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Article

Effect of Protected Soybean Meal Protein on Rumen Parameters, Blood Parameters and Carcass Characteristics of Growing Rahmani Lambs

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Abstract: This paper is to study the effect of heat protected soybean meal protein diets on rumen parameters, blood parameters as well as carcass characteristics in growing lambs. Animals were fed in groups for 120 days feeding period on the same three experimental diets. Control fed diet containing soybean meal (15%) without treatment as consists of concentrate feed mixture (CFM) + clover hay (CH). The T1 fed diet containing (50% soybean meal protected + 50% soybean meal unprotected) as consists of CFM + CH. The T2 fed diet containing 100% soybean meal protected as consists of CFM + CH. The obtained results indicated that rumen PH and NH3-N concentrations were lower in T2 than T1 and control group, while TVFA and microbial protein yield were higher in T2 than T1 and control group. Heat treatment had not significant effect on all blood hematological and biochemical parameters under study except white blood cell, creatinine, total lipid and cholesterol showed significant differences. Moreover, heat treatment resulted in improve all carcass characteristics may be due to the improvements in digestibility and feed conversion for groups fed treated soybean meal compared to control group. In connection to chemical composition of meat, heat treatment had not significant effect on EE and Ash contents, while the significant effect was observed on CP, ranged from 75.37 to 77.99, 9.85 to 10.30 and 3.69 to 3.92% for CP, EE and Ash, respectively. The improvements in CP in chemical composition of meat were 0.97 and 2.62 for T1 and T2, respectively. On the light of the above mentioned results, this study recommends the use of heat treatment as a protection method for SBM protein diets in growing lambs at 100% protected soybean meal protein.

Keywords: Rahmani lambs; Heat protected soybean meal; biochemical parameters; hematological parameters; Carcass characteristics.

1. Introduction

Protein is an important limiting nutrient in ruminant animals fed low quality forages. It becomes necessary when animal attains its optimum growth or peak production. This is because nutrient requirements of ruminants vary according to the physiological state like growth, lactation and pregnancy. The highest sources of crude protein is soybean meal (SBM) which considers the most commonly used protein supplement in beef and dairy diets. It is very palatable and has a good amino acid balance and high availability. Its bypass essential amino acid index is just next to ruminal microbial protein beating all other undegradable protein sources **(Chandler, 1989).** Due to the high cost of soybean meal protein supplements, ways and means of protecting the protein from degradation in the rumen whilst retaining the high digestibility is an urgent priority **(Leng 1991)**.

Many experiments have demonstrated the beneficial effects of the technological processing of feeds, particularly heat treatment, introduced by **Manget (1997)**, in reducing the degradation of the crude protein in the rumen without decreasing digestibility in the small intestine. For high producing ruminants, heat treatment of protein supplements has been used for increasing the amount of dietary protein escaping rumen degradation, and to increase the amino acid pool entering the small intestine **(Faldet *et al*., 1991**). In addition, feeding bypass protein to ruminant had reducing dietary amino acid loss as ammonia and urea, energy conservation through less urea synthesis, efficient protein synthesis and improvement in reproductive efficiency (**Tandon, 2008** and **Kumar et al., 2015**). Therefore, the objective of the present study is to investigate the effect of feeding different levels from heat protected soybean meal protein in diets of growing Rahmani lambs on rumen parameters, blood parameters, carcass characteristics and chemical composition of meat.

2. Materials and Methods

The present study was carried out at Department of Animal Production, Faculty of Agriculture, Damietta University for 120 days feeding period during summer 2016. The animals were purchased from a local animal market of Blkas, Dakahlia governorate, Egypt. This study was performed out at private farm in Damietta governorate Egypt.

2.1. Experimental Animals and Tested Materials

Fifteen weaning Rahmani lambs with an average live body weight 19±0.5 kg and 4 months of age were randomly assigned into three groups (each of 5 lambs). The animals of each group were kept in a separate shaded pen. Animals were fed for 120 days and were fed in groups on the same three experimental diets which were as follows: Control (diet containing (SBM 15%) without treatment) as consists of concentrate feed mixture, CFM + Clover hay, CH. The T1 (diet containing 50% heat protected soybean meal + 50% soybean meal unprotected) as consists of CFM + CH and T2 (diet containing 100% heat protected soybean meal) as consists of CFM + CH. The experimental diets used in this study were contained a good quality roughage (CH 3rd cut) and concentrate feed mixture (CFM) to cover the nutrient requirement of DM and TDN which was adjusted according to average daily gain (ADG) and body weights (BW) according to the recommendation of **NRC (1985)**. Animals were weighted at the beginning and thereafter at two-week intervals, and the amounts of diet were adjusted throughout the experimental period according of the BW changes. Fresh water was freely available to animals all the daytime. The tested diets were fed twice daily at 08:00 and 16:00 h. and feed consumed was recorded daily. The formulation of the experimental concentrate feed mixture is shown in Table (1).

