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INFLUENCE OF HEAT-TREATED SOYBEAN SEEDS IN RATIONS OF GROWING LAMBS PERFORMANCE.

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SUMMARY

Thirty growing male lambs with an average of 3.5 months old were randomly divided into three equal groups with an average live body weight of 27.0, 27.7 and 26.6 kg for 1st, 2nd and 3rd groups, respectively. Animals of each group were kept in separate shaded pen and fed one of three tested rations as follows: The basal ration composed of wheat straw (WS) and concentrate feed mixture (CFM) contained 10% soybean meal (SBM) was considered as the control ration (T1). The treated groups were fed the basal ration contained 2.5 %heat-treated soybean seeds (HSBS) and 7.5% SBM (T2) and the basal ration contained 5% HSBS and 5% SBM (T3).

Lambs were weighed at the beginning of the experimental period then at two weeks intervals. At the end of the experimental period which extended for 126 days, four animals from each group were used to determine nutrients digestibility and nutritive values of the experimental rations. Blood samples were taken in the final day of the experiment from the jugular vein before feeding.

Results of digestibility trial indicated that lambs fed T2 and T3 had significantly ($P<0.05$) higher (CP) and (EE) digestibility compared with those fed T1. While CF digestibility was higher for T1 and T2 compared with T3. Rumen parameters indicate that, ammonia –N concentration was currently higher for T1 and T2 than T3. Total VFA's concentration was significantly increased by adding HSBS.

Results of blood serum parameters indicate that, total protein (TP) and globulin were significantly higher for experimental group (T2 & T3) than control group (T1). On the other hand blood urea, AST, ALT, triglyceride, cholesterol and total lipid concentrations were significantly higher for control group than treated groups.

Results of feeding trial indicate that final body weight, total gain and average daily gain (ADG) were significantly increased with low supplementation level of HSBS (T2), but not significantly increased with high supplementation level of HSBS (T2) compared with control group. Also, feed conversion was improved by adding HSBS. The results indicated that inclusion of heat-treated soybean seeds (HSBS) to replace 2.5% of SBM in ration of growing lambs was effective in improving their growth performance.

Keywords: *lambs, heat-treated soybean seeds, soybean meal, growth, digestion.*

INTRODUCTION

Soybean seeds contain highly valuable proteins and oil (39-41% protein and 18 – 21% oil), which makes it a very good feed alternative to animal proteins and oils (McKevith., 2005). Soybean proteins are very similar to that of animal origin, with exception of its lower content of sulfur amino acids (cystine and methionine). However, full fat soybean has very limited use, because it contains a number of harmful components that diminish its nutritional value. These harmful components inhibit the digestive enzymes, leading to decrease the growth rate, and even death of the animal (Del Rosario *et al.*, 2001). Therefore, the raw soybeans is not recommended to be fed by animals or man.

Many anti-nutritional factors have been identified in raw soybeans, but the ones generally considered to be of consequences are:

A. Trypsin and chymotrypsin inhibitors - inhibit protein digestion (Orias *et al.*, 2002).
B. Phytohaemaglutinins (Lectins). Decrease the digestibility of nitrogen-free extract by interfering with the normal absorption of pancreatic amylase to the intestinal epithelium, it is allowing the enzyme to be quickly eliminated in the feces (Palacios *et al.*, 2004).
C. Urease- an enzyme that breaks down urea and release ammonia, which can reduce palatability (Wiriyaumpaiwong *et al.*,2004)
D. Allergenic factors - Glycinin and Beta-Conglycinin (reduce nutrient absorption due to their effect on the integrity of the microvilli in the small intestine (Velasquez and Bhathena, 2007).
E. Lipase and Lipoxygenase - result in peroxidation and beany flavor, respectively (Liener 1994).

Wiriyaumpaiwong *et al.* (2004) reported that heating is very important to inactivate anti-nutritional factors and enhance quality of soybean products. Trugo et al, (2000) showed that several inhibitors in soybean seeds have been isolated up to the present, but the trypsin inhibitor has the most serious consequences. The acceptable activity level is determined in relation to that in full fat soybean accordingly; a decrease of trypsin inhibitor activity of 90 – 95% compared to untreated full fat soybean seeds indicates satisfactory heat processing. However, the successful indicator for the heat process is urease activity (a thermo labile enzyme). The decrease of its activity under the influence of heat is indicating the successful processing.

