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EFFECT OF USING EXTRUDED SOYBEAN SEED ON GROWTH PERFORMANCE OF BUFFALO CALVES

F.M.A. Abo-Donia, A. A.Abdel-Aziz and G.H. Zaza

Animal Production Research Institute, A.R.C., Giza, Egypt

SUMMARY

This study was conducted to investigate the possibility of incorporating extruded Soybean seed ESB (full fat Soybean seeds) in the ration of growing buffalo calves as a partial or complete replacement of corn and Soybean meal and its effect on their growth performance. Three experimental groups of 6 animals each with initial body weight ranged between 97.7 and 96.5 kg (about 4 months old) was used for an experimental period of 120 days. Ether extract percentage were found to be 4.74, 6.68, and 8.4% for the control, 10% ESB and 20% ESB concentrate mixtures respectively. The experimental rations were formulated to be iso-caloric and iso-nitrogenous. Results indicated that inclusion of 10% extruded Soybean seeds in the ration of group 2 and 20% for group 3 improved significantly ($P<0.05$) average daily gain (996, 1008 and 843 g, respectively). Feed efficiency for the control compared with 10% and 20%ESB fed groups expressed as kg of (DM, TDN, DCP) fed/kg gain were (5.33, 4.92 and 4.86; 3.41, 3.14 and 3.11; 0.632, 0.582 and 0.578 respectively). Group fed 10% ESB achieved the best economic efficiency followed by groups fed 20% ESB and the control. No significant differences were found between the control and other two tested groups in the digestibility of OM, CP, CF, and NFE while differences in DM and EE between groups fed 10 and 20% ESB and the control were ($P<0.05$) significant. Nutritive value of the rations in term of DCP and TDN had no significant effect concerning DCP while 10% and 20% ESB rations were significantly higher in TDN compared with the control. The obtained results for rumen liquor PH and VFA,s showed no differences between the three groups while control group had significantly ($P<0.05$) high concentration of NH3-N 3 and 6 hours post feeding compared with the other groups. TL and CH of blood serum showed no differences among the three groups while group fed 20% ESB was significantly higher in blood TG and NEFA,s compared with 10% ESB and control groups. Also group fed 10% ESB was significantly ($P<0.05$) higher in these two parameters compared with the control. It is concluded that 10% of extruded Soybean seeds is a recommended amount in the ration of growing buffalo calves to maintain the fat content at about 7% from weaning up to 7 to 9 months of age.

Keywords: Buffalo, extruded soybean seed, growth

INTRODUCTION

Peterson *et al.* (1975) and Glenn *et al.* (1977) suggested that lipids coating was an effective method for reducing ruminal protein degradation. They also observed a reduction in ruminal ammonia-N (NH3-N) concentration and increased N flow to the abomasum. Full fat Soybeans contain approximately 37.9% crud protein and 18% ether extract (Davenport *et al.*, 1987) and 42% CP and 19% fat on dry matter basis (NRC, 1989). Chouinard *et al.* (1997) reported that cows fed ground raw Soybeans had a higher dry matter intake and a higher percentage of protein in milk than those fed heat-treated Soybeans. Heat treatment destroys anti-nutritional factors and increase RUP content (Faldet and Satter, 1991). Park and Rafalowski (1983) reported that heifers fed sunflower seeds (fat) diets consumed less total dry matter and significantly improving growth efficiency (gain/feed). Positive responses to high fat ration in term of feed utilization and growth of buffalo calves were reported by (El-Bedawy *et al.*, 1996).

Many buffalo breeders in Egypt are facing an unpleasant problem with their young buffalo calves just after weaning. The calves in general show negative growth performance in term of low daily gain, accompanied with hair roughness and scaly skin (El-Bedawy *et al.*, 1996). During suckling period the calf can be fed on an average of 4-liter milk per day. Buffalo milk is characterized by high fat content (about 7%). These amount of milk supply the calves with about 280 gram of fat per day. After weaning calves are commonly raised on low fat starter, which can not supply enough fat to animal as in buffalo milk. The above-mentioned negative growth responses and symptoms could be attributed to deficiency of fat or fat-soluble vitamin like A in the common used starter ration.