Table 1: Formulation of the three experimental concentrate feed mixtures

Ingredients (%)	**Control**	**T1**	**T2**
Soybean meal	15	7.5	-
Heated soybean meal	-	7.5	15
Maize grain	40	40	40
Wheat bran	25	25	25
Rice bran	17	17	17
Premix*	0.4	0.4	0.4
Sodium chloride	1.0	1.0	1.0
Limestone	1.6	1.6	1.6
Calculated chemical composition of the tested diets			
OM	89.28	89.28	89.48
CP	14.77	14.77	14.73
EE	3.61	3.61	3.56
CF	17.78	17.78	18.23
NFE	53.12	53.12	52.96
Ash	10.72	10.72	10.52

**Premix contents per 3 kg are of vit. A. 12000000 IU, vit. D 3, 2200000 IU, vit. E, 10 gm, vit. K 3, 2 gm, copper, 10 gm, zinc, 50 gm, Manganese, 55 gm, Iodine, 1 gm, Selenium, 0.1 gm, Carrier (CaCo3), up to 3000 gm.*

2.2. Heat Treatment Method

The main source of protein in tested CFM in this study was SBM. The heat treatment method of SBM as protection of the high quality proteins from the degradation in the rumen was conducted according to **Stern *et al* (1985)**. Soy bean meal was heated at 145°C in a forced air oven **(POLIN VERONA ITALIA)** for 4 hrs. SBM is placed in a 5 cm thick pan with stirring every hour. After the heating treatment, soybean meal was kept at room temperature (25°C for 3 hours before being mixed with other ingredients to formulate concentrate feed mixtures.

2.3. Blood Parameters

Blood samples were collected in dried clean tubes by jugular vein puncture from all rams after 4h post feeding and immediately centrifuged at 4000 rpm for 15 minutes using PLC-012E Universal Centrifuge Made in TAIWAN. The serum was carefully taken and stored at -20° C until analysis. Blood samples (about 10 ml/animal) were collected at three different intervals of the experiment from each animal at three times (at the beginning of the experiment (0), 2, and 4 months). Samples were obtained from the jugular vein through a clean dry needle into 10 ml heparinized test tubes, blood samples are taken for complete blood count (CBC) analysis using a device **Mindray** (Auto Hematology Analyzer) Model: BC-2800 Made in China. All the biochemical constituents of blood serum were calorimetrically measured using a specific kit by the Chemistry Auto-analyzer **SEAC** Model **Slim**(S/N 3252550) Made in Italy, while globulin was calculated by subtracting the albumin value from the corresponding total protein value.

2.4. Rumen Parameters

At the end of experimental period three animals of each group were used to determine the rumen fluid parameters. Samples of rumen fluid were obtained at 0, 4 and 8h after feeding in order to determine the rumen fermentation characters. The rumen samples were collected using rubber stomach tube inserted into the rumen via the esophagus to determinate the parameters listed below.

2.4.1. PH value

The fluid was strained through 4 layers of cheese cloth pH were immediately determined using a pH meter (Sophisticated microprocessor, pH meter).

2.4.2. Ammonia-N concentration (meq/100ml R.L)

The rumen liquor fluid was taken to measure N-NH3 concentration according to **Conway (1957)**.

2.4.3. Total volatile fatty acids (meq/100ml R.L)

Total volatile fatty acids (TVFA's) were determined by the steam distillation of microkldahl unit as described by **Warner (1964**). The concentration of TVFA was calculated by the knowledge of the amount of 0.01 N NaOH to neutralize the TVFA in the distillate **(Abou Akada and EL-Shasly, 1964)**.

2.4.4. Microbial protein yield (g/kg DOM)

The microbial protein yield was calculated based on the obtained results of the OM digestibility in the rumen for 48 hours and using the value 19.3g microbial nitrogen (MN)/kg OM digestibility the rumen which was a mean of the range from 17.5 to 22.4 values given by **Czerkawski (1986)**.

