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EFFECT OF CALCIUM SALTS OF FATTY ACIDS SUBSTITUATION INSTEAD OF CORN AS SOURCE OF ENERGY IN FINISHING RATION OF BUFFALO BULLS

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ABSTRACT

Eighteen indigenous buffalo bulls of about 295±7.31 Kg body weight and one year of age were randomly allotted into three similar groups. A calcium salt of fatty acids (Ca-SFA) was added to concentrate diet on DM basis of total concentrate as replacement of 25% and 50% of corn grain on energy basis.

The first group (control) received a ration without supplementation (R_1), the 2nd received ration supplemented with Ca-SFA instead of 25% of corn grain (R_2) and the 3rd received a ration supplemented with Ca-SFA instead of 50 % of corn grain (R_3). The three rations were comparable in nutrient contents. The content of ash, fatty acids (FA) and acid ether extract (AEE) were higher in R_2 and R_3 compared to the control ration. Feeding Ca-SFA did not influence on dry matter intake (DMI), average daily gain (ADG), feed conversion and weight gain of supplemented rations.

Nutrient digestibility, except AEE and DE, were not affected with Ca-SFA supplementation to the experimental rations. The digestibilities of cell wall constituent (NDF, ADF, cellulose and hemi-cellulose) were not significantly affected by added Ca-SFA compared with control group. Also, the nutritive values of the experimental rations were lacked any significance.

Rumen activity as pH, TVFA's, NH_3–N and microbial protein synthesis were not affected by feeding Ca-SFA as compared to the control group.

Total cholesterol and free fatty acids (FFA's) in blood serum of bulls were significantly higher (P<0.05) in the treated groups compared to the control group. Ca-SFA supplementation was not affected on the values of total lipids and glucose in blood serum.

It could be concluded that replacement of Ca-SFA instead of 25% up to 50 % the energy of yellow corn could be efficiently utilized in finishing rations of buffalo bulls as by pass-protected fat**.**

Keywords: *Buffalo bulls, calcium salts of fatty acids, growth, digestibility.*

INTRODUCTION

Fat supplements are used as a means to increase the energy density of the diet and many of these are referred to as inert. In this case inertness simply means that the fat or fatty acid supplement has minimal affects on rumen fermentation (Jenkins and Palmquist 1984). Often fat supplements are "rumen-protected" as a means of avoiding the deleterious effects of a high fat diet on microbial fermentation. The requirement for these fat supplements has efficiency in providing both rumen protection and post-ruminal availability (Bauman *et. al.* 2003 and Wu and Papas 1997).

Approximately 80-90% of the lipid entering the small intestine as free fatty acids was attached to feed particles (Davis 1990 and Doreau and Chilliard 1997). Calcium salts of free fatty acids are the predominant source of protected lipids fed to ruminants and these dissociate to some extent in the rumen, but dissociation is much more extensive under the highly acidic conditions of the abomasum. Therefore, dietary lipid supplements protected by the use of Ca salts add to the pool of free fatty acids that enters the small intestine.

This study was undertaken to investigate the effect of feeding protected fat as Ca-SFA of fatty acids supplementation to concentrate feed mixture on DM basis to replacement of 25% and 50% on energy basis of yellow corn grain on growth performance, feed intake, nutrients digestibility, ruminal activity and blood parameters of finishing buffalo bulls.

MATERIALS AND METHODS

This work has been conducted at Seds Experimental Station, Animal Production Research Institute. (Bany-Swaif Governorate). Chemical analyses were conducted at Dokki Laboratory of By-Product Utilization Department. Animal Production Research Institute, Agricaltural Research Center, Ministry of Agriculture. Egypt.

The calcium salt of fatty acids (Ca-SFA) was prepared from soap-stock (It is being produced in large quantities as mainly by products of soap & oil, manufacture during refining the oils) at Cairo Oil and Soap Co. according to El-Bedawy *et. al.* (2005).

