Proc. 3rd All Africa Conf. Anim. Agric. & 11th Conf. Egyptian Soc. Anim. Prod., Alexandria, Egypt, 6-9 November 2000:229-236

PERFORMANCE OF GROWING BUFFALO CALVES SUPPLEMENTED WITH FISHMEAL OR SOYBEAN AND/ OR MOLASSES

M.I. Bassiouni, E.M. Abdel-Raouf and M.K.Mohsen

Animal Production Department, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt

SUMMARY

Twenty growing buffalo male calves with average live body weight 108.70±3.34 kg and about 6 months old were randomly divided into four similar groups of five calves each. All groups were fed for 24 weeks on concentrate mixture, berseem hay and rice straw as a basal diet. One group acted as the control (G1) for 24 weeks, while group two was supplemented (per/head) with 200g fishmeal (G2), group three with 300g soybean (G3) and group four with 300g molasses (G4) for the 1st 8 weeks. The different groups supplemented during the 2nd 8 weeks with 100g fishmeal plus 150g molasses, 150g soybean plus 150g molasses and 100g fishmeal plus 150g molasses, respectively. During the last 8 weeks of the experimental period the supplementation was 300g molasses for both G2 and G3, while G4 was supplemented with 200g fishmeal only. Digestibility trials were carried out at 8,16 and 24 weeks of the experiment.

Results in the first 8 weeks of the experiment showed that groups supplemented with fishmeal or soybean had an improvement in average daily gain and feed conversion. Also, feeding cost decreased compared with either G1 or G4. Moreover, increasing the proportion of CP in the diet increased N-balance, energy and protein utilization.

Addition of molasses with fishmeal or soybean meal to rations of groups 1, 3 and 4 during the 2nd 8 weeks caused similar average daily gain although significantly increased compared with animals in the control group. Moreover, there was an important in N-balance, feed utilization, feed conversion and feed cost.

At the last 8 weeks of the experiment, body weight gain and N-balance were nearly similar in groups supplemented with fishmeal, soybean or molasses. The same trend was found in feed utilization, feed conversion and feeding cost. Also, supplemented fishmeal was worthless.

It could be concluded that basal diet of growing buffalo calves may be supplemented with fishmeal or soybean meal only for 8 weeks from 6 months old. After that supplementation with soybean meal and molasses causes better results concerning daily gain, feed utilization and feed cost/kg gain.

Keywords: ***Buffalo calves, fishmeal, soybean meal, molasses, feed utilization, performance***

INTRODUCTION

Under local circumstance in Egypt buffalo bull calves are slaughtered as veal at the age of 4-6 weeks and of 80kg live-weight. Among farmers the common practice is to allow this calf to suckle its dam until weaning time, when it is about 4-5 months old. It is also found that to attain maximum live-weight as well as a high dressing percentage with better meat quality, a high plane of nutrition should be maintained in order to fatten buffalo bull calf to be ready for slaughter at the age of 18 months of 400-450kg live-weight and nearly 57% dressing percentage.

Tamminga (1982) considered the amino acids profile of fish meal (FM) to be similar to that required for bovine growth. Fishmeal (FM) is stable and can be transported without deterioration (Barlow and Windor, 1983), also, rich in crude protein (CP) which is slow degradable in the rumen (ARC, 1980 & NRC 1985) that may enhance animal performance by complementing the microbial protein at the duodenum. Moreover, fishmeal has an enhanced nutritional value due to its content of growth factors known collectively as Animal Protein Factor (APF). Diets of young ruminant animals include up to 15% of fishmeal. However, with older animals, the level is brought down to about 5%. Soybean meal is generally regarded as one of the best sources of protein which contains all the essential amino acids except for methionine which is the chief limiting amino acid, particularly in high-energy diets. Also, fishmeal and soybean meal is considered better protein sources for growth of calves than corn gluten meal or cottonseed meal. (Zerbini and Polan., 1985). Therefore, the present study aimed to investigate the effect of supplementation of fish meal (FM) or soybean meal (SBM) with or without molasses on nutrient utilization, some rumen parameters of growing buffalo calves.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of the Department of Animal Production, Faculty of Agriculture, Kafr El-Sheikh, Tanta University. Twenty buffalo calves at the age of about 6 months with average live body weight of 108.70 ± 3.34kg were randomly distributed among four similar groups of 5 animals each. First group acted as the control (G_1), while the diets of the remaining groups (G_2, G_3 and G_4) were supplemented with fishmeal (FM), soybean meal (SBM), and molasses (MO) as follows:

Experimental Period	Experimental rations			
	G_1	G_2	G_3	G_4
1 – 8 weeks	Basal diet (BD)*	BD + 200g FM	BD + 300g SBM	BD + 300 MO
9–16 weeks	Basal diet (BD)	BD+100g FM +150 MO	BD +150g SBM +150 MO	BD+150g MO +100 FM
17–24 weeks	Basal diet (BD)	BD + 300g MO	BD + 300g MO	BD+200g FM

* Basal diet (BD) consisted of concentrate feed mixture, berseem hay, and rice straw.

Feeding trial lasted for 24 weeks. Animals were fed individually two times daily according to NRC (1988) requirements. All experimental animals were offered concentrate feed mixture (CFM), berseem hay (BH) and rice straw (RS) throughout the experimental period as a basic ration. CFM : BH : RS ratio (on DM basis) was 62.6, 12.4 and 25% during 0-8 weeks ; 63.7, 18.1 and 18.2% during 9-16 weeks and 66.8, 16.6 and 16.6% during 17-24 weeks, respectively. Feeding allowance was adjusted biweekly according to body weight change, actual feed intake of each animal was recorded daily. Fresh water was offered to the animals three times daily. At weeks 8, 16 and 24 three digestibility trials were carried out using three animals from each group to determine the nutritive value of the experimental rations according to Pond *et al.* (1995). Samples of feeds and feces were collected for analysis according to AOAC procedures (1990). The data were analyzed using General Linear Models Procedure adapted by SPSS (1997) for User's Guide, with one way ANOVA model used in the data, where appropriate, means were separated using Duncan's multiple range tests.

RESULTS AND DESSCUSSION

Results obtained from Table 1 indicated that both fish meal (FM) and soybean meal (SBM) are high in CP, EE and low in CF compared with concentrate feed mixture "CFM" (65.04, 42.80 vs 15.94; 5.86,4.80 vs 3.14 and 0.00, 5.45 vs 14.10% for CP, EE and CF, respectively). While molasses (MO) is high in NFE and low in CP and CF than CFM. Calculated chemical compositions (%) of experimental rations pointed out, that supplementing of FM or SBM to basal ration raised CP% while NFE% increased by molasses (MO) addition. All tested rations contained nearly similar EE, CF and ash within each period.

Nutritive values of tested rations are presented in Table 2. Results indicated that supplementing either FM or FM+MO raised TDN content during P_1 and P_2 which may be due to increasing digestion coefficients (%) of OM, EE, CF and NFE. However, adding FM to G_4 diet during P_3 had limited response which may be attributed to improving ruminal fermentation with increasing live body weight. These results agree with Oldham and Smith (1982), who suggested that growing cattle weighing more than 200kg with adequate energy intake could meet their protein requirements from the microbial protein synthesized in the rumen. Based on this suggestion, the lack of response to FM supplementation of diets fed to steers (Steen, 1988, 1989) or fed to heifers (Smith *et al.*., 1985; Mantysaari *et al.*., 1989) might be explained partly by the weight of the animals used. Moreover, supplementing of SBM only or with MO caused slightly lower TDN compared with groups treated with FM. However, supplementing of MO only to buffalo calves weighing less than 172kg lead to significant lower TDN value, while MO supplementation of diets fed to calves weighing more than about 186kg caused an improvement of TDN value.. These results explained the improving rumen fermentation correlated with progressing live body weight. Rations containing FM only had the highest value for DCP (at P_1 and P_3). But supplementing either FM or SBM with MO to basal diet (BD) showed insignificant differences in DCP because dietary CP level was nearly similar (Table 1). However, DCP was higher with FM than SBM diet only. Regarding supplementing of MO only results indicated that, DCP was significantly lower ($P<0.05$) compared with other groups at P_1, yet DCP values was nearly similar with group received FM at P_3. These results indicated that FM was beneficial with growing calves weighing less than 190kg and MO with body weight more than 190kg.