2.5. Carcass Quality

At the end of the growing trial, animals were fasting for 16 hours before slaughter; three animals from each group were slaughtered to study the carcass characteristics. After complete bleeding, slaughtered lambs were skinned; dressed out and hot carcass was weighed. The measurements and classification of carcass was carried out according to **Abo Ammo (1992)**. Head scalp, skin, Legs, digestive system, Liver, Kidneys, Testes, Ribs 9. 10. 11, Ocular muscle and Fat entrails were weighed at the same time after skinning. Dressing percentages (A) and (B) were calculated according to **Abo ammo (1992)** using the following equations:

$$\text{Dressing percentage (A)} = \frac{\text{Hot carrcass weight kg}}{\text{Slaughter weight kg}}$$

$$\text{Dressing percentage (B)} = \frac{\text{Hot carrcass weight kg}}{\text{Slaughter weight kg} - \text{Rumen content kg}}$$

Weight of meat, bone, fat/kg in carcass was calculated according **to Field *et al.* (1963)** and **Mokhtar (1974)** by using the following equations:

$$\textbf{Meat kg (lean carcass weight)} = \frac{\text{Meat weight in 9,10,11 ribs cut g}}{\text{9,10,11 ris cut g}} \times 100$$

$$\textbf{Fat carcass weight} = \frac{\text{Fat weight in 9,10,11 ribs cut g}}{\text{9,10,11 ribs cut g}} \times 100$$

$$\textbf{Bone carcass weight} = \frac{\text{Bone weight in 9,10,11 ribs cut g}}{\text{9,10,11 ribs cut g}} \times 100$$

The eye muscle area was measured by planimeter. It was dried at 65 ^{0}C for 48 hrs, 105^{0}C (constant weight) then grind and samples were taken to determine, protein, ether extract and ash according to **A.O.A.C. (2012)**.

2.6. Statistical Analysis

Data were statistically analyzed according to **PROC ANOVA** using computer program of statistical analysis system **SAS, 2012** to test the effect of treatment on rumen parameters, blood parameters and carcass characteristics according to the following statistical model:

$$Y_{ij} = \mu + T_i + E_i.$$

Where, Y_{ij} is the individual observation of the parameter measured**.**

μ =is the overall mean.

T_i=the effect of treatment in each group.

E_i= the random error term.

Differences between means were tested for significance using multiple range tests according to **Duncan (1955)**.

3. Results and Discussion

3.1. Ruminal Fermentation Parameters

Results in Table 2 demonstrated the effect of different levels from heat protected SBM protein diets on some rumen parameters (PH, NH3-N and TVFA) as well as microbial protein yield. Heat treatment had not significant effect on rumen PH and TVFA concentration. PH values were in descending order with increasing the levels of heat protected protein in animals due share being at range from 6.60 to 6.83 that consider the optimal rang for high activity for micro-organisms in the rumen (5.5 -7) **(Mehrez *et al.* 1977)**. With regard to sampling times, higher and lower values were observed before feeding and after 4 hours, respectively. Meanwhile, the values of TVFA were in ascending order with elevated levels from protected protein. For sampling time, lower and higher values were observed before feeding and after 4 hours, respectively for control diet and T2, while the lower and higher estimates were showed before feeding and after 8 hours, respectively in T1. The increase in TVFA concentration at 4 and 8 hours post feeding leaded to decrease in ruminal PH value. The present results were in general agreement with the findings of **Yoon *et al.* (1990)**; they reported non-significant influence of heat treatment for soybean meal on rumenal pH in sheep. In addition, the concentration of ruminal VFA in the rumen liquid for the untreated soybean meal was significantly higher than that for heat treated protein may be due to the tendency towards a lower organic matter disappearance in the rumen for the treated protein group in sheep**.** In contrast; **Yang *et al.* (1986)** reported a significant decrease in rumen pH with heat treated SBM and this decrease was associated with a decreasing in rumen NH3 and increasing VFA concentration. Moreover, **Dosky *et al.* (2013)** reported that ruminal pH decreased significantly ($P<0.05$) at 2 and 4 h post feeding for heat treatment and formaldhyde treatment as compared to control. On the other hand, **El-Shabrawy *et al.* (2012)** indicated that protected protein by zinc sulphate had not