Feeding the already adapted calves to milk of high fat content for an extended period after weaning on high fat rations is the main objective of the present study as well as to investigate its effect as a non-specific source of energy on growth performance and nutrients utilization of post-weaned buffalo calves.

MATERIALS AND METHODS

Eighteen weaned four months old buffalo calves were randomly divided into three groups 6 animals each. The initial average live body weight values were 97.7, 97.0 and 96.5 kg for groups 1, 2 and 3 respectively. The rations were formulated to be iso-caloric, iso-nitrogenous. The first one had no extruded Soybeans and served to be the control while the second and the third represented rations contained 10 and 20% extruded Soybeans replacing both Soybean meal and yellow corn respectively. Roughage was offered in form of wheat straw and clover hay. The experimental period lasted for 120 days followed by a ten days digestibility trail. Concentrate mix was prepared and composite once every month (Table 2). Samples of ingredients and the concentrate mix as well as wheat straw and clover hay were chemically analyzed (Tables, 1 and 2). Animals were fed individually twice a day at 8.00 a.m. and 2.00 p.m. while water provided 4 times/day. Weight of the animals were taken and recorded once every two weeks and feed intake was re-adjusted according to NRC (1984). Digestibility trial, rumen fluid samples and blood samples were carried out at the end of the experimental period. Fecal samples were collected from the rectum two times per day from 3 animals representing each group for 10 days to determine the digestibility of the nutrients by acid insoluble ash (AIA) method according to Van Keulen and Young (1977). Chemical analyses of feed and feces were determined according to A.O.A.C (1984). Rumen fluid samples were collected by using stomach tube from 3 animals per group before and after 4 h of feeding to determine ruminal pH, TVFA's (Kromann *et al.*, 1967), ammonia-nitrogen concentration (Conway, 1963) and molar proportions of VFA's (Erwin *et al.*, 1961). Blood samples were drawn from jugular vein into heparinized tubes 4 hours after the morning feeding at the end of the digestibility trail and centrifuged for 20 min. at 1200 xg. The supernated was frozen at – 20 °C and stored for subsequent analysis. Plasma total lipid (TL), total glycerid (TG) and cholesterol were determined by using kits. The experimental data were statistically analyzed as one way analysis of variance according to (SAS, 1990) using the following model: $X = U + Xi + Eij$

Where i =1-3, (1) control, (2) 10% EXSB and (3) 20% EXSB. Significant differences among treatment means were detected using (Duncan's multiple range of test 1955).

Table 1. Chemical analysis of the feed ingredients on dry matter basis

Ingredients	DM	OM	CP	CF	EE	NFE	Ash
Soya bean meal	93.22	93.65	47.20	5.25	0.50	40.70	6.35
Cotton seed cake	92.16	91.27	26.50	23.12	5.50	38.15	6.73
Linseed cake	91.50	88.46	33.46	9.02	7.39	38.59	11.54
Yellow corn	90.28	89.05	9.95	5.06	5.30	77.74	1.95
Full fat soya	92.56	93.21	36.80	8.50	20.55	27.36	6.79
Clover hay	88.02	86.28	16.01	34.67	1.62	33.98	13.72
Wheat straw	93.11	89.07	1.79	39.71	0.62	46.95	10.93

RESULTS AND DISCUSSION

Chemical composition of ingredients, clover hay, wheat straw, formula of concentrate mixture and its chemical analyses are presented in Tables 1 and 2. Incorporation of extruded soybean seeds (ESB) in ration 2 at 10% and in ration 3 at 20% levels allowed to reduce the proportion of corn in the control ration from 53.5 to 51% and from 53.5 to 46.5% respectively (Table 2). Chemical analyses of the diets showed that the three concentrate mixtures had similar concentration of DM, OM, CP and CF. Mean time EE was increased linearly from 4.74% in the control diet to 6.68% and 8.4% as a result of adding ESB to the other 2 diets at levels of 10% and 20% respectively. On the other hand NFE content was decreased as the level of ESB increased in the diets. The increase of EE content in diets 2 and 3 compared with the control was mainly due to the high content of crude fat in ESB. While the decrease of NFE in diet 2 and diet 3 compared with the control was mainly due to the decrease of corn proportions in these diets.