Table 1. Chemical analysis of feed ingredients and calculated composition of the experimental rations

Item	DM	Composition of DM, %					
		OM	CP	EE	CF	NFE	Ash
Ingredients							
CFM	90.20	88.78	15.94	3.14	14.10	55.60	11.22
Fish meal (FM)	90.25	84.02	65.04	5.86	0.00	13.12	15.98
Soybean meal (SBM)	89.13	94.50	42.80	4.80	5.45	41.45	5.50
Molasses	65.40	80.50	3.80	1.90	0.00	74.80	19.50
Berseem hay (BH)	89.42	87.36	15.13	1.88	27.71	42.64	12.64
Rice straw (RS)	89.89	84.04	2.65	1.52	34.36	45.51	15.96
Calculated chemical							
From 1 - 8 weeks (p_1)							
G_1	90.02	87.42	12.52	2.58	20.85	51.47	12.58
G_2	90.04	87.26	15.03	2.74	19.85	49.64	12.74
G_3	89.98	87.91	14.62	2.73	19.78	50.78	12.09
G_4	88.76	87.06	12.07	2.54	19.77	52.68	12.94
From 9 –16 weeks (p_2)							
G_1	90.00	87.66	13.38	2.62	20.24	51.42	12.34
G_2	89.54	87.46	14.10	2.66	19.50	51.20	12.54
G_3	89.51	87.70	13.96	2.66	19.47	51.61	12.30
G_4	89.54	87.46	14.10	2.66	19.50	51.20	12.54
From17 –24 weeks (p_3)							
G_1	90.02	87.76	13.59	2.66	19.73	51.78	12.24
G_2	89.16	87.50	13.25	2.64	19.03	52.58	12.50
G_3	89.16	87.50	13.25	2.64	19.03	52.58	12.50
G_4	88.86	87.84	14.42	2.69	19.09	51.64	12.16

Table 2. Digestibility and feeding values of experimental rations

Item	Experimental rations				S.E.M
	G_1	G_2	G_3	G_4	
Digestibility coefficients and nutritive values during 0 – 8 weeks (p_1)					
DM	66.68	65.01	65.19	63.31	1.1020
OM	68.15^{ab}	70.57^{b}	65.88^{ab}	64.99^{a}	.7916
CP	78.26^{b}	71.00^{ab}	64.59^{a}	69.19^{a}	1.1727
EE	64.21^{a}	78.49^{b}	68.23^{a}	67.51^{a}	1.1391
CF	59.66^{bc}	62.23^{c}	46.98^{a}	49.29^{ab}	1.6279
NFE	69.33^{a}	73.33^{b}	73.48^{b}	69.80^{a}	.5195
TDN	61.65^{ab}	64.26^{b}	60.24^{ab}	58.73^{a}	.7271
DCP	9.80^{bc}	10.67^{c}	9.44^{b}	8.35^{a}	.1490
Digestibility coefficients and nutritive values during 9 – 16 weeks (p_2)					
DM	58.91	65.89	60.15	60.61	1.1352
OM	66.75^{b}	72.71^{a}	68.61^{b}	67.87^{b}	.5011
CP	60.54^{c}	57.53^{bc}	56.24^{b}	50.48^{a}	.5425
EE	64.56^{a}	77.67^{c}	69.66^{b}	70.13^{b}	.7306
CF	62.67^{a}	73.65^{b}	65.46^{a}	63.53^{a}	.9317
NFE	70.09^{a}	76.27^{c}	73.09^{b}	74.20^{bc}	.4427
TDN	60.63	66.18	62.49	61.70	.4619
DCP	8.10	8.12	7.85	7.12	.0736
Digestibility coefficients and nutritive values during 17 – 24 weeks (p_3)					
DM	60.84	63.77	61.08	63.74	.4242
OM	65.11^{a}	69.82^{b}	64.93^{a}	69.18^{b}	.4860
CP	54.95^{ab}	58.71^{c}	57.05^{bc}	53.02^{a}	.4893
EE	62.01^{a}	76.79^{c}	70.04^{b}	70.49^{b}	.6944
CF	65.32^{a}	71.82^{b}	64.69^{a}	65.68^{a}	.9146
NFE	67.85^{a}	71.54^{b}	67.95^{a}	75.30^{c}	.4247
TDN	59.20^{a}	63.62^{b}	61.10^{ab}	63.06^{b}	.4483
DCP	7.47^{a}	7.78^{ab}	7.56^{a}	8.09^{b}	.0672