Eighteen indigenous buffalo bulls of about 295.0 ± 7.31 kg body weight and one year of age were randomly allotted into three similar groups. Bulls were housed in three open shaded paddocks. Animals were adapted for the experimental rations for two weeks before experimental period. Animals were weighted biweekly during 120 day experimental period. Ca-SFA of fatty acids was mixed by 0, 4 and 8% to replace of corn on energy basis in CFM and pelleted. The concentrate feed mixtures (CFM's) were manufactured at El-Marge animal feed factory, Ministry of Agriculture Table 1. The 1st group received ration containing CFM without fat supplementation, the 2nd group received CFM containing 4% Ca-SFA and the 3rd group received CFM containing 8% Ca-SFA. The CFM's had almost similar protein and energy content as shown in Table (2). All groups received berseem hay (BH) and rice straw (RS). Concentrate mixture, BH and RS were fed according to the biweekly body weight changes in order to cover the NRC (2000) requirements. The chemical composition of the concentrates feed mixtures, experimental rations (which, were calculated according to consumed diet Table 4), Ca-SFA and roughages (BH and RS) are shown in Table 2. Drinking water was available two times daily after one hour of feeding. Mineral mixture blocks were freely available to animals.

Table (1): Formulation of concentrate feed mixtures on DM basis% and the cost LE / ton on fresh basis.

Item	(CFM 1) 0 % Ca-SFA	(CFM 2) 4 % Ca-SFA	(CFM 3) 8 % Ca-SFA
Yellow corn	40	30	20
Calcium salts of fatty acids	-	4	8
Soybean meal	14	15	١٦
Cotton seed meal	15	15	15
Wheat bran	19	٢٠	٢٥
Rice bran	4	٨	8
Molasses	٤	٤	٤
Ground limestone	٣	٣	٣
Common salt	١	١	١
Cost LE / ton	1258.98	1251.90	1253.95

The price of Yellow corn, Calcium salts of fatty acids, Soybean meal, and Cotton seed meal, Wheat bran,
Rice bran, Molasses, Ground limestone, Common salt, were LE 1250, 1650, 1650, 1050, 950, 750, 800, 95,
120, respectively.

Digestion trials was carried out at the end of the experimental period using three replicates applying the acid insoluble ash (AIA) technique suggested by Van Keulen and Young (1977). Therefore, each nutrient digestibility represented an average of six values. During the digestion trial, animals were fed at 06.30 and 18.30 hrs and grape samples were collected at 06.00 and 18.00 hr. Chemical composition of feeds or residuals and feces was determined according to A.O.A.C. (1996). Acidified ether extract was determined as described by Drackley *et al.* (1985) modified by Abo-Donia *et. al.,* (2003a). Total fatty acids (FA's) in Ca-SFA were determined by A.O.C.S. (1973). Gross energy value (GE) was determined for both feed and feces by using Gallen Kump ballistic bomb calorimeter (Catalog No. (CBB: 330-1010).
At the end of digestibility trial, rumen fluid samples were collected from three animals of each group by using stomach tube before, 3 and 6 hrs post feeding for two consecutive days. Ruminal pH were determined by the HNNA pH meter, mode [HI8424], total VFA's concentrations were determined by steam distillation as described by Kromann *et al*. (1967), molar proportions of VFA's (Erwin *et al*. 1961) and ammonia-N (Conway, 1978). The synthesized microbial protein (MP) in the rumen was calculated by multiplying the truly digested organic matter (DOM) by 19.30% according to Czerkawski (1986). True DOM was calculated assuming that it was 0.65 of the apparently DOM (ARC, 1984).

Blood serum samples were withdrawn from the left jugular vein before morning meal from 3 animals of each group. Serum total lipids, cholesterol and glucose were determined using commercial kits (Biomerieux 69280 Marcy-1, Etoile, France®). Free fatty acids (Itaya and Ui, 1965)

Statistical analysis was carried out using SAS (1996). Digestibility, blood and performance data were analyzed as one-way analysis of variance according to the following model: **$Y = \mu + x_i + e_{ij}$**

Where:

Y= observation

µ= mean

x_i =the effect of treatment for 1=1-3, 1 control, 2 = 4% Ca-SFA and 3 = 8 % Ca-SFA

e_{ij} = experimental error

Rumen data was statistically analyzed as two-way analysis of variance according to the following model : **$Y = \mu + x_i + xj + x_{ij} + e_{ijk}$**

Where:

Y= observation

µ= mean

x_i= the effect of treatment for 1=1-3, 1 control, 2 = 4% Ca-SFA and 3 = 8 % Ca-SFA

x_j= the effect of sampling time for 1=1-2 1 before feeding and 2 = 4 hrs post feeding

e_{ijk} = experimental error

Duncan's Multiple Range Test (Duncan, 1955) was used to separate the means when the main effect was significant.

