

Effect of feeding frequency and nano-selenium concentration of mother ewes on lamb growth and some blood biochemical characteristics during lactation

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Abstract

This study was conducted at the Animal Production Department farm, College of Agriculture and Forestry, University of Mosul, from December 1, 2024 to February 22, 2025. Sixteen Awassi ewes and their litters (16 lambs) were used and randomly assigned to four treatments to study the effect of feeding frequency (twice and three times daily) and nano-selenium (2 and 4 mg daily) on lamb weight, weight gain, and some blood biochemical parameters. The average weight of the ewes was 50.93 ± 1.86 kg, and the average weight of the lambs was 4.64 ± 0.09 kg. The ewes and their litters were divided into four feeding groups, each consisting of four ewes and four lambs. They were fed a concentrated feed with a 6-hour grazing period per day. The results showed that the body weight of lambs in the two groups, whose mothers were fed three times daily in the fourth, sixth, eighth, tenth, and twelfth weeks of the treatment, increased by 12.86, 18.50, 22.75, 24.16, and 26.08 kg, respectively. Regarding the effect of Nano selenium levels on lamb body weight, it was observed that lambs whose mothers were fed 4 mg Ns in the sixth, eighth, tenth, and twelfth weeks were weightier than lambs whose mothers were fed 2 mg Ns. However. The three-times-daily feeding treatment achieved the highest weight gain of 21.42 kg and the highest average daily weight gain of 0.31 kg/day. The 4 mg/day nano-selenium treatment achieved the highest weight gain of 29.72 kg and the highest average daily weight gain of 0.30 kg/day. The fourth feeding group (three feedings and four with selenium) achieved the highest weight gain of 21.87 kg and the highest average daily weight gain of 0.31 kg/day. Both treatments (twice feeding with 2 mg/day selenium and three feedings with 2 mg/day) also outperformed in total protein (5.98 and 6.26 g/100 ml) and albumin (2.99 and 2.99 g/100 ml), while triglyceride values decreased to 23.57 and 23.92 mg/100 ml, respectively. The third treatment (three feedings with a 2 mg/day dose) also outperformed the third treatment (three feedings with a 2 mg/day dose) achieving 3.27 g/100 ml globulin. The treatment (two feedings with 4 mg/day) also outperformed the first treatment (two feedings with 2 mg/day) in terms of glucose, reaching 50.42 mg/100 ml. The first treatment (two feedings with 2 mg/day) outperformed the first treatment (two feedings with 2 mg/day) in terms of cholesterol, reaching 118.17 mg/100 ml .

Keywords: Feeding frequency, Nano selenium, lamb growth, weight gain, blood traits.

Introduction

Livestock represents is a fundamental component of the agricultural sector in Iraq playing a significant role in achieving food security and providing primary sources of animal protein such as meat and milk [1]. Awassi ewes are an important breed prevalent in Iraq and the Middle East, characterized by their high ability to adapt to hard environmental conditions and their high production efficiency in both milk and meat, making them a prime choice for breeders in the region [2]. The amount of milk produced per ewe is an important economic trait and directly affects the growth of lambs, especially in the early stages of their life [3]. Lamb production is the primary goal of sheep farming in Iraq, and the number of lambs born per ewe annually is one of the most important measures of sheep reproductive performance [4]. The Nutrition is key factor for dairy ruminants and even small changes in nutrition significantly impact physiological characteristics and milk production. Although feeding a single feed is common, it is the main factor contributing to decreased milk production. Feeding frequency also has a broad impact on ruminants, including feed intake and digestion [5]. Mohammad et al., [6] studied the effect of feeding frequencies of once daily (control group), twice, three times, and four times daily on 16 Karadi sheep with an average starting live weight of 27.00 ± 0.10 kg. The results showed that lambs fed four meals daily had significantly higher live weights (40.80 kg) compared to lambs fed once daily (37.75 kg), twice daily (37.95 kg), and three times daily (36.67 kg). Williams et al. [7] studied the effect of feeding frequencies on four mixed diets, each containing the same amount of alfalfa hay, pasture silage (basic forage), and grains at different ratios (barley, canola, wheat, and corn). Each diet was fed twice daily, morning and evening. Results for hematological parameters showed that haptoglobin concentration was higher in the serum of cows fed a barley diet, and sodium

