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The Effect of Replacing Slow-Release Urea (Menogen) Instead of Fast-Release Urea on The Weight of Awassi Ewes and Their Newborns Until Weaning, Milk Production, and Some Biochemical Blood Traits

1st Waseem A. Hashem[1], 2nd Mothna A. M. Tayeb[2]
1. Department of Animal Production, Technical College Agricultural of Mosul, Northern Technical University, Mosul, Iraq,
2. Animal Resources Department, College of Agriculture and Forestry, Mosul University, Mosul, Iraq

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Corresponding author:
Name: Waseem Amer Hashem
Affiliation : Technical College Agricultural of Mosul, Northern Technical University, Mosul, Iraq
Email: wasseem_amer@ntu.edu.iq

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A B S T R A C T

The study was conducted in the sheep field of (Kosar) company in the Kalk district. It was conducted to determine the effect of adding slow-release urea to the concentrated diet gradually instead of fast-release urea in an attempt to improve the efficiency of feed utilization , improve rumen conditions, and its reflection on the productive performance and some blood biochemical indices of Awassi ewes milk. 24 heads of newly parented ewes aged between 3-4 years distributed to four groups was the sample. It has fed onthe same concentrated diet. The first group treated with 1.5 urea only and the second Treated with 1 % urea and 0.6 % slow-release urea .The third Treated with 0.5 % urea and 1.2 % slow-release urea and the fourth Treated with 1.8 % slow-release urea only .The study took two months, from the birth of ewes until weaning lambs, with a Completely Randomized Design. The total average weight gain for ewes was (8.37, 9.72, 6.74, 5.67) kg, and through the results, it was observed that there is a positive effect of adding Menogen to Awassi ewes feeds in the average daily and total milk production as the fourth treatment significantly ($P\leq0.05$) exceeded the rest of the treatments. The percentage of fat, protein and lactose in milk also has significantly ($P\leq0.05$) exceeded in the fourth treatment than the rest of the treatments, no significant difference was observed between treatments in total blood protein concentration albumin and globulin . But blood urea concentration was significant increase ($P\leq0.05$) in favor of fourth treatment and first one compared to first treatment computationally with third, plasma cholesterol concentration increased significantly ($P\leq0.05$) with increasing level of slow-release urea in third treatment compared to other treatments, triglycerides concentration in blood decreased significantly ($P\leq0.05$) with increasing level of slow-release urea for third treatment and fourth one compared to first one computationally with second. Blood enzyme ALT was significantly increased ($P\leq0.05$) in third treatment followed by fourth treatment and first one compared to second, AST enzyme decreased significantly ($P\leq0.05$) in third treatment compared to first one and second one computationally with fourth.

Introduction

There is an increased interest in the optimal use of dietary protein in dairy sheep to enhance production efficiency, reduce feed cost, and mitigate the environmental impacts of dairy products. Feeding dietary protein to milk-producing sheep involves formulating meals containing a balance of rumen degradable protein (RDP) and undegradable protein (RUP) to meet the animal's nutritional requirements. The hydrolysis of RDP in the rumen leads to the release of ammonia (NH_3) in the rumen which synchronized with fermentable energy.It is used to manufacture microbial crude protein (MCP) [1] which is considered one of a high-quality protein with high digestibility and balance and as a source for amino acid (AA) formation [2]. That is digested and absorbed in the small intestine to meet the amino acid needs of dairy ruminants [3].

Urea is an NPN compound that can be used to supply rumen degradable protein (RDP) in ruminant feeds [4]. Economically, the cost of urea has led to increased interest in using it as a partial alternative source to plant protein, such as soybean meal (SBM) to prepare (RDP) [5]. However, the use of urea in ruminant feeding is limited due to its rapid hydrolysis to NH_3 in the rumen which exceeds carbohydrate degradation leading to an increase in blood ammonia concentration and an increased risk of NH_3 poisoning. The lack of synchronization in ammonia production and available fermentable energy can negatively affect the Efficiency of MP formation or utilization [1] which may weaken the availability of digestible protein for milk production. Coating or encapsulation techniques have been used to develop slow-release urea (SRU) products that can control urea degradation and synchronize ammonia degradation in the rumen with energy digestion and reduce the cost of metabolic removal of ammonia toxins to urea in the liver [5]. Many studies proveded that replacing plant protein with SRU in feeding can improve the productive performance of ruminants [6].