significant effect of rumen PH and VFA while the significant effects were observed on NH3-N and total nitrogen. In connection to rumen N-NH3, heat treatment had significant effect on N-NH3 values in rumen liquor and they were in descending order with increasing the levels of bypass protein in animal diets. Result showed that NH3-N values in T2 were lower than those observed in T1 and control group with non-significant differences between T2 and T1, while the significant differences were showed between control group and both of T1 and T2. Also, NH3-N values in T1 and T2 were less than control group may be due to heat protected SBM protein diets. Lower and higher values were observed before feeding and after 4 hours, respectively. The present results corresponded with **Keery and Amos, (1993)**; they showed that increasing the amount of rumen undegreaded protein in animal diets resulted in significant decrease in ruminal NH3-N concentration. Also, **Dosky *et al.* (2013)** reported that rumen NH3 concentration decreased significantly ($P<0.05$) by the dietary treatments (heat and formalhyde treatments for soybean meal) at 2 and 4h post feeding as compared to control. The obtained values of NH3-N would satisfy microbial needs for N and hence maximize rate of fermentation of the experimental diets in the rumen since optimal NH3-N concentration were 15.0 to 23.5 mg/100g/vol RL for roughage and concentrate diets **(Mehrez *et al.* 1977)**. With regard to microbial protein yield, the present results indicated that protected protein had not significant effect on microbial protein yield. **Sallam *et al.* (1998)** found that microbial protein synthesis was increased as NH3-N and total VFAs concentrations increased in the rumen when different protein sources in diet of sheep.

Table 2: The effect of level of heat protected SBM protein diets on some rumen parameters

Parameters	Time	Treatment		
		Control	T1	T2
PH values	0	7.37±0.01	7.41±0.24	7.15±0.01
	4	6.40±0.04	6.29±0.08	6.30±0.03
	8	6.73±0.16	6.74±0.03	6.36±0.07
	Means	**6.83±0.15**	**6.81±0.17**	**6.60±0.13**
NH3-N concentration (mg/100ml RL)	0	19.99±0.11	19.03±0.27	18.09±0.66
	4	23.39±0.41	21.33±0.79	20.76±0.11
	8	20.25±0.12	17.80±0.45	18.30±0.34
	Means	**21.21±0.96^{a}**	**19.39±0.94^{b}**	**19.05±0.77^{b}**
TVFA's (mMol/L RL)	0	7.03±1.28	8.23±0.99	9.61±0.43
	4	11.03±1.67	10.96±0.26	12.00±1.70
	8	10.26±0.14	11.30±0.40	10.76±1.36
	Means	**9.44±0.86**	**10.16±0.58**	**10.79±0.72**
Microbial Protein yield g/Kg		13.51±0.21	13.54±0.27	13.62±0.24

Note: Values marked in different superscripts in the same row were significantly different (P≤0.05)
Time (0, 4 and 8 hours after feeding)

3.2. Blood Hematological Parameters

The results in Table 3 showed the effect of heat protected SBM protein diets on some blood hematological parameters. Heat treatment had not significant effect on all blood hematological parameters under study except white blood cell showed significant differences. The present results indicated that the highest values of RBC'S were showed in T2 followed by control group and T1, while the values of WBC'S were in descending order with increasing the levels of heat protected SBM in animal diets. The lowest and highest values of RBC'S were observed at the beginning of the experiment and after 4 months, respectively. Meanwhile, maximum and minimum values of WBC'S were detected at the beginning of the experiment and after 4 months, respectively for control group; at the beginning of the experiment and after 2 months, respectively for T1; after 2 and 4 months, respectively for T2, respectively.

Concerning hemoglobin values, control group was higher than T1 and T2 with non-significant differences and the all values were in descending order with increasing sampling. Meanwhile, hematocrit values in T2 were higher than those observed in control group and T1 with non-significant differences and the all values increased with increasing sampling time.

Regarding platelet count, maximum and minimum values were detected in T1 and control group, respectively and the highest values were observed at 4 months, while the lowest values were showed at the beginning of the experiment. Mean cell volume (MCV) had approximately the same values in all groups with none clearly differences at different sampling time. Regarding mean corpuscular hemoglobin (MCH), T2 gave the lowest value, while control group gave the highest one with non-significant differences and the all values were decreased with increasing sampling time.

Mean corpuscular hemoglobin concentrations (MCHC) were higher in control group compared to T1 and T2 with non-significant differences and the maximum and minimum values were recorded at the beginning of the experiment and after 4 months, respectively. Red cell distribution width (RDW) increased with elevated levels from bypass protein and the all values decreased with increasing sampling time.

The present results corresponded with the findings of **Liker *et al*. (2006)** they reported that protected methionine had not significant effects on red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), red cell distribution width (RDW), hemoglobin concentration (Hb) and haematocrit value (HCT) in beef cattle. Moreover, the present estimates were in general agreement with the normal range of **Peter *et al.* (2002)** in sheep [RBC'S 4-12, Hemoglobin 8-16, Platelet count 100-800×103 and Mean cell volume (MCV) 23-48]. It is well known that hematological characteristics are good indicators of animal physiological status (**Khan and Zafar, 2005**).