The most common procedures for thermal processing of soybean are cooking, extrusion and roasting or toasting. Cooking is a relatively simple procedure in which the soybean is cooked in water or steam and dried. Extrusion involves pushing the material through a series of restriction rings by means of a system of coils, which creates high pressure (30 – 40 bars) and high temperature as the consequence of friction and movement of the processed beans. Roasting or toasting is dry heating of the soybean seeds, which generally decreases its initial moisture. The bean temperature varies from 110 to 165°C. Many procedures for processing full fat soybean have been perfected up to the present time. It is important to stress that all of the processes are valid and satisfactory as long as they can be controlled. Namely, a too high temperature causes damage to the protein, which decreases the quality of the final product (Kricka *et al.*, 2001).

The objective of this experiment was designed to evaluate the effect of partial replacement of SBM with HSBS seeds in ration for growing lambs on the nutrients digestion and growth performance.

MATERIALS AND METHODS

Animals:

The field experiment was carried out at experimental farm project (sheep farm), nuclear research center, atomic energy authority, at Inshas to study the effect of supplementing heat treated full fat soybean seeds (HSBS) to the ration of male lambs on nutrient digestibility, growth performance and some blood parameters.

Thirty male lambs (Ossimi x Barki) with average initial live body weight (LBW) of 27.1kg and about 3.5 months of age were divided into three similar groups in live body weight and age (ten animal each), each group housed separately in shaded pen. The initial average live body weights of three groups were 27.0, 27.7 and 26.6 Kg for 1st, 2nd and 3rd groups, respectively.

Experimental rations and feeding trial:

The basal ration composed of wheat straw (WS) and concentrate feed mixture (CFM). The treated groups received one of the three tested rations.

1st group fed ration one (T1): CFM contained 10% SBM and 0.0% HSBS.

2nd group fed ration two (T2): CFM contained 7.5 % SBM and 2.5% HSBS.

3rd group fed ration three (T3): CFM contained 5.0% SBM and 5.0% HSBS.

The full fat soybean seeds which cultivated at Inshas were heated at 150°C for 20 minutes (HSBS). Formulation of the different rations is shown, in Table (1). The animals were fed daily (CFM) & wheat straw at 3%and 0.5%, respectively of their LBW to cover the nutritional requirements for growth according to NRC (1985). Daily rations were offered in two equal meals at 8.0 a.m. and 2.0 p.m. Fresh water was available at all the time and animals were healthy. Lambs body weight was recorded before morning feeding at the beginning of the experiment then biweekly intervals till the end of the experiment, which lasted for 126 day. Feed intake was daily recorded, mean daily gain and feed conversion was calculated to evaluate lambs performance on experimental rations.

Table (1): Formulation of experimental rations.

Item	T_1 100% SBM	T_2 75%SBM+ 25%HSBS	T_3 50%SBM+ 50%HSBS
Crushed yellow corn	35.0	35.0	35.0
Sugar beet pulp	27.4	27.4	27.4
Wheat bran	10.0	10.0	10.0
Soybean meal	10.0	7.5	5.0
Heat treated Soybean seeds	0.0	2.5	5.0
Undecortecated cotton seed meal	15.0	15.0	15.0
Common salt	1.0	1.0	1.0
Mineral mixture*	0.5	0.5	0.5
Dicalcium phosphate	1.0	1.0	1.0
AD_3E	0.1	0.1	0.1
Total	100.0	100.0	100.0

**Mineral mixture: each kg containing zinc 7200mg, cupper 1800mg, iron 1800mg, manganese 3600mg, cobalt 18mg, iodine 110mg, selenium 18mg, sodium 74.3g, the carrier material (calcium carbonate) up to 1000g.*

Digestibility Trial:

Three digestibility trials were carried out at the end of growth experiment. Four animals from each group were selected at random to study the effect of supplementing HSBS to the ruminant rations on nutrient digestibility and nutritive value. The animals were placed individually in metabolic cages for 10 days as preliminary period followed by 7 days as collection period. The rations were offered daily and refusals (if any) were recorded daily. Total feces were collected daily and weighted. Feces samples (10%) were sprayed with 10% H_2SO_4 and dried at 60°c for 24 hours. Then finally samples were kept for chemical analysis. Total urine was individually collected in a glass bottle containing 100ml. of diluted sulphuric acid (10%). Urine volume was recorded and a sample of 5% was taken and kept in the refrigerator until analysis at the end of collection period, composite samples of feed offered and feces were mixed separately, finally grounded and kept for chemical analysis. Dried samples of offered feed, refusals, feces and urine were analyzed according to the methods of the (A.O.A.C., 1996).

Rumen Parameters:

Rumen liquor samples were taken from three animals of each group at two consequence days following the collection periods of digestibility trials. The samples were with drawn by a rubber stomach tube at zero, 3 and 6 hrs post feeding.

The pH values for collected rumen liquor samples were measured immediately by using pH meter model 211 digital, then filtered through two layers of cheese cloth for determination of total volatile fatty acids (TVFA's) as described by Warner (1964) and ammonia–N (NH_3-N) concentration according to A.O.A.C. (1996).

Blood parameters:

Blood samples were taken at the last day of feeding trial from the jugular vein from each animal before the morning meal. The samples were directly collected into vacuum tube and centrifuged at 500 g (3000 rpm) for 15 min. Serum was separated into polypropylene tube and stored at -18 °c until analysis for total proteins and albumin according to (Weichselbaum, 1946) and (Doumas *et al.*, 1971) respectively. Globulin values were calculated by the difference between total protein and corresponding values of albumin. Urea concentration was estimated by the method of Henry & Davidsohn (1974). Glutamic-Oxaloacetic transaminasis (AST) and glutamic-pyruvic transaminasis (ALT) were determined as described by Reitman & Frankel (1957). Also, Triglyceride was determined as described by (Schalm, *et al.* 1975), cholesterol was determined according to (Allain *et al.*, 1974) and total lipid according Postma and Stroes (1968).

Statistical Analysis:

Data of the feeding trial, digestibility trials and blood parameter were carried out as one-way classification and the difference among means were tested by using Duncan's multiple test (Duncun. 1955). The statistical model was as follows:

$X_{ij} = \mu + A_i + e_{ij}$

Where: X_{ij} =represents observation μ = Overall mean. A_i = effect of experimental rations.

e_{ij} = experimental error.

RESULTS AND DISCUSSION

Chemical analysis of Feed Ingredient and Experimental Rations:

The data of chemical analysis for feed ingredients and experimental rations are presented in Table (2). The results indicated that both crude protein (CP) and nitrogen free extract (NFE) contents of SBM are higher than HSBS; while crude fiber (CF), ether extract (EE) and ash content of the HSBS are higher than SBM. Grieshop *et al.* (2003) found that soybean seeds were rich in dietary fiber 13.7–16.5 g/100 g. Also, Sessa and Wolf (2001) reported that oil and protein content together of dry soybean seeds account for about 60% by weight; protein at 40% and oil at 20%. The remainder consists of 35% carbohydrate and about 5% ash.

Chemical composition of the experimental rations indicated that increasing of HSBS in rations decreased CP and NFE, but increased CF content.

Table (2): Chemical composition of diet components and total rations (% on DM basis).

Item	DM	CP	CF	EE	NFE	Ash
Soya been meal	87.95	48.43	7.27	2.21	35.88	6.21
Heated soybean seeds	90.20	36.80	11.85	21.12	24.68	5.55
Wheat straw	91.91	3.21	38.15	2.78	37.53	18.33
Experimental rations:						
T1	91.17	18.59	15.13	2.33	57.73	6.22
T2	91.30	18.32	16.69	3.65	54.87	6.47
T3	91.52	18.08	18.66	4.31	51.97	6.98

Digestibility Trials:

The dry matter intake, nutrients digestibility and nutritive value of experimental rations are shown in Table (3). Dry matter intake (DMI) as metabolic live body size (LBW) $^{0.75}$ is slightly increased with HSBS inclusion into the experimental rations. The higher intake It may be due to that heating enhances flavor and aroma (Mebrahtu, *et al.* 2004), and perhaps due to animals seem to prefer roasted products.