Daily dry matter intake (DMI) is shown in Table 3. Calves fed rations contained 10% and 20% ESB showed significantly ($P<0.05$) higher DMI compared with the control group. This increase in DMI in the two groups fed diets contained 10 and 20% ESB may be attributed to high fat content of these rations since buffalo calves at this age are naturally adapted to high fat feed. These results are in full agreement with similar results obtained by Hussein *et al.* (1995) and El-Bedawy *et al.* (1996).

Table 2. Formula of concentrate feed and its chemical analysis on dry matter basis

Mixtures Ingredients	Control Mix. %	10%ESB Mix. %	20%ESB Mix. %
Soya bean meal	13.00	5.50	-
Cotton seed cake	20.00	20.00	20.00
Linseed cake	10.00	10.00	10.00
Yellow corn	53.50	51.00	46.50
Full fat Soya bean	-	10.00	20.00
Sod. Chloride	1.00	1.00	1.00
Sod. Bicarbonate	0.50	0.50	0.50
Di Cal. Phosphate	0.50	0.50	0.50
Lime stone	1.00	1.00	1.00
Min. and Vit. Mix	0.50	0.50	0.50
Total	100.00	100.00	100.00
	Chemical analysis (%) on dry matter basis:		
DM	91.43	91.44	91.47
OM	92.13	91.98	91.74
CP	20.11	19.99	20.63
CF	8.92	9.25	9.58
EE	4.74	6.68	8.40
NFE	58.43	56.53	53.19
ASH	7.80	7.55	8.20
Price/Kg/LE	0.52	0.54	0.58

Each Kg of Vit. And Min. mix contains 97% NaCl, 0.35% Zn, 0.2% Mn, 0.2 Fe, 0.15% Mg, 0.03% Cu, 0.007% I, 0.0005% Co and 0.002% Se, 7511 IU/g Vit. A and 8800 IU/g Vit. D3

Average daily gain in Table 3 and Figures 1,2 showed that calves fed 10 and 20% ESB were significantly higher ($P<0.05$) in this trait compared with control calves. As shown in Table 3 calves fed 10% and 20% ESB are significantly ($P<0.05$) higher in average daily gain compared with control group during the whole experimental period. These results are in good agreement with results of Deuel (1955) and El-Bedawy *et al.* (1996). By fragmenting the whole experimental period into sub periods one-month each, it can be notice that average daily gain at the first three periods were significantly ($P<0.05$) higher in favor of calves fed 10 and 20% ESB rations compared with the control. While in the fourth period differences in average daily gain between the three groups diminished and no significant differences were observed in this parameter among the three groups. This could be attributed to the advance of calves in age toward the maturity of rumen since rumen of calve reaches full development at age of 6 to 9 months (Church, 1991). Consequently high fat level in the feed may not have significant effect on the growth performance of buffalo calves after this age. El-Bedawy *et al.* (1996) attributed the significantly higher daily gain associated with the higher TDN intake for calves fed on ration contained high fat level to the high potentiality of buffalo calves to high dietary fat as non specific source of energy as well as the high fat consumption from suckling milk of 7% fat for 4 month pre-weaning period followed by feeding high fat ration post-weaning.

Results presented in Table 3 indicate that calves fed rations contained 10 and 20% ESB were significantly ($P<0.05$) higher in consumption of DMI and TDN compared with the control. The high TDN intake for the groups fed 10 and 20% ESB is mainly due to the high DMI and agreed with results obtained by Park and Rafalowski, (1983) and Tjardes *et al.* (1998). Feed conversion presented in Table 3 in term of kg DM/kg gain and kg TDN/kg gain were significantly ($P<0.05$) better in favor of calves Fed 10 and 20% ESB compared with the control. Smith *et al.* (1981) reported that feeding fat supplement improved growth efficiency (gain/feed) which was generally inversely to DM intakes.