Table 3: The effect of level of heat protected SBM protein diets on some blood hematological parameters

Parameters	Time	Treatment		
		Control	T1	T2
Red blood cell (RBC's) X10^6/µl	0	3.89±0.19	4.16±0.21	4.37±0.47
	2	6.34±0.42	5.69±0.14	6.54±0.65
	4	7.74±0.47	7.33±0.34	7.92±0.39
	Means	5.99±0.47	5.73±0.37	6.28±0.51
White blood cell (WBC's) X10^3 /µl	0	15.16±3.14	14.68±1.18	11.00±1.72
	2	14.64±2.37	12.28±1.60	13.70±1.35
	4	12.88±1.75	13.34±1.26	8.05±0.97
	Means	14.22±1.35^a	13.43±0.77^{ab}	10.91±1.00^b
Hemoglobin (Hb), g/dl	0	11.48±0.55	11.50±0.33	11.02±0.58
	2	11.42±0.21	10.30±0.40	10.80±0.43
	4	10.76±0.27	10.08±0.40	10.72±0.16
	Means	11.22±0.21	10.62±0.26	10.85±0.22
Haematocrit HCT%	0	11.72±0.61	12.66±0.68	13.37±1.41
	2	19.22±1.28	16.80±0.48	19.82±2.13
	4	23.50±1.53	22.22±1.22	24.05±1.47
	Means	18.14±1.45	17.22±1.14	19.08±1.59
Blood Platelets (PLT)X10^3 /µl	0	355.00±29.74	392.00±30.88	246.75±31.92
	2	194.40±39.89	308.80±74.49	367.50±69.08
	4	401.00±55.73	446.00±39.06	396.25±87.13
	Means	316.80±33.04	382.26±31.49	336.83±39.97
Mean Cell Volume (MCV)	0	30.14±0.08	30.50±0.19	30.72±0.35
	2	30.38±0.35	29.60±0.12	30.30±0.30
	4	30.38±0.17	30.30±0.25	30.35±0.35
	Means	30.30±0.12	30.13±0.14	30.45±0.18
Mean Corpuscular Haemoglobin (MCH)	0	29.54±1.27	27.72±0.88	25.77±2.08
	2	18.24±1.21	18.06±0.61	16.82±1.25
	4	13.98±0.50	13.70±0.19	13.57±0.53
	Means	20.58±1.84	19.82±1.60	18.72±1.72
Mean Corpuscular Haemoglobin concentration (MCHC)	0	98.36±4.16	91.44±3.35	84.20±6.32
	2	60.32±3.7	61.30±2.04	55.97±4.79
	4	46.20±1.86	45.48±0.95	44.92±2.20
	Means	68.29±6.16	66.07±5.24	61.70±5.57
Red Cell Distribution Width (RDW)	0	18.78±0.66	19.54±0.56	18.42±1.44
	2	14.10±0.24	13.50±0.00	14.50±0.00
	4	13.70±0.20	14.30±0.37	14.02±0.62
	Means	14.78±0.65	15.02±0.74	15.53±0.76

Note: Values marked in different superscripts in the same row were significantly different (P≤0.05)
Time: (at the beginning of the experiment (0), 2 and 4 months).

3.3. Blood Biochemical Parameters

Results in Tables 4 presented the effect of heat protected SBM protein diets on some biochemical parameters. Heat treatment had not significant effect on all blood parameters except its effect on creatinine, total lipid and cholesterol was significant. Total protein estimates were higher in control group than T1 and T2 with non-significant differences and the highest values were showed after 4 months in T1 and T2, while they were after 2 months in control group. In connection to albumin detection, T2 gave the highest values compared to control group and T1 with non-significant differences and the lowest values were showed at 4 months, while the highest values were detected at the beginning of the experiment.

The values of globulin were in descending order with elevated levels from SBM in animal diets and the highest values were recorded at 4 months for T1 and T2, while they were at 2 months in control group. The present results agreed with **El-Reweny (1999 and 2006)**; they found that the concentration of total protein, albumin, and globulin did not significantly change by using different sources of protein and protected protein treatment methods , while **Abdel-Ghani *et al.* (2011)** reported significant differences in total protein and albumin ($P<0.05$ or $P<0.01$, respectively) at 2 and 4 months. Moreover, **El-Shabrawy *et al.* (2012)** found that the higher values of total protein and its fractions (Albumin and Globulin) were showed for cows fed diets contained Zn-CFM:CFM and Zn-CFM diets than those given CFM diets. The higher total protein and its fractions in lambs fed on diets containing protected protein may be due to the higher RUP, which consequently increased AA supply in the small intestine.

