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Impact of partial and total replacement of urea nitrogen instead of soybean meal protein on reproductive performance of Awassi lambs

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Abstract

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In female increase urea intake may affect negatively in fertility as a result of the change in oviduct acidity this effect of urea noticed also in male semen quality. We expect that inclusion urea instead of soya protein may not affect in semen qualities in male duo to high starch ratio in the ration. The study aimed to find out the effect of partial or total replacement urea as a substitute for soybean meal on the reproductive performance of Awassi male sheep. In this study, 15 Awassi lambs were used with an average initial weight of 60.30 kg, aged 11–13 months. Lambs were randomly divided according to their weight into three groups. The first group (T1) animals were fed a ration containing soybean meal, the second group (T2) 50% of soybean meal was replaced by urea, and the third group (T3) urea was totally replaced with soybean meal. The results showed a feed intake decrease consumed 1.14 kg, in the second treatment compared with the first and third treatments (1.34, 1.34 kg). The average daily and total weight gain 0.116 and 7.00 kg, decreased significantly ($P < 0.05$) in total replacement of urea compared with partial replacement of urea and control treatment 0.191 and 11.50 kg and 0.174 and 10.50 kg, respectively. Partial replacement urea for soybean meal led to a significant decrease ($P < 0.05$) in semen characteristics compared with T1 and T2. On the other hand, partial urea replacement led to a significant ($P < 0.05$) increase in the concentration of blood plasma cholesterol 172.48 mg/dl, compared to the second and third treatments, 134.28 and 137.14 mg/dl, respectively. with feeding starch diets inclusion urea Partially are totally instead of soybean meal has determine effect in semen quality.

Keywords: partial and total urea nitrogen; soybean meal; semen parameters; ram

Introduction

Many factors can be effect of the feed prices includes the agricultural season, supply and demand, and availability of natural pastures. Therefore, animals feeding is considered one of the significance challenges for breeders because it is raised production costs and reduce the profits. In recent years, several methods have been proposed to enhance feed utilization one of these is the activation rumen microorganisms or using an alternative source of feed lower in cost without affect animal performance and growth. Rumen is a complex environment that contains many microorganisms that contribute in the feed digestion Jiao et al. (2015). Urea is used as a source of non-protein nitrogen in ruminant feeding to balance the protein in the diet and increase energy utilization when diets contain high carbohydrates. also, urea produces in the liver and about (40–80%) of it is reused in the digestive system according to protein intake Lapierre & Lobley (2001). urea is degraded rapidly in the rumen within 2 hours after feeding and form ammonia through urease enzyme, ammonia can be used by cellulate bacteria as a source of nitrogen and may be leads to enhance the cellulose, and hemicellulose digestion in the plant cell wall Millam (2016), but when concentrate fed to the animal rumen pH may decrease and reduce absorption of ammonia across the rumen wall without effect on

animals growth, in contrast some studies were suggested that using urea in ruminant feeding produce microbial protein less than 20% as compared soybean meal NRC (2001). This study was carried out to find out the effect of partial and total replacement of urea nitrogen instead of soybean meal in ration consist of concentrate on the reproductive performance of Awassi lambs.

Materials and Methods

Ethical Approval and Animals

This study was conducted in Animal Production department at College of Agriculture and Forestry/University of Mosul. Fifteen Awassi lambs were used with an average weight of 60.30 ±2.99 kg and aged 11–13 months.

Experimental Design

Lambs were divided into three groups (5 lambs per group). They were fed on experimental rations. The first group was control fed on a ration that contained 10% soybean meal as a source of protein, in the ration of the second group soybean meal is replaced partially by 50% with urea, while in the third group soybean meal 100% were replaced with urea. The lambs were fed *ad libitum* with experimental rations, and the remainder was collected every morning and weighed to calculate the actual amount of feed intake. Fresh water was freely provided.

Sampling and Analysis

Semen was collected monthly through the period of study which lasted three months using the Ejaculator method, according to Wolf et al. (1965). The semen was kept in a water bath at (37°C) the ejaculate volume, mass and individual motility movement, percentage of live, dead and deformed sperm and using light microscope using the method that suggested by Melrose & Laing (1970), and semen concentration using hemocytometer, according to what was reported by Simth & Mayer (1955). The blood samples were withdrawn from the jugular vein after five hours of feeding using plastic syringe. Blood serum was separated by centrifugation (3000 rpm) for 20 min to determine the concentration of total protein, albumin, glucose, cholesterol, triglycerides, and urea using a Ready-made analysis kit from (Biolabo) company by means of a spectrophotometer (Biotech Engineering Management CO.LTD.UK).