RESULTS AND DISCUSSIONS

Chemical Composition:

Chemical composition of the concentrate feed mixtures, experimental rations, Calcium salts of fatty acids and roughages (BH and RS) are presented in Table (2). It showed that the three CFM's and rations were comparable in nutrient content except the fatty acids (FA's) and acid ether extract (AEE) they were higher in CFM_2, CFM_3 and (R_2) and (R_3) than the control one. The content of AEE was much higher than that of ether extract, because fatty acids in Ca-SFA are incompletely extracted without acid treatment (Drackly *et. al*. 1985, Abo-Donia 2003 and Abo-Donia *et. al*. 2003b). Total amount of fatty acids were higher for rations containing Ca-SFA than the control ration, as expected and were in reasonable agreement with acid ether extract kim *et. al.* (1993), Abo-Donia *et. al.* (2003b) and Aiad *et al.* (2005). The chemical composition of the roughages analysis. These results were nearly similar to those reported by (BH and RS) was within the normal published ranges for CP, CF, and CWC (Abu- Raya 1967 and CLFF 2001).

Digestibility and Nutritive Values:

Nutrient digestibilities and nutritive values of the experimental rations are presented in Table (3).

Table (2) Chemical composition of the concentrates feed mixtures, experimental rations, Ca-SFA and roughages (BH, RS).

Item	Concentrate feed mixture			Ca-SFA	Roughages		Experimental Rations *		
	CFM1	CFM2	CFM3		BH	RS	R1	R2	R3
Chemical compassion %									
DM	90.24	90.44	90.61	94.78	90.29	93.00	90.99	91.10	91.18
OM	90.52	89.19	88.16	78.22	87.50	87.20	88.99	88.30	87.77
CP	18.11	18.37	18.62	…	12.30	3.50	12.96	13.10	12.35
CF	9.42	9.95	10.62	…	28.50	40.50	21.78	22.05	21.80
AEE	4.12	7.27	10.34	78.22	1.60	0.93	2.74	4.38	5.79
EE	3.40	3.34	3.23	4.11	2.70	1.30	2.69	2.66	2.45
NFE	58.87	53.60	48.58	…	45.10	42.27	51.51	48.78	47.82
Ash	9.48	10.81	11.84	21.78	12.50	12.80	11.01	11.70	12.23
FA	3.15	6.10	8.95	74.66	…	....	2.05	3.59	5.59
Cell wall constituent %									
NDF	20.08	20.58	21.31	…	62.99	71.89	43.01	43.25	43.51
ADF	14.69	15.41	16.26	…	46.34	55.47	32.30	32.65	33.00
ADL	1.61	1.60	1.61	…	7.90	10.37	5.29	5.28	5.26
Cell	13.09	13.81	14.65	…	38.44	45.40	27.01	27.38	27.74
H-Cell	5.39	5.17	5.04	…	16.65	16.11	10.72	10.60	10.51
GE**	4.025	4.136	4.245	7.402	3.982	4.101	4.036	4.094	4.147

***Formulas of experimental rations were calculated from average feed consumed during experimental period**
**** Mcal/kg**

Table (3): Effect of feeding of Ca-SFA on nutrient digestibility, cell wall constituent and nutritive values of the experimental rations.

Item	Experimental Rations			P<
	Control	4 % Ca-SFA	8%Ca-SFA	
Nutrient digestibility % :				
DM	69.04±0.56	69.91±0.78	70.04±2.2	ns
OM	71.61±0.42	72.11±1.28	71.99±2.38	ns
CP	56.88±1.01	57.19±1.56	57.15±2.37	ns
CF	66.12±0.16	66.04±1.47	65.80±1.88	ns
AEE	$68.56±0.72^{c}$	$87.90±0.92^{b}$	$91.57±0.70^{a}$	*
NFE	77.96±0.49	76.60±2.99	74.90±3.98	ns
DE	$68.57±0.33^{b}$	$72.71±1.31^{ab}$	$75.95±2.11^{a}$	*
Cell wall constituent %				
NDF	64.89±1.33	61.85±1.63	61.78±2.24	ns
ADF	63.08±1.64	59.04±2.15	59.07±2.51	ns
ADL	6.82±0.34	6.80±1.90	5.94±1.03	ns
Cellulose	71.23±0.65	71.76±3.26	71.31±3.26	ns
Hemi cellulose	71.57±1.84	66.90±2.32	67.08±3.03	ns
Nutritive value % :				
TDN	66.07±0.38	68.49±1.24	69.81±1.11	ns
DCP	7.37±0.11	7.49±0.48	7.06±0.45	ns

$^{a,\ b\ and\ C}$ Means in the same row having different superscripts are significantly different at (P< 0.05).
ns = non- significant difference.