Blood glucose estimates were higher in T1 than T2 and control group with non-significant differences and the highest values were showed at 4 months. Meanwhile, the lowest values were detected at 2 months in T2 and at the beginning of the experiment in control group and T1. In contrast; **Dosky *et al.* (2013)**, noticed that heat treated soybean meal diet increased significantly ($P<0.05$) blood serum glucose concentration (76.33 mg/dl) as compared to control (72.89 mg/dl), while this increase was not significant in formaldehyde treated soybean meal diet, the increase in blood glucose may be due to the positive effect of protein protection methods on the nutritive values.

The values of bilirubin in the present study were in descending order with increasing the levels of bypass protein in animal diets. The lowest and highest estimates were recorded at the beginning of the experiment and after 4 months, respectively. Regarding creatinine detection, significant differences were observed between T2 and both of control group and T1, while non-significant differences were showed between control group and T1. Minimum and maximum values were recorded after 2 and 4 months, respectively in T1and T2, while they were after 2 months and at the beginning of the experiment, respectively in control group. Plasma cereatinin concentration was used as an indicator to reflect degradation of protein animal tissue (**Salem, 1983**).

Table 4: The effect of level of heat protected SBM protein diets on some blood biochemical parameters

Parameters	Time	Treatment		
		Control	T1	T2
Total protein, g/dl	0	6.46±0.12	6.40±0.10	6.37±0.07
	2	7.34±0.27	6.76±0.26	7.02±0.11
	4	6.96±0.27	7.02±0.16	7.00±0.14
	Means	6.92±0.15	6.72±0.12	6.80±0.10
Albumin, g/dl	0	3.73±0.29	3.57±0.06	3.69±0.10
	2	3.04±0.06	3.03±0.10	3.20±0.04
	4	3.00±0.04	2.94±0.02	3.07±0.01
	Means	3.26±0.13	3.18±0.08	3.32±0.08
Globulin, g/dl	0	2.72±0.36	2.82±0.08	2.68±0.05
	2	4.29±0.31	3.72±0.19	3.82±0.14
	4	3.95±0.27	4.07±0.16	3.92±0.15
	Means	3.65±0.24	3.54±0.16	3.47±0.18
Glucose, mg/dl	0	63.60±2.46	53.20±2.22	60.75±2.39
	2	65.40±2.44	75.80±6.11	59.50±2.21
	4	73.20±2.70	84.00±4.39	77.50±3.17
	Means	67.40±1.75	71.00±4.24	65.91±2.82
Biliroin	0	0.18±0.03	0.20±0.03	0.12±0.02
	2	0.48±0.05	0.24±0.02	0.25±0.02
	4	0.50±0.07	0.38±0.03	0.42±0.02
	Means	0.38±0.04	0.27±0.02	0.26±0.03
Creatinine, mg/dl	0	1.40±0.08	1.36±0.09	1.02±0.09
	2	1.30±0.16	1.14±0.09	0.85±0.06
	4	1.32±0.05	1.58±0.14	1.32±0.19
	Means	1.34±0.06^{a}	1.36±0.07^{a}	1.06±0.08^{b}
Urea-N, mg/dl	0	50.72±1.21	54.12±3.61	47.17±2.16
	2	49.20±2.49	48.90±2.94	49.45±2.95
	4	55.18±2.56	52.04±2.67	46.37±1.96
	Means	51.70±1.35	51.68±1.75	47.66±1.31
Total lipid mg/dl	0	142.60±17.46	121.80±3.74	158.52±8.05
	2	153.26±6.65	133.50±6.39	133.17±9.15
	4	151.18±6.09	149.10±6.06	169.57±2.45
	Means	149.01±6.19^{ab}	134.80±4.20^{b}	153.75±5.93^{a}
Triglyceride mg/dl	0	47.20±5.53	39.80±1.85	59.00±4.37
	2	52.40±6.38	50.20±4.40	42.00±4.41
	4	50.40±0.92	54.60±2.83	62.50±1.32
	Means	50.00±2.68	48.20±2.38	54.50±3.31
Cholesterol mg/dl	0	61.80±8.34	53.20±3.00	62.25±2.52