Statistical Analysis

The results were statistically analyzed using a one-way complete random design (CRD) according to the following design by using SAS (2005) program, and the significance between the means was determined by the Duncan (1955) polynomial test.

$$Y = \mu + Ti + eij,$$

where μ is the overall mean, Ti is the fixed effect of dietary treatments, and *e*ij is the residual effect. Differences were considered significant if ($P < 0.05$) (Table 1).

Table 1. Chemical components and composition of the experimental diets

Ingredients	Experimental diets		
	T1	T2	T3
Crushed barley	60	65.35	69.7
Wheat bran	21	18	15
Soybean meal	10	5	–
Wheat straw	8	10	13
Urea	–	0.65	1.3
Limestone	0.5	0.5	0.5
Sodium chloride	0.5	0.5	0.5
Chemical composition, %			
Dry matter	91.27	90.89	90.56
Organic matter	96.94	97.05	97.10
Crude protein	13.88	13.80	13.80
Ether extract	2.54	2.48	2.43
Crude fiber	9.05	9.39	9.98
Metabolisable energy, M.J/kg	10.33	10.19	10.00

Note: Chemical composition was laboratory determined according to AOAC (2000). the energy was calculated from the tables of the chemical composition of Iraqi feed materials Al-Khawaja et al. (1978)

Results

Table 2 showed that replacing 50% of soy protein with urea decreased the amount of feed consumed 1.14 kg/day compared to 1.34 and 1.34 kg/day, for the first and third treatments conversely, conversely feed conversion efficiency improved 5.96 kg of feed/kg of weight gain compared with T1and T3 7.70 and 11.55 kg feed/kg of weight gain, non-significant decrease in final body weight was observed in T3 67.10 kg compared to T1 71.00 kg and T2 71.8 kg, while daily and total weight gain significantly decreased ($P < 0.05$) as compared with T1 and T2. The results in Table 3 showed that the substitution of urea nitrogen 50% instead of soybean meal protein led to a significant decrease in semen characteristics ($P < 0.05$) compared with T1. In contrast, the semen characteristics did not deteriorate upon urea substitution completely in T3, and it was similar to that recorded in theT1. Table 4 shows no significant differences between treatments in plasma concentration of blood proteins, glucose, triglycerides, and urea. However, the cholesterol

Table 2. The effect of an experimental ration on the productive performance of male Awassi lambs

Traits \ Treatments	T1	T2	T3
Initial weight, kg	60.50 ± 2.79	60.30 ± 4.07	60.10 ± 2.11
Finial weight, kg	71.00 ± 2.07	71.80 ± 3.46	67.10 ± 2.33
Daily gain, kg	0.174 ± 0.01 a	0.191 ± 0.01 a	0.116 ± 0.01 b
Total gain, kg	10.50 ± 0.63 a	11.50 ± 1.16 a	7.00 ± 0.64 b
Feed intake, kg	1.34	1.14	1.34
Feed efficiency kg feed/kg weight gain	7.70	5.96	11.55

* a,b, Means values within a column with different superscripts differed (P < 0.05)

Table 3. The effect of experimental ration on the semen characteristics of Awassi lambs

Traits \ Treatments	T1	T2	T3
Volume/ml	2.64±0.20 a	1.77 ± 0.25 b	2.07± 0.16 a
Texture	3.19± 0.14 a	2.44± 0.23 b	3.02±0.09 a
Individual movement, %	85.20±2.55 ab	78.20± 1.95 b	87.00±2.30 a
Mass motility, %	4.46± 0.10 a	3.86 ± 0.10 b	4.16± 0.12 ab
Live sperm, %	87.78 ± 2.35 a	76.36 ± 1.82 b	87.15 ±2.38 a
Dead sperm, %	12.21± 1.02 b	23.62 ± 1.83 a	12.84±2.38 a
Distorted sperm, %	2.97± 0.12 b	3.14± 0.25 b	4.17 ±0.23 a
Sperm concentration/$\times 10^9$	2.45± 0.14 a	1.71± 0.09 b	2.42 ±0.13 a

