Egyptian J. Anim. Prod., 33, Suppl. Issue, Nov. (1996): 103-111

EFFECT OF DIETARY FAT ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHING BULLS

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SUMMARY

Fourteen Baladi (*Bos indicus)*bulls of 310 Kg initial average body weight in two similar groups were individually fed fat unsupplemented or supplemented rations. Dietary fat was supplemented at rate of 7.5% of concentrate DM. Bulls were slaughtered at 400 Kg body weight.

Fat supplement significantly decreased the digestibilities of all nutrients except ether extract which increased from 61.57 to 81.84%. Total ruminal VFA's concentrations (P=0.001) decreased but ruminal pH, molar proportions of propionate and valerate insignificantly increased by fat feeding. Insignificant decreases in ruminal ammonia-N concentration, molar proportions of acetate, butyrate and acetate: propionate ratio, were associated with fat feeding.

No significant differences between fat unsupplemented and supplemented groups in total gain in weight during the experimental period (98.57 Vs 97.57 Kg) and the period needed to achieve the slaughter weight (95 Vs 94 day). The average daily gain was 1.05 Kg for the control group and 1.06 Kg for the fat supplemented group. However, dry matter intake by bulls fed fat supplemented ration was higher than the control.

Dressing percentage was lower (P=0.0397) for the fat supplemented group than the control group. Tenderness and cooking loss were almost similar between the two groups but higher (P=0.019) pH of the muscle extraction was found for the fat supplemented group.

Feeding fat increased knife separable fat from 22.3 to 25.3 Kg, which was corresponding to 5.95 and 6.90 percentage of empty body weight. Physical composition of the best ribs showed that fat decreased from 22.31 to 20.21% and bone percentage increased from 9.76 to 11.99 by fat feeding. Chemical composition of the *longissumus dorssi* muscle had not been affected by dietary fat supplement.

It was concluded that the supplementary fat had not improved the body weight gain or carcass traits of finishing Baladi bulls yet the knife separable fat and the proportions of unsaturated fatty acids in the muscle increased. Moreover there is evidence that the proportion of dietary protein should be increased during fat feeding.

Keywords: Cattle, dietary fat, metabolism, carcass quality

INTRODUCTION

Traditional rations of productive animals have contained no or little added fat; the only sources of fatty acids were those occurring naturally in feedstuffs. Use of dietary fat was limited for long time mainly to broiler diets and milk replacers for young animals (Palmquist, 1988).

Addition of dietary protected or unprotected fats improve milk yield of high yielding dairy cow feeding . However, variable responses have been recorded for fat addition in finishing diets for cattle (White *et al.*, 1992).

The practical constraints or limits for optimal utilization of supplemental fat in growing-finishing diets for feedlot steers have not been resolved. Considerable attention has been directed explaining the variability in weight gain response by cattle fed fat-supplemented diets. Factors that might be implicated include diet energy density, ingredient composition of the basal diet and diet acceptability (Zinn, 1989).

The objective of the present study was to evaluate the response of native finishing bulls for supplementary fat in live animal performance and carcass traits.

MATERIALS AND METHODS

Fourteen Baladi (*Bos indicus*) bulls of 310 Kg initial average body weight were randomly divided according to the body weight into two similar groups . Animals were fed unsupplemented finishing ration (group 1) or supplemented with feed grade yellow grease (group 2). The control ration was formulated according to the allowance of Ghoneim (1967). Yellow grease was obtained from Poultry slaughterhouse and substituted the concentrate DM of the control ration at rate of 7.5%. Rice straw was fed *ad libitum*. Composition of the experimental rations are shown in Table 1.

Animals were individually fed once at 8.00 a.m. and watered twice daily. The residues from rice straw were daily weighed to calculate its *ad. libitum* intake. Body weight was weekly recorded and average daily body gain (ADG) was calculated. Period in days needed for each animal to reach body weight of 400 kg was recorded. One week prior to slaughtering, grap samples were collected for 7 days to determine the nutrient digestibilities using the acid insoluble ash (AIA) method according to Van Keulen and Young (1977).

Four bulls from each group were slaughtered at 400 Kg body weight. Bulls were not fed or watered 14 h prior to slaughtering. External and internal offals were weighed. Dressing was calculated as the percent of carcass weight to live body weight. Knife separable fat was removed and weighed. The best (9,10,11) ribs were separated into lean fat and bone to calculate the physical composition. Tenderness, cooking loss % and pH of lean were measured. *Longissumus dorssi* muscle of the best ribs were kept frozen for DM, EE and ash analyses.