The present study indicated that the lambs fed the experimental rations showed similar DM and OM digestibility values. The CP digestibility values were significantly increased ($p<0.05$) with T2 followed by T3 compared with T1.

Faldet and Satter (1991) found that rations of cow were formulated to be isonitrogenous by replacing corn and SBM with raw soybeans or heat-treated soybeans. The proportion of protein supplement in the ration on a DM basis was 10% SBM, 13% raw soybeans, or 13% heat-treated soybeans. The soybean seeds were heat-treated to maximize the amount of available lysine passing to the small intestine.

Orias *et al.* (2002) reported that quantities of all individual essential amino acids (EAA's) except for methionine reaching the duodenum were increased with the addition of extruded soybeans to the rations; because soybean seeds are a relatively poor source of methionine for ruminants. Likewise, flows of all individual nonessential amino acids (NEAA's) were increased except for glycine. While SBM protein digestibility is approximately 85%, ranging between 82% and 94% for individual amino acid digestibility is degraded rapidly in the rumen. Also, they found that heating of soybeans at 157°C did

not negatively affect AA's digestion in the small intestine; on the contrary, it actually improved it.

The results of this study were in agreement with Abu Ghazaleh *et al.*, (2002) who found that HSBS exhibits more available protein for the post-ruminal tract than SBM. Whereas, HSBS showed the lowest value of immediately degradable protein (slowly degradable fraction) and a protein effective degradability of 11.0%; SBM had the highest immediately degradable fraction compared to HSBS, and an effective degradability 40.9%. Based on these results, HSBS is potentially able to supply higher amount of bypass protein, with lower degradation rate (an average 5%/h) compared to SBM (15%/h).

Table (3): Dry matter intake, digestibility coefficients and nutritive values of the experimental rations.

Item	T_1 100% SBM	T_2 75%SBM+ 25% HSBS	T_3 50%SBM+ 50%HSBS
No. of animal	4	4	4
DMI from CFM g/Kg LBW $^{0.75}$	57.99	59.45	59.92
DMI from WS g/Kg LBW $^{0.75}$	8.97	9.26	8.58
Total DMI g/Kg LBW $^{0.75}$	66.96	68.71	68.50
Apparent digestibility %			
DM	73.05 ±0.95	75.13 ± 1.54	73.26 ±1.12
OM	75.30 ±0.78	77.04 ± 1.48	75.33 ±1.08
CP	62.74^{b} ±2.08	67.86^{a}± 1.6	65.26^{ab}±0.98
CF	57.84^{ab}±2.41	64.46^{a}±2.54	55.23^{b} ±2.86
EE	77.84^{b} ±1.93	88.19^{a}±0.24	87.35^{a} ±0.73
NFE	46.35 ±0.46	51.81 ±1.25	49.65 ±1.05
Nutritive value %			
TDN	70.06^{b}±0.99	73.81^{a}±1.35	72.79^{ab}±0.94
DCP	10.31^{b}±0.2	11.35^{a}±0.26	10.92^{ab}±0.12
DE, M Cal/Kg DM*	3.09 ±0.04	3.25 ±0.03	3.21 ±0.04
ME, M Cal/Kg DM **	2.67 ±0.02	2.83 ±0.01	2.79 ±0.04
NE, M Cal/Kg DM***	1.59^{b} ±0.03	1.69^{a} ±0.04	1.66^{a} ±0.01

a, b Means in the same row with different superscripts differ significantly (P<0.05).
*The calorific values of the experimental rations estimated as follows: *DE (M cal/Kg DM)= 0.04409(TDN%), ** ME (M cal/Kg DM)=1.01(DE, M cal/Kg DM) - 0.45, *** NE (M cal/Kg DM)=0.0245 (TDN%) - 0.12 (NRC 1985).*

Bailoni *et al.* (2004) discussed that heat processing does not influence the total protein content, but it may cause considerable changes in some properties of the proteins. Due to denaturation, solubility of the protein is decreased, but their digestibility increase. Thus, heat processing ought to have a positive effect upon the nutritional value of the soybean seeds. Consequently, thermal processing aims to inactivate anti-nutritional factors present in full fat soybean seeds and not to cause any nutritional damage to proteins in the process.