The Ca-SFA supplement significantly (P< 0.05) increased the digestibility of ether extract (EE) and digestible energy (DE). These results are in good agreement with those of Abo-Donia *et. al.,* (2003b), EL-Bedawy *et. al*., (2003) and Aiad *et. al*., (2005). The high EE digestibility of fat supplemented rations might be due to the high digestibility of added dietary fat (Palmquist and Conrad, 1978, El-Bedawy *et al.,* 1994a, b, Khattab *et. al.,* 2001 and Aiad *et.al*., 2005). Palmquist (1984) reported that, calcium soap was solubilized significantly as fatty acids, which increase the solubility of the acid-soap complex in the bile salt. Ruminant animals can digest fats with a high degree of efficiency ranged between 80% and 90% for a variety of fatty oils and fatty acids (Moore and Christie, 1984). This high efficiency was maintained even when the dietary intake of fatty acids was greatly increased.

Digestibilities of crude protein (CP), crude fiber (CF) and nitrogen free extract (NFE) had not affected by fat supplement. Crude fiber was not affected by added fat, which could indicated that added protected fat did not affect on the cellulotic activity in the rumen. The digestibility's of cell wall constituent (NDF, ADF, cellulose and hemi-cellulose) were not affected significantly by supplemented Ca-SFA compared with control group. Although adding Ca-SFA improved the energy values of the diets expressed as TDN, but the differences were not significant. The values of DCP did not significantly differ among the tested groups. The herein results agreed with those obtained by Abo-Donia *et al*. (2003b) and Aiad *et. al*. (2005). On the other hand El-Bedawy (1995) found that TDN value was improved by feeding Ca-SFA supplemented diets but DCP values were not improved.

Growth trial and animal performance:

The result in Table (4) indicated that no significant differences were observed in DM intake with different rations. Also feed conversion (kg DM, TDN and DCP/ kg gain) was almost similar for different dietary treatments. These results agreed with those of White *et al* (1992), and Aiad *et al* (2005) who reported that added fat did not affect ADG and feed conversion.

Data shown in Table (4) illustrated that the average initial weights of the experimental groups was almost similar. The corresponding values were 0.940, 1.040 and 1.060 kg for R1, R2 and R3 respectively with insignificant. These results indicated that the use of Ca-SFA as a energy supplement had no ill effect on average daily gain of buffalo bulls. Results obtained in this study are in line of the findings of, El-Bedawy *et al.* (1996), Abod-Donia *et al.* (2000) and Aiad *et al.* (2005) which were carried out on growing buffalo calves fed protected fat ranged about 0.926 to 1.066 kg/h/d. These differences in ADG reported by different investigators may be due to different plane of nutrition used.

Table (4): - Effect of feeding Ca-SFA level on performance of buffalo bulls

Item	Experimental Rations			P<
	Control	4 % Ca-SFA	8 % Ca- SFA	
Feed intake kg/h /day :				
CFM	4.51± 0.17	4.52± 0.10	4.53± 0.16	
Berseem hay	1.81± 0.18	1.81± 0.14	1.81± 0.11	
Rice straw	2.33± 0.21	2.33± 0.19	2.33± 0.10	
Total DM intake	8.64± 0.37	8.65± 0.23	8.66± 0.36	
Feed conversion :				
Kg DMI/kg gain	9.19± 0.84	8.32± 0.31	8.17± 0.33	ns
Kg TDN/kg gain	6.54± .56	5.94± 0.22	5.93± 0.24	ns
Kg DCP/kg gain	0.745± 0.05	0.684± 0.02	0.741± 0.02	ns
Average body weight (kg) :				
Initial body weight	295.0 ± 7.31	295.0 ± 6.42	295.7± 10.34	ns
Final body weight	407.0± 16.26	419.0 ± 7.81	422.8 ±10.34	ns
Duration period / days	120	120	120	
Total gain	112 .0 ± 9.81	124. 7 ± 3.69	127.2 ± 2.17	ns
ADG	0.933± 0.08	1.040 ± 0.03	1.060 ± 0.02	ns

Rumen fluid parameters:

Effects of feeding bulls on different experimental rations on ruminal parameters are shown in Table (5). Ruminal pH values were nearly similar for all experimental groups. All values were above 6.00 values which indicated a better digestion, (Mertens 1978). Generally, the overall mean of ruminal pH value was not affected by Ca-SFA supplementation and / or sampling times. Ammonia nitrogen concentration (NH_3-N mg/dl) was significantly increased ($P<0.05$) in the rumen fluid of bulls fed R_2 and R3 than the control rations at 0, 3 h and 6 h. after feeding .The overall mean was significantly ($P<0.05$) higher by applying the Ca-SFA. Similar trend was observed by Aiad *et. al*. (2005) and Abo-Donia *et. al*. (2003b) and Abdelhamid *et. al.,* (2003).

