflower oil.

IV. CONCLUSION

Based on this study, it could be concluded that the interaction of dietary vitamin A and sunflower oil supplement did not an effect on fat deposition position of Brahman beef cattle.

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