Feeding either FM or SBM without or with MO decreased DM intake computed per head/100kg LBW or metabolic body size (Table 3), which may be attributed to the significant intensification of energy and CP of supplementing rations and (or) may be due to fishmeal that improved roughage utilization in buffalo heifers (Akbar and Tareque (1989). Although inclusion of FM or SBM only or with MO in the tested rations decreased DM intake by 3-5% than control group, yet TDN and DCP intake did not decrease by the same rate. Despite, DCP for groups supplemented with FM (at p_1) and FM+MO or SBM+MO (at p_2) was increased, yet DM intake was decreased, since FM or SBM contains higher energy and CP. Moreover, animals fed MO (at p_3) showed the same trend. Also, positive correlation between rumen activity and increasing body weight was reflected on daily gain and feed efficiency, which showed differences between experimental and control groups (Tables 3 & 5).

Results of nitrogen balance (Table 4) revealed that, supplementing either FM or SBM with or without MO increased nitrogen intake by 25.70, 9.35 and 15.98% at p_1, p_2 and p_3 respectively. However, it was noticed that groups fed FM or SBM had higher (P<0.05) fecal nitrogen (g/calf/day) than control group yet, higher N balance was observed in-groups fed FM or SBM with or without MO, which could be due to the higher improvement in CP intake and more utilization of FM and SBM nitrogen by growing buffalo calves and (or) the high digestibility of organic matter (OM) might have increased the use of the dietary N. Oldham and Smith (1982); Chalupa (1975) and Mehrez *et al.* (1980) suggested that several factors influence the response of growing ruminants to nitrogen of FM or SBM supplementation. Such factors include weight of animals used; ruminal microbial activity, source and level of energy and the length of time that organic matter was stored before processing.

Table 3. Effect of different experimental rations on daily feed intake of buffalo calves

Item	Experimental rations				S.E.M
	G_1	G_2	G_3	G_4	
Daily feed intake during 0 – 8 weeks (p_1)					
DM/100kg B.W (kg)	3.02	2.84	3.01	3.25	.0791
DM/1kg $W^{.75}$ (g)	95.35	89.91	95.23	102.22	2.5029
TDN/100kg B.W (kg)	1.87	1.82	1.81	1.91	.0614
TDN/1kg $W^{.75}$ (g)	59.12	57.70	57.37	60.41	1.9432
DCP/100kg B.W (g)	297.46	303.29	283.73	271.58	10.2011
DCP/1kg $W^{.75}$ (g)	9.41	9.59	8.97	8.59	.3226
Daily feed intake during 9 – 16 weeks (p_2)					
DM/100kg B.W (kg)	3.37	3.24	3.21	3.18	.5768
DM/1kg $W^{.75}$ (g)	106.52	102.57	101.43	100.49	2.4279
TDN/100kg B.W (kg)	2.05	2.14	2.00	1.96	.0536
TDN/1kg $W^{.75}$ (g)	64.71	67.81	63.39	61.99	1.6945
DCP/100kg B.W (g)	273.43	291.85	276.79	255.42	7.2145
DCP/1kg $W^{.75}$ (g)	8.65	9.23	8.75	8.08	.2281
Daily feed intake during 17 – 24 weeks (p_3)					
DM/100kg B.W (kg)	3.09	3.01	2.83	2.75	.0609
DM/1kg $W^{.75}$ (g)	97.66	95.08	89.43	86.94	1.9258
TDN/100kg B.W (kg)	1.83	1.91	1.72	1.73	.0405
TDN/1kg $W^{.75}$ (g)	57.87	60.44	54.64	54.82	1.2823
DCP/100kg B.W (g)	230.94	233.87	213.57	222.37	4.9982
DCP/1kg $W^{.75}$ (g)	7.30	7.40	6.75	7.03	.1581