Total VFA's was 10.73, 10.24 and 10.40 (meq/dl) before feeding for R1, R2 and R3 respectively as shown in Table (4). In general, VFA insignificantly increased for all groups after 3 h post feeding. The higher values were reported for the R3 while the lowest values were reported for the R1. Similar results were noticed by Abdelhamid *et. al.* (2003), Abo-donia (2003) and Aiad *et. al.* (2005). Proportion of acetate was significantly ($P<0.05$) increased with feed Ca-SFA, while propionate was significantly ($P<0.05$) decreased. Butyrate was not affected by Cs-SFA supplementation to the experimental rations. These results are in agreement with those found by White *et. al.* (1992) and Aiad *et. al*. (2005).

The synthesized microbial protein in the rumen was slightly higher with bulls fed R_2 than these fed the other two rations. This result reflected better-feed efficiency of this ration than the other two rations.

Table (5): - Effect of feeding of Ca-SFA level on some rumen parameters

Item / Time	Experimental Rations			±SE	P<
	Control	4 % Ca-SFA	8 % Ca- SFA		
pH					
0	6.28 ± 0.11	6.31 ± 0.11	6.29 ± 0.13	0.11	ns
3	6.2٦ ± 0.26	6.22 ± 0.28	6.26 ± 0.18	0.26	ns
6	6.32 ± 0.12	6.35 ± 0.12	6.36 ± 0.13	0.13	ns
Overall mean	**6.28±0.09**	**6.29±0.09**	**6.30±0.09**	0.09	**ns**
NH_3-N(mg/dl)					
0	9.60^{b}	11.01^{a}	11.96^{a}	0.23	*
3	9.52^{b}	11.34^{a}	12.45^{a}	0.22	*
6	9.33^{b}	10.86^{a}	11.88^{a}	0.26	*
Overall mean	**9.49^{c}**	**11.07^{b}**	**12.09^{a}**	0.13	*****
TVFA's meq/dl)					
0	10.73	10.24	10.40	0.20	ns
3	11.60	11.76	11.94	0.64	ns
6	10.98	10.72	10.88	0.85	ns
Overall mean	**11.10**	**10.91**	**11.07**	0.37	**ns**
Acetate , %					
0	58.86^{b}	59.44^{a}	59.54^{a}	0.05	*
3	58.15	59.15	59.15	0.11	ns
6	58.96	59.35	59.41	0.12	ns
Overall mean	**58.90^{b}**	**59.31^{a}**	**59.31^{a}**	**0.06**	*
Propionate , %					
0	25.25a	24.92b	24.88b	0.05	*
3	25.07	24.88	24.85	0.09	ns
6	25.09	24.88	24.84	0.07	ns
Overall mean	**25.14^{a}**	**24.89^{b}**	**24.86^{b}**	**0.04**	*
Butyrate, %					
0	11.89^{a}	11.64^{b}	11.58^{b}	0.03	*
3	12.05	11.98	12.01	0.15	ns
6	11.96	11.77	11.75	0.18	ns
Overall mean	**11.79**	**11.79**	**11.78**	0.08	ns
MP (g/h/d)	1014	1037	1031		ns

$^{a, b}$ Means in the same row having different superscripts are significantly different at (P< 0.05). ns = non-significant difference. * = (P< 0.05)

Blood Serum parameters:

Blood serum parameters as affected by different rations fed to bulls are shown in Table (6). The present data indicated that there was no significant effect in serum total lipids and glucose. Free fatty acids and cholesterol in blood serum were increased (P<0.05) in treated rations (R_2 and R_3) than the control one. These results are related to the high content of saturated fatty acids in Ca-SFA. The herein results are supported with those reported by Steele (1980), El-Bedawy *et. al*. (1994b) Abo-Donia (2003) and Aiad *et. al*. (2005). All serum parameters were within the normal range as reported by William (1997). The estimated values of investigated serum parameters could show that there was no depressing effect of Ca-SFA replacing corn grain.

Table (6): - Effect of feeding Ca-SFA on some blood parameters.