Rumen fluid samples were collected from the slaughtered bulls after 12 h fasting. Ruminal pH was immediately measured at sampling, ammonia-N (Conway 1963), total VFA's concentrations (Kromann *et al.*,1967) and molar proportions of VFA's (Erwin *et al.*, 1961) were determined.

Samples of yellow grease and *Longissumus dorssi* muscle were analyzed for fatty acid analysis using gas-Liquid chromatography (Mason and Waller, 1964).

Chemical composition of feeds, feces and meat was determined according to the A.O.A.C. (1984) methods.

Difference between the two treatment means was tested for significance using Student using *t* test (Steel and Torrie, 1990).

RESULTS AND DISCUSSION

Fats incorporated to substitute 7.5% of the concentrate feed mixture and yellow corn on DM basis which represents 5.52% of the total ration dry matter increased total ether extract of the ration from 2.46% to 8.63% but decreased CP by 1.12 and NFE about 5 digestion units (Table 1).

Table 1. Ingredients and chemical composition of the experimental rations.

Item	Control		Fat supplemented ration	
	Kg/h/d	%	Kg/h/d	%
Berseem hay	1.165	14.04	1.172	13.71
Rice straw[1]	0.702	8.46	0.760	8.89
Concentrate feed mixture	3.286	39.59	3.198	37.40
Yellow corn	3.130	37.71	2.932	34.28
Grease	0	0	0.472	5.52
Vit. min. premix	0.018	0.20	0.018	0.20
Total	8.301	100	8.552	100
Chemical composition, %				
DM	92.16		90.23	
DM composition				
OM	91.19		91.54	
CP	12.82		11.70	
CF	12.53		12.60	
EE	2.46		8.63	
NFE	63.38		58.61	
Ash	8.81		8.46	

1 *Ad. libitum* intake

Table 2 showed that fat supplement significantly decreased the digestibilities of all nutrients except ether extract. Zinn (1992) found that addition 6 % yellow grease for feedlot steers ration decreased ($P < 0.05$) ruminal organic matter digestion by 5 % and net flow of microbial nitrogen to the small intestine by 14.5 %. Digestibility of EE increased from 61.57 to 81.84%. The increased digestibility of EE which is characterized by high energy value did not improve the TDN value of the fat supplemented ration because of the depression in the other nutrient digestibilities. In this connection, White *et al.* (1992) found that the apparent ether extract digestibility increased quadratically ($P< 0.05$) with increasing fat level from 0 to 2.5 or 5 % of diet dry matter for finishing steer rations.

The decrease in DCP% was more drastic because of fat supplement which decreased the dietary CP percentage by 1.12% (Table 1) and its digestibility by about 12% (Table 2). Fat supplement had an obvious adverse effect on nutrient utilization of the high concentrate ration (22% roughage) of the finishing bullock as shown in Table 2. Palmquist (1988) reported that the attempts to increase energy

intake by increasing fat content of the ration are limited by the effects of dietary fat on rumen microbial activity and digestibility of the other nutrient particularly fiber.

Table 2. Nutrient digestibilities and nutritive value of the experimental rations.

Item	Control	Fat supplemented ration	SE	Prob.
Digestibility, %				
DM	58.94	49.22	3.34	0.020
OM	57.98	46.88	4.79	0.040
CP	53.11	40.67	4.83	0.030
CF	27.57	9.21	9.51	0.060
EE	61.57	80.84	4.47	0.006
NFE	64.78	51.21	4.99	0.026
Nutritive value				
TDN,%	54.77	51.62	4.16	0.200
DCP,%	6.81	4.77	0.63	0.155

Feeding fat decreased total VFA's concentration (P=0.001) but insignificantly increased ruminal pH, molar proportion of propionate and valerate. Insignificant decreases in ruminal ammonia-N concentration, molar proportion of acetate and butyrate and acetate: propionate ratio were associated with fat feeding (Table 3). The low molar proportion of acetate either in the unsupplemented or fat supplemented rations may be due to their low roughage content (22% roughage, Table 1). Zinn (1989) found that yellow grease supplement at rate of 4% or 8% of rations of finishing steer did not influence ruminal pH but decreased ruminal molar proportions of acetate and increased propionate.

Table 3. Basic pattern of rumen metabolites of bulls fed fat supplementedrations.

Item	Control	Fat supplemented ration	SE	Prob.
pH	6.78	7.34	0.18	0.116
Total VFA's, meq./100 ml	9.76	6.26	0.72	0.001
Ammonia-N, mg/100 ml	43.57	39.82	1.55	0.269
Acetate (Ac),%	37.62	35.13	3.09	0.366
Propionate (Pr), %	25.79	32.77	2.95	0.142
Butyrate,%	29.02	24.13	2.26	0.166
valerate, %	7.57	7.97	3.22	0.479
Ac : Pr ratio	1.60	1.07	0.24	0.159

No significant differences were detected in the total gain in weight during the experiment period (98.57 vs. 97.57 Kg), also the period needed to achieve the slaughter weight was not statistically different (95 vs. 94 day). The average daily gain was 1.05 Kg for the control group and 1.06 Kg for the fat supplemented group (Table 4).