Data of efficiency of dietary energy and protein utilization are given in Table 5. Efficiency of ME and DCP utilization for animals weighing less than 190kg (during p_1 and p_2) was higher in-group fed FM followed SBM but its values were nearly similar in groups fed either FM or SBM with MO. Similar results obtained by Qrskov *et al.*. 1971 suggested that feed efficiency (feed required per unit of gain) was improved (p<0.05) with increased FM supplementation. On the other hand, its values was not affected by MO supplementing at early weighing (less than 190kg). However, when body weight of animals was more than 190kg efficiency of DCP utilization and ME was nearly similar by either supplementing MO or FM. These results indicated that, improvement of ME utilization succeeded increment dietary DCP which reflected on daily gain.

Data in Table 6 showed that animal performance parameters were affected by experimental rations. The average of body weight of G_2 had higher value, followed by G_3 and G_4 during different experimental periods. Moreover, its values were significantly higher (p<0.05) than control group during p_2 and p_3. Average daily gain was significantly higher (p<0.05) in animals fed FM only followed by SBM only at p_1 but G_4 (fed MO only) showed slight increase than control group. However, supplementing of FM to G4 at p_3 did not improve (p>0.05) average daily gain compared with groups fed MO. Daily gain in animals fed FM or SBM with molasses (at p_2) increased significantly (p<0.05) than control group. The present results indicated that supplementing either FM or SBM was more profitable with growing buffalo calves weighing less than 190 kg. In contrast, calves weighing more than 190kg may be supplemented with MO only as a source of energy.

Table 4. Effect of different experimental rations on nitrogen balance of buffalo calves

Item	Experimental rations				S.E.M
	G_1	G_2	G_3	G_4	
Nitrogen balance g/calf/day during 0 – 8 weeks (p_1)					
N intake	72.15	90.93	90.46	73.34	
Fecal N	15.68^{a}	26.37^{b}	32.03^{c}	22.60^{bc}	.8733
Urinary N	38.26	36.46	34.54	31.72	1.1017
N balance	18.20^{a}	28.10^{c}	23.88^{bc}	19.02^{ab}	.7854
N balance (%from intake)	25.23	30.90	26.40	25.93	.9449
Nitrogen balance g/calf/day during 9 – 16 weeks (p_2)					
N intake	105.97	115.96	115.73	115.96	
Fecal N	41.82^{a}	49.24^{b}	50.64^{b}	57.43^{c}	.5909
Urinary N	45.23^{a}	38.22^{b}	37.29^{b}	33.64^{b}	1.0254
N balance	18.92^{a}	28.50^{b}	27.80^{b}	24.90^{b}	.5349
N balance (%from intake)	17.85^{a}	24.58^{b}	24.02^{b}	21.47^{b}	.4676
Nitrogen balance g/calf/day during 17 – 24 weeks (p_3)					
N intake	117.48	118.67	118.67	136.26	
Fecal N	52.92^{a}	48.99^{a}	50.96^{a}	64.01^{b}	.5865
Urinary N	44.10	44.04	42.59	44.28	1.2509
N balance	20.45^{a}	25.63^{ab}	25.12^{ab}	27.97^{b}	.9783
N balance (%from intake)	17.45	21.60	21.17	20.53	.7907