Menogen is a Chinese origin product , which is urea coated with palm oil in a ratio of 12% palm oil and 82% urea., its nitrogen content reaches 38% equivalent to 237.5% protein and its degradation rate is slow reaching up to 8 hours inside the rumen compared to regular urea which does not last an hour. The aim of the study is to determine the results of using slow-release urea (Menogen) [7], instead of fast-release urea in milk production and its components for newly born ewes, the efficiency of protein utilization, and blood components.

Materials and Methods

The experiment was conducted in the sheep field of (Kosar) company in the Kalk district to determine the effect of adding slow-release urea to the concentrated diet gradually instead of fast-release urea in an attempt to improve the efficiency of feed utilization, improve rumen conditions, and reflect that on the production of Awassi ewes milk using 24 heads of newly born ewes aged between 3 and 4 years with an average weight of 49.36 kg. Experimental ewes were selected based on the proximity of the birth date, their age, and their milk production rate after observing them for several days. They were distributed to four treatments fed on a Basic concentrated diet similar in its energy and protein content and different in its urea content which was gradually replaced with slow-release urea (Menogen). The first treatment took (1.5% urea only). The second treatment (1% urea and 0.6% slow-release urea), the third treatment (0.5% urea and 1.2% slow-release urea), and the fourth (1.8% slow-release urea only). The study took two months until weaning lambs. The basic diet consisted mainly of barley, wheat bran, soybean meal, urea, hay, and were similar in their metabolic energy and protein content as shown in Table (1). The ewes were fed two meals, morning and evening, and the feed was calculated based on production needs. The weight of the ewes and lambs was taken at the end of each month before the morning feeding, as well as blood samples for the ewes at the end of each month were drawn from the jugular vein two hours after providing the evening feed meal, and the blood serum was separated using a centrifuge (3000 rpm) for 10 minutes and kept under freezing (-20˚C) until analysis. To estimate the concentration of urea, total protein, albumin, triglycerides, and AST and ALT enzymes, a ready-made French analysis kit (Biolabo) was used by a spectrophotometer of English origin. As for milk samples, they were milked for two consecutive days biweekly, and an average measurement of milk production was taken, after isolated the lambs from their mothers for 12 hours before starting the milking process. This process continued until weaning. The milk is weighed and samples are taken from it, placed in plastic containers, and transferred directly to the nutrition laboratory in the Agricultural Technical College to read its components using a total Eko milk type Lactoscan device where protein, fat, lactose percentages, and non-fat solids percentage in milk were estimated.

Table 1. Components and chemical composition of the experimental feeds

Feed material	SRU 0%	SRU 0.6%	SRU 1.2%	SRU 1.8%
Cracked barley	66.5	66.5	66.5	66.5
wheat bran	25	25	25	25
Soybean meal	5	5	5	5
Urea	1.5	1	0.5	-
Menogen (SRU) *	-	0.6	1.2	1.8
Calcify	1	1	1	1
Salt	1	1	1	1
Chemical composition of experimental diets				
Dry matter	90.17	90.11	90.30	90.25
Organic matter	94.38	94.41	94.18	94.26
Crude protein	18.14	18.13	18.12	18.11
Crude fat	2.66	2.72	2.86	2.92
Crude fiber	9.31	9.26	9.28	9.21
Metabolic Energy Kilo Kcal/kg feed **	2.713	2.710	2.712	2.714

* Calculated in the laboratory

** Metabolic energy was calculated from the chemical analysis tables of Iraqi feed materials as stated in [8].

The data was analyzed using the Completely Randomized Design (CRD) using the statistical Analysis system [9] by computer, and using the mathematical model equation:

$$Yij = \mu + Ti + eij$$

Yij = the value of observation j for treatment i.

μ = the overall average.

Ti = the effect of experimental treatments.

eij = the experimental error of the observation.

The averages were compared using Duncan's multiple range test [10] to determine significant differences between the averages.