Data in Table (3) recorded, better (P<0.05) digestion coefficients of CF with T2 followed by T1 compared with T3.This result may be attributed that T1 and T2 containing the highest degradable protein that more closely match to microbial synthesis which, acting on CF digest, and /or the efficiency of microbial protein synthesis was increased with T1

and T2 that contained low fat; because protozoa concentrations tended to decrease when fat was fed. Decreased ruminal protozoa concentration may have decreased intraruminal N recycling (Oldich and Firkins, 2000).

Data in Table (3) showed, better ($P<0.05$) digestion coefficients of EE with T2 and T3 compared with T1. Similar results were observed by Abd El-Aziz *et al.* (2007) who found that feeding rations containing HSBS had significantly ($P<0.05$) higher digestibility of EE compared with the control ration. Accordingly, the values of TDN, DCP and NE were significantly ($P < 0.05$) increased with feeding rations containing HSBS.

Rumen activity:

Concentrations of ruminal pH, NH_3N, and VFA's are presented in Table (4). Ruminal pH was not significantly affected ($P>0.05$) by experimental rations and pH values were within the normal range (6.64 to 7.53); according to Devant *et al.* (2001) who reported relatively high ruminal pH above 6 for rations containing soybean meal. The values of pH were suitable for the best activity of cellulolytic bacteria in the rumen according to Van Soest (1983), who reported that a 6.7 ± 0.5 degree was the optimum pH value for cellulolytic microorganisms' activity. The results showed also, that pH values tended to decrease, where the lowest values were recorded at 3 hr post feeding. This may be due to that the soluble carbohydrate is very fast fermented by rumen microorganisms which producing more propionate decreasing pH values, after that fermentation of the structural carbohydrates which need long time producing acetate delaying the decreased pH value (Salama *et al.*, 2005). Similar results have been reported by Boraei (2003) who found that value of pH in rumen liquor before feeding was significantly ($P<0.05$) higher than at 3 hrs after feeding. Also, Abdel-Rahman et al (2005) found that pH of rumen 2hr post feeding for sheep fed rations containing unheated and heated SBM were 6.83 and 6.18, respectively.

Ammonia-N concentrations were greater for T1 and T2 than for T3, which is due to the higher degradable protein concentration of these rations. However, there was no significant difference in ruminal NH_3N concentration between the lambs fed experimental rations. On the same trend Plegge *et al.*(1985) found a decrease in ruminal NH_3N concentrations when feeding roasted soybean seeds.

The highest value of ruminal NH3-N was detected with T1 at 3 hr, while the lowest value of ruminal NH_3-N was detected with T3 at 3 hr after feeding compared to other groups. This result may be due to the action of SBM that has fast degraded and resulted in high releasing ammonia, which is leading to increase the microbial protein synthesis due to using NH3-N in build up their bodies. Generally, the time was effective on ruminal NH3-N concentration. The value of NH3-N was significantly ($P<0.05$) lower at zero time (before feeding) in all rations than at 3 hr after feeding. Similar results were recorded with Mousa (2003).

Total VFA's concentration tended to be significantly higher ($P<0.05$) when lambs fed ration of T2 compared with ration of T1, but no significant differences were detected in VFA's concentrations in contrasts between T2 and T3, and between T3 and T1.

Total VFA's concentration was affected by the time after feeding. The lowest ($P<0.05$) values were recorded at zero time then increased by the time after feeding while the highest value was recorded at 6 hr. Similar results were detected by El-Badawi et al, (2001) who found that ruminal VFA's concentrations were higher after 4hrs than at zero time of feeding in all experimental groups. The same authors reported also that total VFA's are a source of energy (ATP) in the rumen where the microbial protein synthesis depends upon the availability of ATPs.

Table (4): Effect of experimental rations and sampling time on rumen liquor parameters.