As presented in Table 3 the highest economic efficiency was recorded for the group fed 10% ESB followed in a decreasing order by the group fed 20% ESB and finally the control. However, differences between the control and group fed 20% ESB was very small.

Table 4 summarizes the concentration of ammonia-N, PH and TVFA,s in the rumen fluid for the control as well as the groups fed 10 and 20% ESB. No significant effects were detected as a results of incorporation of ESB at 10 and 20% level in the rations compared with the control on the basic patterns of rumen metabolites except the post feeding that showed higher ($P<0.05$) ammonia-N concentration for the control. The low ammonia-N concentration in the rumen due feeding calves on rations contained ESB might be related to the modification in rumenal nitrogen degradation by heat treatment done on ESB (Faldet and Satter, 1991 and Chouinard *et al.*, 1997).

Chouinard *et al.* (1997) reported that heat treatment increases undegradable intake protein (UIP) and decreases proportion of soluble N by 76%. Statistical evaluation (Table 4) showed no significant

differences in the concentration of rumen pH among the three groups at 3 and 6 hours and the initial values before feeding (Hussein *et al.*, 1995). In spit of groups fed on rations contained 10 and 20% ESB showed higher concentration of TVFA,s in the rumen fluid post feeding, no significant differences were found between the three groups. Similar results were reported by EL-Bedawy *et al.* (1994). Alderich *et al.* (1997) found that rumenal pH and VFA concentrations were unaffected by feeding whole canola seeds to Angus steers.

Table 3. Performance of calves fed rations contained extruded soybean seeds

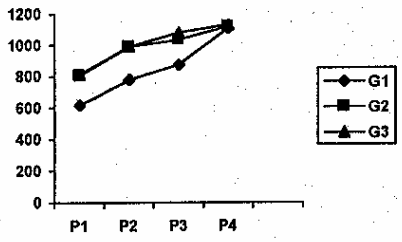
Item	Treatments			
	Control	10%ESB	20%ESB	±SE
No. of animals	6	6	6	
Duration of Experiment day	120	120	120	
Initial L.B.W. kg	97.67	96.500	97.00	1.62
Final L.B.W. kg	198.83^{b}	216^{a}	217.83^{a}	3.36
Total gain kg	101.16	119.500	120.83	2.83
Average daily gain at period 1 in gram	617^{b}	846^{a}	839^{a}	0.05
Average daily gain at period 2 in gram	778^{b}	989^{a}	989^{a}	0.05
Average daily gain at period 3 in gram	872^{b}	1033^{a}	1078^{a}	0.06
Average daily gain at period 4 in gram	1106	1117	1128	0.05
Average daily gain g for whole period	843^{b}	996^{a}	1008^{a}	0.02
Relative gain (% of initial wt.)	103.57	123.83	124.57	
Average daily DM intake (kg) from:				
Conc. Mix.	2.97	3.2	3.2	
Hay	0.88	0.94	0.94	
Straw	0.64	0.76	0.76	
Total	4.49^{b}	4.9^{a}	4.9^{a}	0.02
Av. Daily TDN intake/head/day, kg	2.87^{b}	3.13^{a}	3.13^{a}	0.05
v. Daily DCP intake/head/day, kg	0.531^{b}	0.570^{a}	0.577^{a}	0.71
Feed conversion:				
Kg DM/kg gain	5.33^{b}	4.92^{a}	4.86^{a}	0.13
Kg TDN/kg gain	3.41^{b}	3.14^{a}	3.11^{a}	0.05
Kg DCP/Kg gain	0.632^{b}	0.582^{a}	0.578^{a}	0.02
Economic efficiency				
Cost of Conc. Mix.	1.544	1.7	1.86	
Cost of hay (400 LE/ton)	0.352	0.376	0.376	
Cost of straw (100 LE/ton)	0.064	0.076	0.076	
Total cost	1.96	2.152	2.312	
Price/kg live body Wt./LE	7	7	7	
Average daily revenue	5.9	6.972	7.06	
Net revenue	3.94	4.82	4.748	
Economic feed efficiency, EE	66.8%	69.1%	67.3%	
Relative economic efficiency, REE	100	103.4	100.8	