Results and Discussion

As shown in Table (2), there were no significant differences in the daily feed intake for the four treatments, which were (1.511, 1.510, 1.495, 1.484) kg/day respectively. Also, there were no significant differences in the initial and final weights of the ewes and lambs. The initial weight of the ewes was (48.21, 50.70, 48.46, 50.07) and the lambs were (6.17, 6.30, 6.45, 6.25) kg respectively. The final weight of the ewes was (56.58, 60.41, 56.20, 57.75) kg, and the lambs at weaning were (29.14, 29.82, 29.45, 29.56) kg respectively. The results indicate that there are significant differences in the total weight gain rate for the ewes which was (8.37, 9.72, 8.74, 7.67) kg. The least increase in body weight in the fourth treatment, which came concurrently with the best milk production, concluding that the need for energy to dispose the excess amount of degraded protein to meet milk production requirements may have led to not building a larger mass of body weight to save energy and perhaps this confirms recording the highest milk production in this treatment. The total weight gain rate for lambs was (23.23, 23.51, 23.00, 23.4) kg for the four treatments respectively.

The results in Table (3) Showed the average daily and total milk production for milk during the study period of 8 weeks. The fourth treatment significantly increased ($P \leq 0.05$), followed by the second treatment compared to the third and first. The average of milk production was (247.00, 393.83, 246.50, 406.00) g/12h and the total average milk production was (741.00, 1181.50, 739.50, 1218.00) g/ewe respectively. This shows the superiority of the fourth treatment over the rest of the treatments and the efficiency of using slow-release urea (Menogen) in diet for milk-producing ewes. Perhaps the reason for this increase is due to its association with improved feed conversion ratio and protein utilization efficiency in the fourth treatment, which is a consequence of the slow degradation of Menogen [11]. Due to the lack of research on the use of slow-release urea in sheep, many researches on dairy cows was referred to, which is not consistent with the current study as [12, 13, 14, 15, 16, 17, 18] pointed out that there were no significant differences in the amount of milk produced.

As shown in Table (3), there is a significant increase ($P \leq 0.05$) in the percentage of milk fat in the first, third, and fourth treatments compared to the first, reaching (4.221, 4.836, 4.860, 5.101)% respectively. The reason for the increase in milk fat percentage may be due to the source of slow-release urea (Menogen) in the fourth and third treatment, which had a role in increasing the number of fiber-degrading bacteria in the rumen and improving the digestion coefficient of fibers, which resulted in an increase in milk fat percentage. The results of this study agree with [14, 15] Who observed a significant increase in the percentage of cow's milk fat when increasing the percentage of slow-release urea in their feeds. However, it diverged with the results of [12, 13, 16, 17, 18, 19, 20], as they pointed out that there were no significant differences in the percentage of cow's milk fat when increasing the level of slow-release urea.

Similarly, the results in Table (3) show a significant of ($P \leq 0.05$) increase in the average percentage of milk protein in the fourth treatment compared to other treatments, with values reaching (4.739, 4.870, 4.764, 5.035)% respectively. The reason for this increase in milk protein percentage may be due to the protein source in the feed, and the role of SRU (Menogen) for increasing the efficiency of utilization of its slowly released nitrogen, which reflected in increasing the level of milk production [21]. This outcome is consistent with Tye et al., (2017) [18], they found a significant increase in the percentage of cow's milk protein when increasing the level of slow-release urea in the feed. However, it did not agree with [12, 13, 14, 16, 18, 20], as they pointed out that there

were no significant differences when increasing the level of slow-release urea in cow feeds.

As for the average percentage of milk lactose, Table (3) shows a significant (P≤0.05) decrease in the fourth treatment compared to the first, and computationally with the second and third, reaching (4.645, 4.508, 4.675, 4.535) % respectively. The reason may be the increase in the amount of milk produced in the fourth treatment and that the percentages of milk components are inversely related to the amount of milk produced. The results of this study is in contrast with that of [12, 13, 14, 16, 17, 18, 19, 20] they pointed out that there were no significant differences in the percentage of milk lactose when increasing the level of slow-release urea in feeds.

The results in Table (3) show a significant (P≤0.05) decrease in the average percentage of Total solids not fat in the second and third treatments compared to the first, and computationally with the fourth, reaching (10.615, 10.050, 10.100, 10.331) % respectively. This explains that the percentage of total solids not fat is inversely related to SNF quantity, as the less milk produced, the higher its components, where the quantity is calculated based on the amount of milk produced. However, this decrease did not affect the fourth treatment Which containing high level of Menogen in the feed composition.

The current study's results agreed with [15], which indicated significant differences in the total solid content ratio. However, these study's results did not agree with the studies conducted on cows, including [13, 14, 16], who indicated no significant differences in the total solid content ratio and quantity of milk when increasing the level of slow-release urea in feed rations.