Item	Sampling time hr.	T_1 100% SBM	T_2 75%SBM+ 25%HSBS	T_3 50%SBM+ 50%HSBS
pH	0	6.80±0.07	6.77±0.05	7.12±0.07
	3	6.44±0.11	6.21±0.06	6.28±0.16
	6	6.45±0.12	6.29±0.08	6.29±0.18
	Mean	6.56±0.11	6.42±0.17	6.56±0.27
NH_3-N,mg/100ml	0	13.38^{B}±0.6	15.21^{AB}±1.40	12.28^{B}±0.95
	3	20.58^{A}±4.25	18.17^{A}±3.49	17.29^{A}±1.48
	6	13.44^{B}±1.73	11.78^{B}±0.48	10.41^{B}±0.29
	Mean	15.80±2.39	15.05±1.85	13.32±2.05
VFA's, meq/100ml	0	10.98^{C}±1.60	14.25^{C}±1.19	15.65^{C}±1.15
	3	15.23^{B}±0.56	19.83^{B}±1.19	17.00^{B}±0.86
	6	18.95^{A}±1.17	21.10^{A}±2.02	20.60^{A}±2.0
	Mean	15.05^{b}±2.30	18.39^{a}±2.11	17.75^{ab}±1.47

a, b Means in the same row with different superscripts differ significantly (P<0.05).
A, B, C Means in the same column with different superscripts differ significantly (P<0.05).

Blood biochemical components:

Results in Table (5) show that serum constituents were increased (P < 0.05) for total protein, albumin and globulin with T2 and T3 compared with T1. Vice versa, Feeding T2 and T3 significantly (P<0.05) decreased urea-N concentration in serum compared with T1. These results congruent with results in Table (4); decreased urea –N in serum reflected the low protein degradability of rations T2 and T3 which containing HSBS and decrease NH3-N which absorbed across the rumen compared with control ration; In the same time, high un-degradable protein that passes to intestine had high protein digestibility that lead to increase serum total protein. These results in good agreement with that reported by Abd El-Aziz *et al.* (2007).

Serum AST, ALT, triglycerides, cholesterol and total lipid were significantly lower (P<0.05) for T2 and T3 than T1. Several nutritional intervention studies in animals and humans indicate that consumption of soybean seeds reduce plasma cholesterol, triglycerides and total lipids. The meta-analysis of the effects of soybean seeds intake on serum lipids concluded that soybean seeds are correlated with significant decreases in serum cholesterol, low density lipoprotein LDL (bad cholesterol) and triglyceride concentrations. However, high-density lipoprotein HDL (good cholesterol) did not increase by a significant amount. Greaves *et al.*, (2000) found that soybean seeds consumption reduces serum total cholesterol, LDL cholesterol, and triglycerides as well as hepatic cholesterol and triglycerides.

Studies in animals indicate that soybean seeds ingestion exerts its lipid-lowering effect by reducing intestinal cholesterol absorption and increasing fecal bile acid excretion, thereby reducing hepatic cholesterol content and enhancing removal of LDL (Velasquez and Bhathena 2007). Also, Gudbrandsen *et al.*, (2006) have shown that feeding obese Zucker rats with soy protein concentrate enriched with isoflavones for 6 weeks reduced fatty liver and decreased the plasma levels of alanine transaminase and aspartate transaminase.

Table (5): Some blood constituents of lambs fed the experimental rations.

Item	T_1 100% SBM	T_2 75%SBM+ 25%HSBS	T_3 50%SBM+ 50%HSBS
Total protein, g/dl	$5.62^{b} \pm 0.68$	$6.52^{a} \pm 0.63$	$7.24^{a} \pm 0.83$
Albumin, g/dl	$2.61^{b} \pm 0.62$	$2.64^{b} \pm 0.24$	$3.12^{a} \pm 0.37$
Globulin, g/dl	$3.01^{b} \pm 0.45$	$3.88^{ab} \pm 0.72$	$4.12^{a} \pm 0.51$
Urea-N, mg/dl	$25.58^{a} \pm 4.5$	$21.7^{b} \pm 3.07$	$20.6^{b} \pm 4.1$
AST, IU /L	$49.1^{a} \pm 5.21$	$45.2^{ab} \pm 5.13$	$42.3^{b} \pm 4.74$
ALT, IU /L	$24.5^{a} \pm 2.01$	$22.6^{b} \pm 2.95$	$21.8^{b} \pm 2.53$
Triglyceride, mg/dl	$93.7^{a} \pm 1.9$	$87.2^{b} \pm 2.0$	$82.4^{b} \pm 1.64$
Cholesterol, mg/dl	$232^{a} \pm 3.55$	$193^{b} \pm 3.8$	$201^{b} \pm 3.3$
Total lipids, mg/dl	$311^{a} \pm 9.01$	$289^{b} \pm 11.2$	$290^{b\ z} \pm 13.0$

a, b Means in the same row with different superscripts differ significantly (P<0.05).