Calves weighing less than 190kg need enough essential amino acids in their diets for tissue protein synthesis. On contrast calves weighing more than 190kg with adequate energy intake can meet their protein requirements from the microbial protein synthesized in the rumen. Similar results were reported by Oldham and Smith (1982) and Mantysaari *et al.* (1989) who suggested that the differences in ADG were not significant (p>0.05) when growing cattle weighing 200 to 450kg had ad libitum access to corn silage based diets supplemented with SBM, FM, meat and bone meal, or two mixtures of several animal by-products. Also, Hovell and Orskov (1989) and Johnson and Rowe (1984) found that growth rates should response to FM or increasing levels of protein in rations of lambs or goats. While Marai *et al.*, (1983) found that mature ewes given all plant protein gained significantly more weight than those fed FM or urea supplements. Feed efficiency as grams of DM intake/ grams of gain was the best with groups fed either FM or SBM only or with MO followed by groups fed MO only compared with control group. These improvements may be due to efficiency of feed utilization as indicated by highest daily weight gain and slight fall in feed intake. Feed cost LE/kg gain was nearly similar in both groups FM and SBM and its values were reduced than both G_1 and G_4 at p_1. In contrast supplementing FM only to calf rations at P_3 increased feed cost than those fed molasses only. While calves fed either FM or SBM with MO have lower values than control group. This finding denoted that groups fed either FM or SBM at p_1 continued to advance to reducing feed cost through p_2 and p_3. Also, the lowest feed cost/kg gain; lowest feed efficiency (best value) and highest daily gain were parallel for all groups at p_1. While G_4 (fed FM only at P_3) had best values for feed efficiency and daily weight gain but feed cost was higher. This result means that FM supplementing as the source of protein to growing buffalo calves weighing more than 190kg was not economic. Similar results were obtained by Singh (1983) who stated that supplementing of FM to Haryanal heifers diet introduced to feed cost per head while cost per kg gain was lower.

Table 5. Efficiency of dietary energy and protein utilization by growing buffalo calves fed different ration supplementation with fishmeal, soybean meal and molasses

Items	From 0 – 8 weeks				From 9 – 16 weeks				From 17 – 24 weeks			
	G_1	G_2	G_3	G_4	G_1	G_2	G_3	G_4	G_1	G_2	G_3	G_4
Energy:-												
TDN intake (kg)	2.22	2.43	2.33	2.23	3.00	3.40	3.24	3.17	3.20	3.56	3.42	3.52
DE Mcal	9.79	10.71	10.27	9.83	13.23	14.99	14.28	13.96	14.10	15.70	15.08	15.52
ME Mcal	8.03	8.79	8.42	8.06	10.85	12.29	11.71	11.44	11.56	12.87	12.36	12.73
NE_m Mcal	4.05	4.36	4.23	4.07	4.62	5.24	5.07	4.87	5.22	5.95	5.78	5.70
NE_g Mcal	0.87	1.63	1.32	0.96	1.04	1.96	1.81	1.60	1.33	1.88	1.78	2.10
NE_{m+g} Mcal	4.92	5.99	5.55	5.03	5.65	7.19	6.88	6.46	6.55	7.83	7.56	7.80
Efficiency of ME	61.28	68.24	65.84	62.40	52.08	58.50	58.76	56.49	56.67	60.84	61.14	61.29
Protein:-												
DCP intake (g)	352.9	403.4	365.1	317.07	400.96	416.9	406.7	365.8	403.4	435.4	423.1	451.5
DCP for maintenance g	118.9	126.8	125.6	121.92	146.86	160.2	157.9	153.7	163.5	178.8	175.7	174.2
Available DCP for gain g	233.9	276.6	239.5	195.14	254.10	256.7	248.8	212.1	239.9	256.6	247.3	277.3
Yield of gain protein g	99.24	164.3	139.4	108.08	103.26	164.3	157.5	146.2	115.7	141.4	138.2	162.3
Efficiency of dietary	42.41	59.40	58.20	55.39	40.64	64.00	63.29	68.95	48.23	55.10	55.87	58.53