The results in Table (4) indicate that there are no significant differences between the four treatments in the average concentration of total Blood protein, which ranged between (5.68 -5.86) g/100ml blood. Similarly, for the concentration of albumin and globulin, there were no significant differences in the average concentration of albumin, which ranged between (4.18 - 4.51) and (1.33 – 1.60) g/100ml blood respectively. There are many factors that affect the concentration of blood proteins, the most important of which are the level of nutrition and the physiological condition of the animals. Observing these results, which indicated that there were no clear effects of slow-release urea levels on blood protein concentrations, as well as no differences in albumin concentrations, which is one of the main components of total blood protein, these results are consistent with the study of [12, 13, 16]. Similarly, for albumin results, they agreed with the results of [22, 23, 24], who found no significant differences in sheep blood albumin.

The results in Table (4) indicate a significant increase (P≤0.05) in the concentration of blood urea in favor of the fourth and second treatments compared to the first, and computationally with the third, with concentrations reaching (32.66, 37.50, 35.00, 38.50) mg/100ml blood respectively. The reason for this increase in blood urea may be due to the source of the consumed protein (Menogen), which is slow to degrade, leading to its presence in the blood, especially in the fourth and second treatments that gave high milk production compared to other treatments, which may be related to it Blood proteins, such as albumin, can act as carriers for nutrients, including amino acids, to various tissues in the body, including the mammary glands, Therefore, an increase in blood protein levels can lead to an increased availability of amino acids for the production of milk proteins, which in turn leads to an increase in milk production. [25]. The results of this study are consistent with the study of [26], but differ from the results of studies by [22, 23, 24, 27], who found no significant differences when increasing the level of slow-release urea in sheep feeds. However, [28] indicated a significant decrease in blood urea concentration when increasing the level of slow-release urea in sheep feeds.

Table (4) also shows a significant increase (P≤0.05) in blood plasma cholesterol concentration with an increase in the level of slow-release urea in the third treatment compared to other treatments. The concentration reached (74.16, 78.83, 93.33, 79.16) mg/100ml of blood respectively. The reason for the increase in cholesterol level in the blood plasma of the sheep in the third treatment may be due to an increase in the fat content of the milk and, conversely, a low amount of milk compared to other treatments or it may be due to genetic or health factors. Slow-release urea does not have a direct effect on blood plasma cholesterol [21]. Therefore, the results of the current study did not agree with what was mentioned by [22, 26, 28] that there was no significant difference between treatments dealing with urea in diet and that the normal level of blood plasma cholesterol in sheep ranged between (35-64) mg /100ml of blood, while the study of [12] on cows agreed with the results of the current study as it mentioned a significant superiority in blood plasma cholesterol when adding slow-release urea as it reached (78.8, 112.7) mg /100 ml of blood.

While the results in Table (4) indicate a significant decrease (P≤0.05) in the concentration of blood triglycerides with an increase in the level of slow-release urea for the three treatments (second, third, and fourth) compared to the first one containing fast-release urea. The concentrations were (86.16, 82.33, 78.33, 77.33) mg/100ml of blood for the four treatments respectively. This decrease in triglycerides falls within the normal ranges referred to in a number of studies. The results of this study are not consistent with the results of [22, 26, 28] who observed no significant differences in the concentration of sheep blood triglycerides. [29]

also pointed out that fat-treated urea does not affect the concentration of blood triglycerides. [12] found that normal triglyceride concentrations are (63.2-67.8) mg/liter of blood in cows. However, contrary to the results obtained by [27] there was a significant increase in the concentration of sheep blood triglycerides and [14] in cows.

As for the blood enzymes ALT and AST, the results in Table (4) show a significant (P≤0.05) increase in the concentration of the AST enzyme in the third treatment compared to the fourth and first treatments, followed by the second. The concentrations were (102.33, 95.33, 110.66, 105.66) units/liter of blood respectively. The reason for this increase in the third treatment may be due to a decrease in milk production compared to treatments containing slow-release urea and the sheep working at their maximum capacity to increase production because they are in the postpartum period until weaning and need energy. As for the AST enzyme, the results of statistical analysis indicate a significant (P≤0.05) decrease in the concentration of ALT enzyme in the third treatment compared to the first and second and mathematically with the fourth as it reached (17.66, 17.50, 14.50, 16.16) units / liter. This is an indication of the sheep's response to adding slow-release urea which improved blood enzyme performance as mentioned by some researchers in their studies including [19, 24]. However Agreed with the results of Liang et al., (2020) [30] study which indicated a significant decrease in ALT enzyme while there were no significant differences in AST enzyme In blood of beef cattle treated with slow-release urea.