Lambs performance:

Total gain, final body weight and average daily gain (ADG) were significantly affected (P<0.05) by experimental rations (Table 6). Data showed that the trend was found for the HSBS rations to support faster growth rate than SBM ration; it may be due to heat processing which enhances nutritive values as found from digestibility trial and/or decrease rumen degradability and increase by-pass protein which reflect on animal growth.

Albro *et al.* (1993) found that the feeding of raw or extruded soybeans to steers receiving grass hay ad-libitum improved gain and gain efficiency over those of steers fed only hay.

Maclsaac *et.al.* (2005) indicated that at 21 days of age the turkeys fed the starter ration with HSBS ate more feed and were heavier than the birds fed the SBM control diet.

Table (6): Growth performance of lambs fed experimental rations. (Means± SE).

Item	T_1 100% SBM	T_2 75%SBM+ 25%HSBS	T_3 50%SBM+ 50%HSBS
No. of animal	10	10	10
Days of trial	126	126	126
Average feed intake as DM, g/day	950 ±0.50	1000±0.53	1000±0.47
Initial body weight, Kg	27.00 ± 1.8	27.7 ± 2.05	26.6 ± 1.72
Final body weight, Kg	$48.80^{b} \pm 1.78$	$53.4^{a} \pm 3.08$	$52.0^{ab} \pm 2.01$
Total gain, Kg	$21.78^{b} \pm 1.22$	$25.78^{a} \pm 1.33$	$25.44^{ab} \pm 1.28$
Average daily body weight gain, g	$172.8^{b} \pm 9.7$	$204.6^{a} \pm 10.5$	$201.9^{ab} \pm 10.2$
Feed conversion, Kg DM/Kg gain	5.5 ±0.31	4.9±0.33	5.0±0.19

a, b Means in the same row with different superscripts differ significantly (P<0.05).

Lucas (2000) reported that oilseeds are used in animal feed not only of their high protein content; but also their seeds contain energy for the sprouting embryo mainly as oil, compared with cereals, which contains the energy in the form of starch. Soybean seeds are

the only vegetables that contain complete protein. Soy protein is considered to have a similar equivalent in protein quality to animal proteins. Soybeans are one of the best non-fish sources of essential omega-3 fatty acids, which may help reduce the risk of coronary heart disease. Compared to other beans like pinto beans and navy beans, soybeans have a higher fat content. Therefore, whole soybean seeds have the potential of supplying major amounts of both energy and protein to all types of livestock feed (Charron , *et al.* 2005).

Recently, the concentration of insoluble oxalate in soybean seeds was reported to be very high (Massey *et al.*, 2001). Oxalic acid is found in all plants and most of the compound is found as the calcium salt, which is essentially insoluble in water (Nakata, 2003). Calcium oxalate (CaOx) is the principal component of kidney stones, and the gut can directly absorb CaOx in spite of its insolubility. For these reasons, the amount of CaOx in foods is of significant concern (Honow and Hesse, 2002 and John, 2005). However, Kamchan *et al.* (2004) reported that cooked soybean seeds had low levels of oxalate and medium levels of phytate.

In general, HSBS confirmed to be interesting protein sources for growing lambs. They can replace a substantial part, if not completely, of the SBM in the ration without negative effects on rumen fermentation and metabolic profile in growing lambs. The HSBS can be used to modify the meat fat quality by increasing the proportions of fatty acids with beneficial effects on human health (Williams, 2000). These findings indicate that soybeans can be used in a new way to provide healthier ruminant animal products for humans. This may open new market for soybean growers by incorporation of soybeans into ruminant rations. Whereas, consumption of red meat is considered a health risk factor because of its high levels of saturated fat (40 to 50%) and lower levels of polyunsaturated fat. In response to the concerns of the medical community and health-conscious consumers, researchers have sought to increase unsaturated fat concentrations in products from ruminants. Heat-treated full-fat soybean seeds present an interesting fatty acid profile that can improve the quality of fat in animal products according to consumer demand of healthier foods (Chilliard *et al.*, 2000).