TDN intake kg/calf/day (DMI x TDN) / 100., where DMI=dry matter intake kg/day, DE=(0.04409 x TDNx DM). , ME=0.82 x DE. ,
NE_m=77 x $(W)^{.75}$ x 1.33.., NE_g=[0.85(0.0635 x $(W)^{.75}$ x $(EBG)^{11.097}$], where EBG = average daily gain , NE_{m+g}=NE_m + NE_g ,
Efficiency of ME utilization (%)= (NE_{m+g} x 100)/ME.
DCP g/calf/day=(DMI x DCP)/100, DCP for maintenance=6.25[100/70(MFN x DMI + EUN) – MFN x DMI],
where MFN=5mg/kg DMI, EUN=[2.6 x 77 x $(w)^{0.75}$]/1000.(McDoland et.al.,1978).,
Available DCP for gain=(DCP g/calf/day–DCP for maintenance)
Efficiency of dietary DCP utilization % = (yield of gain protein x 100) / available DCP for gain.

Table 6. Performance of buffalo calves fed different rations supplemented with fishmeal, soybean meal and molasses

Items	Experimental rations				S.E.M
	G_1	G_2	G_3	G_4	
No. of animals	5	5	5	5	
Body weight (kg)					
Initial weight	110	108	108	108	3.3414
0-8 weeks (p_1)	134.70	148.90	142.70	135.70	2.7433
9-16 weeks (p_2)	160.40^a	189.80^c	181.90^{bc}	172.10^b	1.6950
17-24 weeks (p_3)	189.20^a	225.00^c	216.30^{bc}	212.50^b	1.6082
Av. Daily weight gain (g)					
0-8 weeks (p_1)	441.06^a	730.35^c	619.64^b	480.36^a	15.1552
9-16 weeks (p_2)	458.94^a	730.35^b	700.00^b	650.00^b	26.2506
17-24 weeks (p_3)	514.29^a	628.57^{ab}	614.29^{ab}	721.43^b	21.9046
Advantage daily gain (%)					
0-8 weeks (p_1)	100	165.59	140.49	108.91	
9-16 weeks (p_2)	100	159.14	152.53	141.63	
17-24 weeks (p_3)	100	122.22	119.44	140.28	
Av. Daily feed intake (kg)					
0-8 weeks (p_1)	3.60	3.78	3.87	3.80	
9-16 weeks (p_2)	4.95	5.14	5.18	5.14	
17-24 weeks (p_3)	5.40	5.60	5.60	5.58	
Feed efficiency *					
0-8 weeks (p_1)	8.16	5.18	6.24	7.90	
9-16 weeks (p_2)	10.78	7.04	7.40	7.91	
17-24 weeks(p_3)	10.50	8.90	9.11	7.74	
Cost of feeds/1kg gain (LE)					
0-8 weeks (p_1)	3.31	2.82	2.74	3.16	
9-16 weeks (p_2)	4.6	3.34	3.23	3.75	
17-24 weeks(p_3)	4.59	3.85	3.94	4.10	
% cost of feeds from G_1					
0-8 weeks (p_1)	100	85.20	82.78	95.47	
9-16 weeks (p_2)	100	72.61	70.21	81.52	
17-24 weeks(p_3)	100	83.88	85.84	89.32	

defined as grams of DM intake / grams of gain.

REFERENCES

Akbar,M.A; A.M.Tareque. 1989. Utilization of by-products and locally available feedstuffs in buffalo rations in Bangladesh. Domestic buffalo production in Asia. Proceedings of the final research co-ordination meeting on the use of nuclear techniques to improve domestic buffalo production in Asia -phase II, 20-24 February 1989, Rockhampton, Australia, organised by the joint FAO-IAEA Division of Nuclear Techniques in Food and Agriculture. 1990, 63-74

AOAC. (1990). Association of Official Analytical Chemists Official Methods of Analysis. 15[th] Edition, Washington D.C.

ARC. 1980. The Nutrient Requirements of Ruminant Livestock. Agricultural Research Council, Commonwealth Agricultural Bureaux, Slough, UK.