was lower in the serum of cows fed a corn diet. Hamdon et al., [8] evaluated the effect of feeding concentrate feed to Abu Delik ewes (weighing 31.0 ± 4.86 kg) twice daily, once in the morning, and once in the evening, on hematological parameters, serum metabolites were within the normal range in all groups, and serum biochemical parameters were not statistically significant between feeding groups, protein was 6.75, 7.20, and 7.16 g/dL, albumin was 3.88, 4.28, and 4.42 g/dL, and globulin was 2.87, 2.92, and 2.74 g/dL in the twice-daily, morning, and evening feeding groups, respectively. Udum et al., [9] studied the effect of feeding frequency on blood glucose, insulin, and unsaturated fatty acids in dairy sheep of similar ages, averaging 26 kg, fed once or twice daily, plasma insulin levels varied significantly between the two feeding groups and sampling times, with the highest values being found in sheep fed twice daily and when the udder sample was drawn in the evening .

Selenium plays an important role in animal health and productivity. It is an essential trace element involved in many vital functions. It acts as a key component of the enzyme glutathione peroxidase, making it an important factor in reducing oxidative stress, enhancing immunity and improving animal reproductive performance [10]. Selenium deficiency has been found to lead to reproductive disorders, impaired immune function and reduced growth rates, making its inclusion in feed essential for improving the productivity of Awassi ewes [11]. In recent years, with advances in nanotechnology, nano-selenium has been developed as a more efficient nutritional supplement compared to conventional selenium. Nano selenium has unique properties, such as increased absorption rates and improved bioavailability which was making it a promising option for enhancing animal health and productivity [12].

Feeding dairy animals supplemental selenium (0.3-0.5 mg/kg dry matter) is important to ensure the animal receives the optimal amount of this micronutrient, especially during the prenatal period. Numerous scientific data have shown that selenium is an essential element in dairy cow nutrition improving animal health, including improving gut health, regulating the immune system [13]. In goats it was concluded that zinc oxide and selenium nanoparticles enhance milk production efficiency and upregulate key genes associated with milk production [14].

In a study of [15] which were effect of 10 ml/day nano-selenium of Holstein cows. The average of milk production was 24.63 kg/day while in the control group without selenium it was 23.02 kg/day. Meanwhile, the percentage of fat, protein, lactose, and ash were (3.73, 3.58, 5.26, and 0.78%), respectively. There were no significant differences with the control group, as these values were (3.84, 3.58, 5.27, and 0.78%), respectively .

The effect of selenium on Awassi lambs varies depending on whether the purpose of production is fattening lambs or milk. Previous studies have shown the importance of selenium in increasing milk production in Awassi ewes. However, [16] found no effect of selenium (Se) supplementation on the growth performance of Awassi lambs. Growth performance (final body weight, average daily weight gain, and feed conversion ratio) of lambs was similar across feeding groups. Selenium supplementation (dietary or parenteral) failed to improve the performance of growing Awassi lambs fed high-concentrate diets containing 0.13 mg selenium/kg dry matter. In their study kareem et al., [17] they showed that blood protein concentrations (total protein, albumin, and globulin) were similar between the feeding groups. Creatine levels were also similar, and blood glucose concentrations decreased significantly in the bran and nanoselenium-fed group compared to the control and bran-only groups. Selenium did not affect blood triglycerides, and no