	2	64.80±2.13	51.80±2.08	59.75±4.25
	4	65.20±5.00	59.40±4.60	67.25±0.62
	Means	63.93±3.10[a]	54.80±2.01[b]	63.08±1.77[a]
Got (Ast), (mg dl-1)	0	20.80±4.53	19.40±3.23	14.75±0.85
	2	44.200±7.10	41.20±4.49	38.00±2.67
	4	86.00±6.97	94.00±3.39	122.25±13.28
	Means	50.33±7.95	51.53±8.60	58.33±14.51
GPT (Alt), (mg dl-1)	0	21.60±7.54	15.60±4.10	10.75±0.47
	2	17.00±1.44	15.00±0.70	17.00±0.70
	4	22.40±1.98	22.20±1.49	26.25±1.10
	Means	20.33±2.53	17.60±1.62	18.00±1.96

Note: Values marked in different superscripts in the same row were significantly different (P≤0.05)

Concerning blood urea, T2 gave the lowest values compared to control group which was higher than T1 with non-significant differences and the highest and lowest estimates were observed after 2 and 4 months, respectively in control group; at the beginning of the experiment and after 2 months, respectively in T1; after 2 and 4 months, respectively in T2. These results were in agreement with the results obtained by **El-Shabrawy *et al*. (2012)**; they reported that blood plasma urea-N concentration was lower for caws given diets contained protected protein by zinc sulphate compared to other groups may be due to the decrease in rumen degradable protein consequently decreased NH3-N and non-protein nitrogen concentration in the rumen liquor.

Regarding total lipids, significant differences were showed between T1 and both of control group and T2, while non-significant differences were observed between control group and T2 and the values were in ascending order with sampling time in control group and T1, while the lowest and highest estimates were recorded after 2 and 4 months, respectively in T2.

In connection to triglycerides, T2 gave the highest values compared to control group which was higher than T1 with non-significant differences. Minimum and maximum values were showed at the beginning of the experiment and after 4 months, respectively in control group and T1 while the lowest and highest estimates were recorded after 2 and 4 months, respectively in T2. On the other hand, **Shamoon *et al*. (2009)** indicated that blood triglycerides were significantly (P<0.01) increased in formaldehyde treated ration as compared with untreated rations by about 10 Mg/100ml for blood triglyceride and 1 g/100ml for albumin.

In connection to blood cholesterol, significant differences were showed between T1 and both of control group and T2, while non-significant differences were observed between control group and T2. The lowest and highest estimates were recorded at the beginning of the experiment and after 4 months, respectively in control group, while they were after 2 and 4 months, respectively in T1 and T2. On the

same trend, elevated cholesterol levels can be indicative of dietary lipid content or tissue catabolism (**Miner *et al*., 1990**).

Regarding the values of GOT, T2 gave the highest values compared to control group which was lower than T1 with non-significant differences and the values were in ascending order with sampling time. Concerning GPT values, it is clearly appears that T1 gave the lowest values compared to control group which was higher than T2 with non-significant differences. The lowest and highest values were showed at the beginning of the experiment and after 4 months, respectively in all groups. Finally, It is clearly appears that heat treatment for soybean meal protein did not affect animal health As well, no satisfactory conditions were observed with overall improvement in blood measurements.

3.4. Carcass Characteristics

Results in Table (5) indicated that heat treatment resulted in improve average body weights compared to control group with difference about 6.54, 5.78 and 2.74, kg before slaughter, after bleeding and after the cavity, respectively. In connection to full and empty digestive system, they were higher in T1 and T2 than control group, may be due to the improvements in feed intake for groups fed treated soybean meal compared to control group.

Table 5: The effect of level of heat protected SBM protein diets on characteristics of carcass

Parameter	Control	T1	T2
Before slaughter kg	38.96±3.11	42.23±1.10	45.50±2.36
After bleeding kg	37.78±3.02	40.93±1.21	43.56±2.22
After the cavity kg	18.56±1.79	20.08±0.61	21.30±1.37
The digestive system is full kg	7.74±1.00	8.71±0.79	8.90±0.35
The digestive system is empty kg	4.65±0.70	4.92±0.37	5.10±0.12
Head kg	2.40±0.19	2.46±0.08	2.80±0.05
The legs kg	1.14±0.04	1.21±0.07	1.30±0.05
Skin and scalp kg	5.68±0.28	6.25±0.62	6.40±0.52
Testes g	230.00±56.86	233.33±33.33	266.66±33.33
Liver g	633.33±44.09	633.33±44.09	766.66±44.09
Kidneys g	106.66±6.66	100.00±0.00	150.00±28.86
Full ribs g	483.33±16.66^{b}	473.33±14.52^{b}	540.00±10.00^{a}
Bone ribs g	105.00±10.00^{ab}	96.66±1.66^{b}	123.33±3.33^{a}
Rib meat g	296.66±11.66^{ab}	278.33±10.13^{b}	318.33±7.26^{a}
Fat ribs g	81.66±4.40^{b}	98.33±6.00^{a}	98.33±1.66^{a}
Fat viscera g	263.33±29.62	223.33±67.41	216.66±44.09
Ocular muscle g	83.33±9.27	88.33±1.66	88.33±1.66
Space of the muscle g	18.45±0.82	20.00±2.32	19.36±1.31