[a,b,c] Means in the same row or column within each parameter having different superscripts differ (P<0.05)

Table 4. Effect of extruded soybean seeds on some rumen parameters

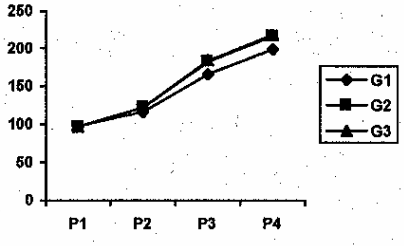
Item	Sampling time, h.	Dites			
		Control	10%ESB	20%ESB	±SE
NH_3-N	0	13.12	10.48	10.44	0.94
mg/100ml RL	3	18.95^{a}	14.61^{b}	14.33^{b}	0.77
	6	15.79^{a}	11.14^{b}	11.06^{b}	0.91
	0	6.22	6.13	6.16	0.05
pH	3	5.91	5.86	5.87	0.04
	6	6.02	5.98	5.93	0.09
VFA's	0	9.51	9.68	9.85	0.18
meq/100ml RL	3	11.82	12.76	13.23	0.61
	6	11.10	11.64	11.93	0.46

[a,b,c] Means in the same row or column within each parameter having different superscripts differ significantly (P<0.05).



Months

Figure 1. Effect of extruded soybeans level on average daily gain
G1: zero extruded soybean, G2: 10% G3: 20% extruded soybeans



Months

Figure 2. Effect of extruded soybeans level on Average body weight
G1: zero extruded soya bean, G2: 10% extruded soyabeans Soybeans G3: 20% extruded soyabeans

Table 5. Effect of extruded soybean seeds on digestibility coefficients and nutritive values of rations fed to experimental animals

Item	Dietary treatments			
	Control	10% ESB	20% ESB	± SE
DM	77.48[b]	80.72[a]	82.41[a]	0.95
OM	80.32	83.62	84.25	1.25
CP	70.75	73.12	73.92	0.93
CF	59.35	60.26	60.32	1.08
EE	78.18[b]	88.32[a]	90.22[a]	1.45
NFE	60.38	60.61	60.28	0.35
Nutritive value				
DCP%	11.56	11.75	12.41	0.24
TDN%	60.39[b]	63.01[a]	63.50[a]	0.44

[a,b,c] Means in the same row or column within each parameter having different superscripts differ significantly (P<0.05).

Nutrients digestibility and nutritive value of the experimental rations are presented in Table 5. Incorporating ESB in calves' rations at 10 and 20% levels had a significant effect (P<0.05) on digestibility of DM and EE. However feeding ESB had no significant effect on digestibility of OM, CF, CP and NFE. Zinn (1992); El-Bedawy *et al.* (1994), Ludden *et al.* (1995) and Hussein *et al.* (1995) reported results in agreement with results of this study. The higher digestibility of EE associated with the incorporation of ESB at 10 and 20% level might be attributed to the high efficiency of calves at this age to utilize high fat level of the feed. El-Bedawy *et al.* (1994) and Palmquist and Conard (1978) attributed significancy of EE digestibility of rations contain high fat levels to the high digestibility of supplementary fat. Feeding ESB had no effect on CF digestibility (Table 5). These results are in agreement with those found by El-Bedawy *et al.* (1996) for post weaning calves while Bendary *et al.* (1994) found depression in CF digestibility by feeding ration contained 8.2% EE to elder buffalo bullock with average body weight of 350 kg. ESB had no significant effect on DCP percentage of the rations. However, ESB at 20 and 10% had higher DCP values compared with the control. ESB at 20 and 10% were significantly (P<0.05) higher in TDN percentage of the rations compared with the control. These differences could be attributed to the high digestibility of most of nutrients of 20% and 10% ESB rations compared with the control (EL-Bedawy *et al.* 1996).