The null response in ADG to fat supplement might be due to the non significant differences in the TDN value of and the lower DCP intake of fat supplemented ration in comparison with the control because of the adverse effect of fat supplement on nutrient digestibility. El-Bedawy *et al.* (1996) found positive response in growth and efficiency of post-weaned buffalo calves to supplementary fat. However, White *et al.*

(1992), Huffman *et al.* (1992) and recorded null or negative response of finishing steers in daily gain and efficiency to supplementary fat. The variable responses in growth performance to supplementary fat might be dependant on the animal age and species. Dry matter intake by bulls fed fat supplemented ration was higher than those fed the control one. However, the daily TDN and DCP intake was lower by the fat supplemented group which resulted in slightly better feed conversion as TDN and significant decrease in amount of DCP needed for 1 Kg body weight gain (Table 4).

Table 4. Growth performance of finishing bullock fed fat supplemented rations.

Item	Control	Fat supplemented ration	SE	Prob.
Initial BW, Kg	311.43	308.14	8.37	0.351
Final BW, Kg	410.00	405.71	2.07	0.302
Duration, day	95	94	11	0.463
Total gain, Kg	98.57	97.57		
ADG (g/day)	1.05	1.06	0.07	0.415
DM intake	8.30^{b}	8.55^{a}	0.14	0.05
TDN intake	4.55^{a}	4.42^{b}	0.07	0.05
DCP intake, g	565^{a}	408^{b}	8	0.01
Feed conversion				
DM	7.98	8.15	0.47	0.36
TDN	4.37	4.21	0.25	0.27
DCP	543^{a}	389^{b}	26.51	0.001

Dressing calculated as a percentage of hot carcass weight to live body weight was lower (P=0.0397) by 1.8% for the fat supplemented group than the control group (Table 5). Haaland *et al.*(1981) found that the percentage of retail yield of steers fed rations supplemented with 5% protected tallow were lower (P<0.05) than those receiving no supplemental fat ration. Tenderness and cooking loss were almost similar between the two groups but higher (P=0.019) pH of the muscle extraction was found for the fat supplemented group. Zinn (1988) found that the addition 4 % yellow grease to the diet of crossbred beef steers increased KpH of the rib eye area.

Feeding fat increased knife separable fat as a quantity from 22.3 to 25.3 Kg, percentage of body weight from 5.44 to 6.24 or percentage of empty body weight from 5.95 to 6.90. However, the Physical composition of the best ribs showed that fat decreased from 22.31 to 20.21% and bone percentage increased from 9.76 to 11.99 for bullock fed fat supplemented ration. There were no significant differences in DM, CP, EE and ash of the *longissumus dorssi* muscle due to dietary fat supplement (Table 5). Haaland *et al.* (1981) found that the kidney and pelvic fat deposit was the only carcass fat measurement increased (P<0.05) by addition of dietary tallow in the ration of finishing steers and Brandt and Anderson (1990) found an increase in backfat thickness and marbling degree by addition of 3.5 % yellow grease to finishing steer diet dry matter.

Table 6 showed that the unsaturated fatty acids composed more than 50% of the total fatty acids in yellow grease. Results in Table 7 showed that animals fed yellow grease had lower percentages of C14:0 (P=0.14), C16:0 (P=0.24) and C18:0 (P=0.21) but higher (P<0.02) percentage of C18:2 in the *longissumus dorssi* muscle fat. No significant difference in C18:1(P=0.44) was found. The percentage of unsaturated fatty acids of the muscle increased from 17.63% to 30.4% by fat

supplement. Therefore, the increase in C18:2 and decrease in C16:0 proportions of bulls fed fat is reflection of dietary changes. However, altering long chain fatty acids composition of the carcass of ruminants is much more difficult than in non ruminants due to the bio-hydrogenation process in the rumen. Brandt and Anderson (1990) found that feeding tallow or yellow grease containing rations to steers increased ($p<0.05$) the proportion of palmitic acid in longissimus muscle and the proportion of stearic acid ($p<0.05$) compared to the control.

Table 5. Carcass characteristics of finishing bullock fed fat supplemented rations.