Note: Values marked in different superscripts in the same row were significantly different (P≤0.05)

Non-significant differences were observed for head, legs, testes, liver, kidneys, fat viscera, ocular muscle, space of the muscle, skin and scalp, although there was increase in favor of groups fed diets contained treated soybean meal (50 and 100%). The significant differences were showed for the weights of full ribs, bone ribs, rib meat and fat ribs as they increased with increasing the proportion of treated soybean meal in animal diets being at range from 483.33 to 540, 105 to 123.33, 296.66 to 318.33 and 81.66 to 98.33, g respectively.

The present results corresponded with the findings of **Al-Jassim *et al.* (1991)**, they reported that the supplementation with undegraded protein had a significant effect ($p<0.05$) on dressing-out percentage and a highly significant effect ($p<0.01$) on final live weight and hot and cold carcass weights. Moreover, **Hassan *et al.* (1991)** investigated the response to supplementation with rumen undegradable nitrogen (RUN) given with diets of either 70:30 or 30:70 roughage: concentrate ratio, upon carcass composition of fat-tail Awassi sheep. The physical composition of the main wholesale cuts and dressing-out % were not affected by RUN supplementation or roughage: concentrate ratio.

3.5. Chemical Analysis of Meat

Dressing percentage, Fat, Meat, Bone and Chemical Composition of meat are given in Table (6). Dressing percentage (A) expressed as carcass weight / slaughter weight were 47.52, 47.55 and 46.82% for control treatment, T1 and T2, respectively and there was no significant difference among groups. Dressing percentage (B) expressed as carcass weight /fasting weight were 61.55, 62.34 and 61.64% for control treatment, T1 and T2, respectively. Non-significant difference in dressing percentage due to the type of heat protected protein in the diet. Fat percentage in T1 was higher than that in control groups and T2 and differences were significant ($P\leq0.05$).

Table 6: The effect of level of heat protected SBM protein diets on chemical composition of meat

Items,%	Control	T1	T2	P-Value
Dressing A	47.52±0.89	47.55±0.89	46.82±1.90	0.964
Dressing B	61.55±1.90	62.34±0.14	61.64±3.45	0.907
FAT	16.93 ± 0.96^{b}	20.74 ± 0.63^{a}	18.21 ± 0.03^{b}	0.018
MEAT	61.37 ± 0.88^{a}	58.78 ± 0.53^{b}	58.94 ± 0.55^{b}	0.059
BONE	21.70±1.76	20.48±0.94	22.85±0.54	0.425
Chemical Composition of meat:				
CP	75.37 ± 0.22^{c}	76.34 ± 0.37^{b}	77.99 ± 0.15^{a}	0.001
EE	10.27±0.04	10.30±0.35	9.85±0.17	0.353
Ash	3.69±0.003	3.92±0.34	3.83±0.03	0.092

Note: Values marked in different superscripts in the same row were significantly different ($P\leq0.05$)

Meat percentage in control group was higher than that T1 and T2 and the differences were significant (P≤0.05). Bone percentage T2 was higher than that in control groups and T1 and differences were significant (P≤0.05). In connection to chemical composition of meat, it is clearly appears that heat treatment had not significant effect on EE and Ash contents, while the significant effect was observed on CP, ranged from 75.37 to 77.99, 9.85 to 10.30 and 3.69 to 3.92% for CP, EE and Ash, respectively.

The improvements in CP in chemical composition of meat were 0.97 and 2.62 for T1 and T2, respectively. Unfortunately, little information is available on the effect of feeding ruminally heat treatment of protein on performance and carcass trait of Rahmani lambs.

4. Conclusion

On the light of above results, using of heat treatment as a tool for protecting soybean meal protein from degradation in the rumen of growing lambs at the two replacing levels (50 and 100% of untreated SBM protein) had a beneficial effect on chemical composition of meat with non-adverse effect on some parameters of rumen liquid, blood measurements.

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