differences were observed in cholesterol and urea concentrations between the three groups. [18] studied the effect of adding nanoselenium at a concentration of 3 mg/ewe per day compared to the control group without selenium, the results showed that adding selenium to the feed did not affect total serum protein or albumin levels. However, adding selenium resulted in a decrease in triglycerides, indicating an improvement in lipid metabolism. Total cholesterol levels also decreased, indicating a positive role of selenium in cholesterol levels. Al-Janabi et al., [19] studied the effect of selenium supplementation on some serum biochemical characteristics of Awassi lambs, they indicated a significant decrease in blood urea levels in the feeding groups supplemented with nano-selenium or vitamin D3 after 45 and 90 days, compared to the control group. There were no significant differences between the supplementation groups. Creatine levels also decreased in the blood. The results also indicated that after 45 days, there was a significant decrease in blood cholesterol levels in the nano-selenium and vitamin D3 groups. However, after 90 days, cholesterol levels increased in the selenium-vitamin D3 combination group. The results also indicated that using selenium alone or with vitamin D3 had a significant effect in reducing triglyceride levels after 45 and 90 days, compared to the control group and vitamin D3 alone .

The present study aimed to investigate the effect of feeding frequency and nano-selenium dosage to Awassi sheep and their interaction on some productive traits of lambs during the 12-week period after birth and some biochemical traits of blood serum.

Material and Methods

This study was conducted at the Animal Production Department farm, College of Agriculture and Forestry, University of Mosul, from 1 December 2024 to 22 February 2025. Sixteen Awassi ewes and their newborn lambs (16 lambs) were used and randomly assigned

to four treatments to study the effects of feeding frequency (twice and three times daily) and nano-selenium dosage (2 and 4 mg daily). A semi-open barn was used, divided internally into four pens, each containing fixed feeders and water troughs. The average weight of the ewes was 50.93 ± 1.86 kg, and the average weight of the lambs was 4.64 ± 0.09 kg. The ewes and their newborn lambs were divided into four feeding groups as follows:

1. The first treatment included four ewes and their four lambs (average weight 4.56 ± 0.21 kg). The ewes were fed twice a day, morning and evening (8 a.m. and 16 p.m.), supplemented with 2 mg of nano-selenium per day. 2. The second treatment included four ewes and their four lambs (average weight 4.67 ± 0.22 kg). The ewes were fed twice a day, morning and evening (8 a.m. and 16 p.m.), supplemented with 4 mg of nano-selenium per day. 3. The third treatment included four ewes and their four lambs (average weight 4.70 ± 0.11 kg). The ewes were fed three times (8 a.m., 12 p.m., and 16 p.m.) with a 2 mg/day dose of nano-selenium. 4. The fourth treatment included four ewes and their four lambs (average weight 4.62 ± 0.23 kg). The ewes were fed three times (8 a.m., 12 p.m., and 4 p.m.) with a 4 mg/day dose of nano-selenium. Ewes were fed a concentrate diet containing 17% soybean meal, 4% soybean hulls, 5% sunflower, 7% ground chickpeas, 20% yellow corn, 23% black barley, 10.475% wheat bran, 6.5% wheat flour, 0.5% Rumix-1, 1% animal feed suspension, 1% lime, 0.5% sodium bicarbonate, 0.025% appetite suppressant, and 4% molasses.

Throughout the experimental period, the animals were under the supervision of a veterinarian, and the established scientific preventive program was followed. The weight of the lambs was measured immediately at birth and every two weeks until the twelfth week of weaning using a sensitive balance. Daily and total weight gain were also calculated. Blood samples were obtained from the animals under study. Blood was drawn

from the jugular vein monthly. 10 ml of blood was placed in glass tubes containing an anticoagulant. The serum was separated by centrifugation (3,000 rpm for 15 minutes). The serum samples were stored in a freezer (-20°C) until biochemical tests were performed. The concentrations of total proteins, albumin, globulin, the globulin/albumin ratio, glucose, cholesterol, and triglyceride concentrations in the serum were determined according to the methods described in [20].

Statistical Analysis: The experiment was designed according to a completely randomized design (CRD), and the data were analyzed using the SAS [21]. statistical program. To test the significance of the differences between the means, Duncan's multiple range test was used at a significance level of ($P \leq 0.05$).