Item	Experimental Rations			P <
	Control	4 % Ca-SFA	8 % Ca-SFA	
Free fatty acids (meq /dl)	31.32 ±2.53[b]	52.18±6.15[a]	53.68±3.39[a]	*
Total lipids (g / dl)	6.76±0.04	6.94±0.07	6.76±0.06	ns
Cholesterol (mg / dl)	190.5±4.19[b]	204.0 ±3.39[ab]	214.1±1.81[a]	*
Glucose (mg / dl)	55.54±1.28	49.56±1.32	49.44±1.27	ns

[a, b] Means in the same row having different superscripts are significantly different at (P< 0.05).
ns = non-significant différence. * = (P< 0.05)

Economic evaluation:

The economic evaluation of the experimental rations for growing buffalo bulls is presented in Table (7). Results showed that average costs in L.E. for one kg. Gain for R1, R2 and R3 were 8.19, 7.32 and 7.19, respectively, these led to a decreasing in cost of kg gain by about 10.62 and 12.21% for rations R2 and R3 respectively.

Table 7: - Economical evaluation for using of Ca-SFA

Item	Experimental Rations		
	Control	4% Ca-SFA	8% Ca-SFA
Total gain, kg	112.00	١٢٤,٦٧	127.17
Feed consumed as fresh, kg	1139	1139	1140
Price of feed consumed, LE	917.39	913.14	914.37
Price of total gain, LE	1456	1620.71	1653.21
Cost to produce kg gain, LE	8.19	7.32	7.19

The price of one ton of berseem hay and rice straw were L.E 550, 100, respectively
Price of kg live body weight L.E 13

Conclusion

It is concluded that adding Ca-SFA as energy source in finishing buffalo bull's rations instead of 25 and 50% from the energy of yellow corn had no detrimental effect on their growth performance. Accordingly, it could be used to cover the shortage gap of energy supplements. Protected fat as Ca-SFA has another advantage from economic point of view tin since its market price is relatively lower than yellow corn. So, it can decrease in cost of gain production and improve economical efficiency.

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تأثير إحلال الدهن الكالسيومي محل الذرة كمصدر للطاقة في علائق التهيئة للعجول الجاموسي.

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استخدم في هذه الدراسة عدد ١٨ عجل جاموسي متوسط أوزانها ٢٩٥ ± ٧,٣١ ومتوسط أعمارها عام . تم توزيعها عشوائيا على ثلاثة مجاميع متساوية . الدهن الكالسيومي كان يضاف على أساس المادة الجافة بنسبة ٤-٨ % في العلف المركز كبديل للذرة بما يعادل ٢٥ –٥٠ % على اساس الطاقة من الذرة . ووزعت العلائق كما يلي:

- المجموعة الأولى تتناول العليقة المقارنة والتي يحتوي على دريس برسيم و قش الارز و علف مركز لا يحتوي على دهن كالسيومي.
- المجموعة الثانية تتناول عليقة تحتوي على دريس برسيم و قش الأرز و علف مركز يحتوي على ٤ % دهن كالسيومي
- المجموعة الثالثة تتناول عليقة تحتوي على دريس برسيم و قش الأرز و علف مركز يحتوي على ٨ % دهن كالسيومي

أظهرت النتائج ما يلي:

- إضافة الدهن الكالسيومي لم تسبب أي تغير في كمية المادة الجافة الماكولة ومتوسط النمو ومعامل التحويل الغذائي والزيادة الوزنية مقارنة بمجموعة المقارنة
- لم يحدث تغيرات معنوية في معاملات هضم العناصر الغذائية فيما عدا مستخلص الايثر الحامضي, الطاقة المهضومة والتي تأثرت معنويا في المعاملات المضاف لها الدهن الكالسيومي مقارنة بمجموعة المقارنة.
- أظهرت تحليلات سائل الكرش والبروتين الميكروبي المحسوب عدم وجود اختلافات معنوية بين المجاميع التي تتناول الدهن الكالسيومي ومجموعة المقارنة.
- أظهرت العلائق المحتوية على الدهن الكالسيومي زيادة معنوية في الأحماض الدهنية الحرة والكلسترول مقارنة بمجموعة المقارنة بينما لم يحدث تغيرات معنوية في مستوى الليبيدات الكلية والجلوكوز فى سيرم الحيوانات التي تناولت الدهن الكالسيومي مقارنة بمجموعة المقارنة.

وتوصى الدراسة بامكانية استخدام الدهن الكالسيومى كمصدر للطاقة ليحل محل ٢٥ الى ٥٠% من طاقة الذرة فى علائق التهيئة للعجول الجاموسى.