Barlow, S. M. and M.L. Windor. 1983. Fishery by-products. In: M. Rechcigl, Jr (Ed.) CRC Handbook of Nutritional Supplements. Volium II. Agricultural Use. Pp 253-272. CRC Pree, Inc., Boca Raton, FL.

Chalupa, W. 1975. Rumen bypass and protection of proteins and amino acids. J. Dairy Sci. 68:1198.

Hovell,F.D.D; E.R Orskov. 1989. The role of fish meal in rations for sheep. Technical-Bulletin,-International-Association-of-Fish-Meal-Manufacturers,-UK. 23:15.

Johnson,T.J; J.B Rowe.1984. Growth and cashmere production by goats in relation to dietary protein supply. Proceedings-of-the-Australian-Society-of-Animal-Production. 15: 400-403.

Mantysaari, P. E., C. J. Sniffen, T. V. Muscato, and M. L. Thonnet. 1989. Performance of growing dairy heifers fed diets containing soybean meal or mainly by-product meals. J. Dairy Sci. 72:2107.

Marai,I.F.M; AM.Aboul-Naga; F.Z.Swedan; A.S.El-Snobsksny; A.A.W.Abdel-Malek and N.R Saad, 1983. Flushing treatments of subtropical ewes bred three times each within two years. Animal Production Department, University Faculty of Agriculture, Zagazig, Egypt. Beitrage-zur-Tropischen-Landwirtschaft-und-Veterinarmedizin. 1983, 21: 2, 213-218.

McDoland, P., Edwards, R.A. and Greenhalgh, J.F.D., 1978. Animal Nutrition (2nd Ed.) Langman, Ino, NewYork.

Mehrez, A. Z., E. R. Ørskov and J. Opstvedt, 1980. Processing factors affecting degradability of fish meal in the rumen. J. Anim. Sci. 50:737.

NRC., 1985. Ruminant Nitrogen Usage. National Academy Press, Washington, DC.

NRC., 1988. Nutrient requirements of domestic animals. No.9. National Research Counical, Washington, D.C. USA.

Oldham,J.D. and T. Smith. 1982. Protein-energy interrelationships for growing and lactating cattle. In: E. L. Miller, I. H. Pike and A.J.H. Van Es (Ed.) Protein Contribution of Feedstuffs for Ruminants: Applecation to feed Formulation. pp 103-130. Butterworths, London.

Pond, W.G., D.C.Church and K.R.Pond, 1995. Basic Animal Nutrition and Feeding. 4th Ed. New York, Chichester, Brisbane, Toronto and Singapore.

Ørskov, E. R., I. McDonald, C. Fraser and E.L. Corse, 1971. The nutrition of the early weaned lamb. III. The effect of ad libitum intake of diets varying in protein concentration on performance and on body composition at different live weight. J. Agric. Sci. (Camb.) 77:351.

Singh,B.B A. 1983. Cereal and oil cake free ration for cattle. Indian-Veterinary-Medical-Journal. 7: 3, 156-160.

Smith, T., J. W. Siviter and R. J. Merry, 1985. Further comparisons of energy and protein sources for growing cattle. J. Agric. (Camb.) 104:485.

SPSS, 1997. Spss Base 7.5 for Windows, User's Guide; Spss Inc.

Steen, R.W.J., 1988. The effect of supplementing silage based diets with soyabean and fish meals for finishing beef cattle. Anim. Prod. 46:43.

Steen, R.W.J., 1989. A comparison of soya-bean, sunflower and fish meal as protein supplements for yearling cattle offered grass silage based diets. Anim. Prod. 48:81.

Tamminga, S., 1982. Energy-protein relationships in ruminant feeding: similarities and differences between rumen fermentation and postruminal utilization. In: E. L. Miller, I. H. Pike and A.J.H. Van Es (Ed.) Protein Contribution of Feedstuffs for Ruminants: Applecation to Feed Formulation. pp 4-17. Butterworths, London.

Zerbini, E. and C.E.Polan, 1985. Protein sources evaluated of ruminating Holchtin calves. J. Dairy Sci. 68: 1416-1424.