Finally, it could be concluded that adding heat-treated soybean seeds up 2.5% to animals' ration was effective in improving the growth performance of lambs.

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تأثير استخدام بذور فول الصويا المعاملة حراريا في العلائق علي أداء الحملان النامية

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اجري هذا البحث بهدف دراسة تأثير اضافة افضل مستوى من بذور فول الصويا المعاملة حراريا لعلائق ذكور الحملان علي النمو ومعدلات الهضم وكذلك بعض قياسات الدم . أستخدم في هذه التجربة ثلاثين حملا، تم تقسيمها إلى ثلاث مجموعات متساوية وتم تغذيتها علي إحدى العلائق التالية : العليقة الأولى : تتكون من علف مركز يحتوي علي ١٠٪ من كسب فول الصويا والعليقة الثانية: تتكون من العلف المركز الذى يحتوى علي ٢٠.٥٪ من بذور فول الصويا المعامة حراريا و٧.٥٪ من كسب فول الصويا ، والعليقة الثالثة : تتكون من العلف المركز المحتوى علي ٥٪ من بذور فول الصويا المعامة حراريا و٥٪ من كسب فول الصويا ، كما قدم الي الحملان تبن القمح كمصدر للاعلاف الخشنة.

امتدت تجربة النمو إلى١٢٦ يوم حيث تضمنت تقدير كمية الغذاء المأكول ومعدلات النمو من خلال وزن الحيوانات مرة كل أسبوعين ، وتم أخذ عينات فى نهاية التجربة لتقدير بعض قياسات الدم، وفي نهاية تجربة النمو تم إجراء تجربة هضم باستخدام أربع حملان من كل مجموعة لتقدير معاملات الهضم لكل عليقه من العلائق المختبرة و القيمة الغذائية وميزان النيتروجين وكذلك أخذ عينات من كرش الحيوانات لتقدير بعض قياسات الكرش.

وكان من النتائج المتحصل عليها من هذه الدراسة مايلي:

١. سجلت الحملان المغذاة على العليقتين الثانية والثالثة أعلى معدل هضم لكل من البروتين الخام ومستخلص الاثير بالمقارنة بالعليقة الاولى ، كما سجلت الحملان المغذاه علي العليقة الثانية أعلي قيم لهضم الالياف الخام.

٢. لوحظ زيادة امونيا الكرش فى مجموعة الحملان المغذاة على العليقة الاولى والثانية زيادة معنوية بالمقارنة بالحملان المغذاة على العليقة الثالثة.

٣. أعلي تركيز للاحماض الدهنية الطيارة لوحظ مع المجموعة الثانية ثم الثالثة بالمقارنة بالمجموعة الاولي.

٤. لم يوجد اختلافات معنوية بين المجموعات في قياسات الدم المختلفة فيما عدا البروتين الكلي والالبيومين اللذان سجلا زيادة معنوية بينما الانزيمات الناقلة لمجموعة الامين والجلسريدات

الثلاثية والكوليسترول سجلوا نقصا معنويا بالمجموعتين الثانية والثالثة بالمقارنة بالمجموعة الأولي.

٥. لوحظ أن متوسط الزيادة اليومية للوزن و الكفاءة التحويلية للغذاء سجلتا أفضل النتائج مع المجموعة الثانية و الثالثة المحتوية على بذور فول الصويا المعاملة حراريا.

من هذه الدراسة يمكن التوصية باستخدام بذور فول الصويا المعاملة حراريا بصورة ناجحة كجزء من العلف المركز المستخدم كعلائق للحملان النامية بنسبة تتراوح من ٢.٥ – ٥٪، حيث أنها حسنت من معاملات الهضم و القيم الغذائية ومعدل النمو للحملان النامية بدون اي اثار جانبية علي وظائف الكبد أو الحالة الفيسولوجية للحملان.