Conclusions

The results of the current study showed that replacing rapidly degradable urea (RDU) with slow-release urea (SRU) completely led to an improvement in the feed conversion coefficient and the efficiency of utilization of the consumed protein. Additionally, there is an increase in both average daily and total milk production, including its components. As for blood traits, a significant increase was observed in the concentration of blood plasma urea for the fourth treatment containing slow-release urea (SRU) compared to other treatments due to its slow degradation which takes a full 8 hours, while other blood traits were lower in the fourth treatment compared to other treatments.

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Table 2. The effect of experimental diets on the digestion coefficient of dietary compounds.

Traits	SRU 0%	SRU 0.6%	SRU 1.2%	SRU 1.8%
matter intake kg/day	1511 ± 0.69	1510 ± 0.36	1495 ± 0.57	1484 ± 0.52
Initial weight of ewes (kg)	48.21 ± 3.99	50.70 ± 2.36	48.46 ± 1.87	50.07 ± 2.52
Final weight of ewes (kg)	56.58 ± 2.90	60.41 ± 2.60	56.20 ± 2.09	57.75 ± 2.01
Total weight gain of ewes (kg)	8.37 ± 1.75	9.72 ± 2.40	8.74 ± 2.55	7.67 ± 2.23
Initial weight of lambs (kg)	6.17 ± 0.64	6.30 ± 1.36	6.45 ± 0.88	6.25 ± 0.94
Final weight of lambs (kg)	29.14 ± 2.27	29.82 ± 2.27	29.45 ± 2.30	29.56 ± 2.74
Total weight gain of lambs (kg)	23.23 ± 2.19	23.51 ± 2.78	23.00 ± 2.50	23.64 ± 2.57

Table 3. The effect of slow-release urea on daily and total milk production until weaning.

Parameters	SRU 0%	SRU 0.6%	SRU 1.2%	SRU 1.8%
mean milk yield g/12h	247.00 ± 10.23 b	393.83 ± 13.35 a	246.50± 6.97 b	406.00 ± 7.87 a
fat (%)	4.221 ± 0.14 b	4.836 ± 0.14 a	4.860 ± 0.14 a	5.101 ± 0.33 a
protein (%)	4.739 ± 0.23 b	4.870 ± 0.17 ab	4.764 ± 0.12 b	5.035 ± 0.13 a
lactose (%)	4.645 ± 0.24 ab	4.508 ± 0.10 b	4.675 ± 0.17 a	4.535 ± 0.16 b
S.N.F (%)	10.615 ± 0.36 a	10.050 ± 0.15 b	10.100 ± 0.46 b	10.331 ± 0.18 ab
Milk Total Product gm/ewe	741.00 ± 30.70 b	1181.50 ± 40.06 a	739.50 ± 20.93 b	1218.00 ± 23.63 a

Different letters horizontally indicate differences (P≤0.05)

Table 4. Effect of experimental diets on some blood measurements.

Parameters	SRU 0%	SRU 0.6%	SRU 1.2%	SRU 1.8%
Total protein gm/ dl	5.78 ± 0.09	5.86 ± 0.36	5.86 ± 0.16	5.68 ± 0.36
albumin gm/ dl	4.18 ± 0.40	4.41 ± 0.29	4.51 ± 0.39	4.35 ± 0.15
Globulin gm/ dl	1.60 ± 0.29	1.45± 0.14	1.35 ± 0.23	1.33 ± 0.22
Urea mg/ dl	32.66 ± 2.58 b	37.50 ± 1.04 a	35.00 ± 2.75 ab	38.50 ± 3.98 a
Cholesterol g/100ml	74.16 ± 3.48 c	78.83 ± 0.98 b	93.33 ± 4.63 a	79.16 ± 2.48 b
Triglyceride mg/ dl	86.16 ± 2.40 a	82.33 ± 3.20 ab	78.33 ± 6.56 bc	77.33 ± 1.86 c
ALT enzyme IU/L	102.33 ± 2.87 b	95.33 ± 5.88 c	110.66 ± 3.61 a	105.66 ± 3.55 b
AST enzyme IU/L	17.66 ± 1.86 a	17.50 ± 1.97 a	14.50 ± 1.37 b	16.16 ± 2.31 ab

Different letters horizontally indicate differences (P≤0.05)