Changes in concentrations of selected blood metabolites are presented in Table 6. Feeding ESB causes increase in all lipid constituents of blood. These results are in agreement with the findings obtained by Willey *et al.* (1952); Chandler *et al.* (1968); Marchello *et al.* (1971) and Wrenn *et al.* (1979). Although calves fed on 20% ESB diet had the highest total lipid and cholesterol in their blood, the differences between group fed 10% ESB, 20% ESB and the control lack significance (P<0.05).

This suggests that dietary inclusion of extruded soybean seeds up to 10% could be effective limit in raising lipid of blood serum. Nonetheless, Marchello *et al.* (1971) observed a reduction of total serum

lipid of steers fed 15% animal fat diet. They pointed out that the failure of blood lipid to increase from high fat diet (5 or 10%). Triglycerides (TG) and non-esterified fatty acids (NEFA) concentrations of blood serum were higher ($P<0.05$) for calves fed 20% ESB diet compared with the calves' fed 10% and the control. Mean time, calves fed 10% ESB diet were significantly ($P<0.05$) higher in these two parameters compared with the control. Goering *et al.* (1976); Palmquist and Conard (1978); Smith *et al.* (1978) and Yang *et al.* (1978) obtained results similar to the results obtained in this study.

Table 6. Effect of extruded soybean seeds on blood parameters of experimental animals

Parameter	Dietary treatments			
	Control	10% ESB	20% ESB	± SE
TL mg/100ml	513.67	532	572	17.45
TG mg/100ml	67.2^{c}	80.6^{b}	99.86^{a}	3.74
Ch. mg/100ml	208.01	210.79	215.32	7.86
NEFA mg/100ml	190.31^{c}	258.26^{b}	300.25^{a}	18.12

^{a,b,c} Means in the same row or column within each parameter having different superscripts differ significantly ($P<0.05$).

A linear increase in TG and NEFA with ESB inclusion in the diets may represent a greater transfer (Depeters *et al.*, 1989) of dietary lipid into blood (Table 6). The relation between the positive increase of TG as well as the increase of NEFA seems to suggest that hydrolyses of TG was partially responsible for the increased NEFA pool (Table 6). Many studies have shown an elevation in blood cholesterol when lipid supplemented or other sources of lipid were fed to sheep (Nestel *et al.*, 1978) lactating (Smith *et al.*, 1978 and Yang *et al.*, 1978) and growing (Wrenn *et al.*, 1979) dairy animals. The highest effect of dietary fat upon total blood cholesterol occurred with high fat diet (20%ESB- 215.32 mg/100 ml) followed in a decreasing order by 10% ESB diet (210.79 mg/100 ml) and the least was for the control (208.01 mg/ 100 ml). These findings appear to indicate that total feed (fat) intake, age and physiological status of animals influence concentrations of serum cholesterol. The increase in serum cholesterol might be due to the increase in its intestinal bio- syntheses. These findings are similar to those obtained by Nestal *et al.* (1978) and Park and Rafalowski (1983).

In summary, our main concern in the study was to evaluate effects of feeding extruded soybean seeds as a fat supplement on general buffalo calves performance during early stage of life. No health or feeding problems from feeding extruded soybean seeds was observed during the entire trial period. Inclusion of extruded soybean seeds at 10 and 20% level to diets maintained energy intake with less starch without adverse effects on rumen fermentation and growth performance. Our data revealed that feeding buffalo calves extruded soybean seeds at 10% level of the concentrate mixture of weaned buffalo calves (calf starter feed) can maintain a satisfactory level of lipid (about 7%) in the mixture. This level had the best physiological effect on growth performance as well as the best economical return of these calves during their early stage of life. This may confirm that incorporation of ESB at 10% of weaned buffalo calf starter is worth to recommend due to its high economic and growth efficiency results.

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