* a,b, Means values within a column with different superscripts differed (P < 0.05)

Table 4. The effect of experimental diets on some biochemical blood characteristics of Awassi sheep

Traits \ Treatments	T1	T2	T3
Total protein, gm/dl	6.81 ± 0.12	6.58 ± 0.15	6.93 ± 0.21
Albumen, gm/dl	3.93 ± 0.07	3.96 ± 0.05	3.93 ± 0.07
Globulin, gm/dl	2.88 ± 0.19	2.62 ± 0.15	2.79 ± 0.10
Glucose, mg/dl	72.74 ± 2.69	66.80 ± 4.09	71.64 ± 2.68
Cholesterol, mg/dl	134.28 ± 6.71 b	172.48 ± 8.44 a	137.14 ± 5.08 b
Triglyceride, mg/dl	42.92 ± 2.93	42.36 ± 2.17	42.88 ± 4.07
Blood urea, mg/dl	48.14 ± 2.10	47.66 ± 1.84	46.85 ± 1.00

* a,b, Means values within a column with different superscripts differed (P < 0.05)

concentration increased significantly (P < 0.05) in the T2 (172.48) mg/100 ml compared with the T1 (134.28) mg/100 ml and T3 (137.14) mg/100 ml, respectively.

Discussion

Data in Table 2 showed that partial replacement soybean meal with urea lead to improve diet utilization while this was not achieved when urea substituted totally with soybean meal the lack of efficiency in urea nitrogen utilization in the third treatment compared to amino acids from soybean meal may be the explain the role of amino acids in enhance microbial protein synthesis and its effect in lambs' growth (Kertz, 2010). The results were in agreement with the findings of Xu et al. (2019), Rad et al. (2016) and Spaghero et al. (2017) that feeding lambs at different levels of urea or substituting urea instead of soybean meal. but results not agreement with Aliyi (2021), Abyane et al. (2020), and Abera et al. (2018) they noted that feeding lambs on urea-treated wheat straw, led to an increase in the dry matter intake, final body weight, and the rate of weight gain, therefore, the addition of urea and the kind of diet will be affected on response to the addition of urea.

Table 3 illustrates the effect of protein source in semen characteristics, we found that partial replacement of urea instated of soybean meal led to decrease ejaculated volume, semen concentration and live sperm with increase in dead sperm, on the contrary this negative effect of semen parameters was not recorded in T3 when urea completely substitut-

ed with soybean meal, the reason for the decrease in semen characteristics in T2 is not clear, it may be related to the improvement in feed conversion efficiency, resulting from the decrease in the amount of feed consumption while causing a negative relationship to semen characteristics refer to that the improvement of feed efficiency negatively affects sperm movement due to the fat deposition in the scrotum, which has a negative relation in semen chrematistics Coulter et al. (1997), Coulter & Kozub (1989). Awda et al. (2013) and the increase in cholesterol in the T2 may be agree with this finding which could be associated with fat deposition in the body. It was noted in the studies of Abd-Aziz (2001), El-Azab et al. (1998) that feeding rams on urea-treated rice hay led to a significant increase in ejaculation volume, individual motility, and sperm concentration in the ejaculation. While Rocha et al. (2020), Kobeisy et al. (2015), Abi Saab et al. (2003) and Cortada et al. (2000), not find a significant effect of feeding rams at different levels of urea or hay treated on semen characteristics. Blood parameters in Table 4 showed no effect significantly of urea substituted with soybean meal on blood proteins, glucose, triglyceride and urea while cholesterol increase significantly in T2 as compared other treatments, this may be due to higher efficiency in nitrogen utilization by rumen microorganism, these results were agreed with what Abyane et al. (2020) found for the concentration of total protein and albumin, in contrary Eryavuz et al. (2003) noted that feeding lambs on urea led to a significant increase in the concentration of blood urea compared to the control treatment.

Conclusion

Despite the decrease in the productive performance and some characteristics of semen when soybean meal nitrogen replaced by urea, but could be recommend it is possible to completely replace urea instead of protein source in the diet, with taking into consideration the content of degradable protein and energy balance in the diet.

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