Item	Control	Fat supplemented ration	SE	Prob.
Dressing %	58.25[a]	56.42[b]	0.87	0.0397
Physical properties				
Tenderness	9.60	9.93	0.81	0.3477
Cooking loss,%	44.39	44.35	1.19	0.486
pH	5.78[b]	6.00[a]	0.08	0.019
Total knife separable fat				
Kg/h	22.3	25.3	4.2	0.245
% LBW	5.44	6.24	1.03	0.234
%EBW	5.95	6.90	1.12	2.13
Physical composition ,%				
Lean	67.93	67.81	3.21	0.486
Fat	22.31	20.21	3.44	0.282
Bone	9.76[b]	11.99[a]	0.64	0.001
Chemical composition, %				
DM	27.44	26.58	1.95	0.337
EE	3.51	3.71	0.73	0.397
CP(N x 6.25)	22.86	21.81	1.28	0.222
Ash	1.08	1.06	0.10	0.445

Table 6. Fatty acid composition of yellow grease

Fatty acid[1], %	Yellow grease
14:0	0.86
16:0	11.87
18:0	17.88
18:1	21.42
18:2	33.11
Other	14.86

1 Carbon length: number double bonds.

Table 7. Fatty acid composition of eye muscle lipids

Fatty acid[1], %	Control	Fat supplemented ration	SE	Prob.
14:0	10.05	6.28	3.19	0.1407
16:0	16.77	14.76	2.60	0.2353
18:0	44.15	36.25	5.17	0.0202
18:1	13.61	12.91	5.23	0.4489
18:2	4.02	17.49	9.29	0.2138
Other	11.53	12.31	6.25	0.4527

1 Carbon length: number double bonds.

It could be concluded that the supplementary fat had not improved the body weight gain or carcass traits of finishing Baladi bulls but it increased the proportions of the unsaturated fatty acids in the muscles. Moreover, there is evidence that the proportion of dietary protein should be increased during fat feeding.

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تـاثير إضافـة الدهن لعليقـة التهيئـة علـى الأداء الإنتـاجى وصفـات الذبيحـة فـى عجــول التسمين البقرية

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أستخدم ١٤ عجلا متوسط أوزانهم ٣١٠ كجم فى مجموعتين متشابهتين فى تجربة، غذيت احداهما على عليقة تهيئة لاتحتوى دهنا والأخرى تحتوى على شحم حيوانى(دهن دواجن) أضيف بنسبة ٧,٥٪ من المخلوط المركز. وذبحت هذه العجول عندما وصل أوزانها الى ٤٠٠ كجم.

وقد أظهرت النتائج أن إضافة الدهن قد قللت من معامل الهضم لكل المركبات الغذائية ماعدا مستخلص الإثير الذى زاد معامل هضمه من ٦١,٥٧٪ الى ٨١,٨٤٪. كما أدت التغذية على الدهن الى أنخفاض نسبة الأحماض الطيارة الكلية وزياده درجة حموضة سائل الكرش ونسبة البروبيونات والفاليرات معنويا. كماأدت التغذية على العليقة المحتوية على الدهن الى انخفاض غير معنوى فى تركيز أمونيا الكرش ونسبة الخلات والبيوترات ونسبة الخلات : البروبيونات.

لم تلاحظ فروق معنوية بين المجموعتين فى الزيادة الكلية فى الوزن (٩٨,٥٧ مقابل ٩٧,٥٧ كجم) ولا فى الوقت اللازم للوصول الى وزن الذبح (٩٥ مقابل ٩٤ يوما) وكانت الزيادة اليومية فى الوزن ١,٠٥ مقابل ١,٠٦ كجم يوميا لمجموعة الكنترول والدهن على الترتيب على الرغم من أن المأكول من المادة الجافة يوميا كان أعلى فى مجموعة الدهن.

كما أظهرت النتائج أن نسبة التصافى منخفضة فى مجموعة الدهن عن مجموعة الكنترول، وكانت المجموعتان متشابهتين فى درجة طراوة اللحم والفقد بالطبخ ولكن درجة حموضة مستخلص اللحم كانت أعلى فى مجموعة الدهن.

وقد سببت التغذية على عليقة الدهن زيادة فى دهن الذبيحة المفصول بالسكين من ٢٢,٣ كجم للراس الى ٢٥,٣ كجم والتى تقابل ٥,٩٥ و ٦,٩٠٪ من الوزن الفارغ للجسم. الا أن تشفية الضلوع ٩، ١٠ و ١١ أظهرت انخفاض فى نسبة الدهن من ٢٢,٣١ الى ٢٠,٢١٪ وزيادة فى نسبة العظم من ٩,٧٦ الى ١١,٩٩ . و بينما لم يتأثر التركيب الكيماوى (بروتين - دهن - رماد) للعضلة العينية معنويا بالتغذية على الدهن، وجد أن نسبة الأحماض الدهنية الغير مشبعة زادت فى العضلات.