Results and Discussion:

1. Effect of feeding frequency, nano-selenium concentration and their interaction on body weight (kg) during different weeks of growth of Awassi lambs during the lactation period:

Table (1) shows the effect of feeding frequency for Awassi ewes on the body weight of lambs for the different weeks of the lactation period. It was shown that there was a significant superiority at the probability level ($p \leq 0.05$) in the body weight of the lambs of the two groups whose ewes were fed three times a day in the fourth, sixth, eighth, tenth and twelfth weeks of the treatments (12.86, 18.50, 22.75, 24.16 and 26.08 kg) respectively over the group of lambs whose mothers were fed twice (11.93, 16.40, 20.31, 21.68 and 23.12 kg) respectively. In the second week, the group of lambs whose mothers were fed twice outperformed the group of lambs whose mothers were fed three times (7.25 and 6.37 kg) respectively. As for the effect of the level of nano-selenium on the body weight of the lambs, we note a significant difference in the sixth week. The eighth, tenth, and twelfth

weeks saw a significant increase in body weight for lambs whose mothers were fed 4 mg nano-selenium (17.90, 22.18, 24.00, and 25.37 kg), respectively, compared to the lambs whose mothers were fed 2 mg nano-selenium (17.00, 20.87, 21.85, and 23.83 kg), respectively. However, in the second and fourth weeks, there was no significant difference. The interaction effect between feeding frequency and nano-selenium concentration in the second week showed that the first and second treatments (7.37 and 7.12 kg) outperformed the third (6.12 kg). In the sixth, eighth, and tenth weeks, the fourth treatment (19.12, 23.50, and 25.00 kg) outperformed the remaining treatments. In the twelfth week, the third and fourth treatments, which reached values of 25.00 and 26.50 kg, respectively, recorded a significant superiority over the first and second treatments, which reached values of 22.00 and 24.25 kg, respectively.

.2Effect of feeding frequency, nano-selenium concentration, and their interaction on weight gain in lambs .

It concluded from table (2) the effect of feeding frequency on the weight gain of lambs for different weeks of Awassi ewes. We note the presence of a significant difference at the probability level ($p \leq 0.05$), as the treatment whose mothers were fed twice in the second week and the daily weight gain reached 2.63 and 0.27 kg respectively, outperformed the treatment whose mothers were fed three times daily, as their values reached 1.71 and 0.31 kg respectively, while there was superiority in the fourth and sixth weeks for the treatments whose mothers were fed three times, which reached 6.49 and 5.63 kg respectively, over those who were fed twice, which reached 4.68 and 4.46 kg respectively, and there was no significant difference for the eighth, tenth and twelfth weeks. The effect of the concentration of nano-selenium on the weight gain of lambs for different weeks of Awassi ewes was 2 mg/day and 4mg/day. There was significant difference in the sixth week between the

treatment whose mothers were given 4 mg of nano-selenium, reaching 5.60 kg, and the treatment given 2 mg of nano-selenium reaching 4.50 kg. There was no significant difference between the treatments in the remaining weeks. The interaction between the effect of feeding frequency and nano-selenium showed a significant increase in weight gain in the fourth week for the third and fourth treatments, 6.87 and 6.11 kg, respectively, compared to the first and second treatments, 4.62 and 4.75 kg, respectively. In the sixth week, we note that the fourth treatment, which reached a value of 6.38 kg, outperformed the first, second and third treatments, which reached values of 4.12, 4.18 and 4.86 kg, respectively. There was no significant difference in the second, eighth and twelfth weeks. However, in the tenth week we note a decrease in the first treatment which reached a value of 0.62 kg compared to the second and fourth treatments, which reached 2.12 kg for both treatments. The significant improvement in the lamb group born to mothers treated with nano-selenium may be due to the fact that nano selenium improves the animal's immunity and utilization of food, which is reflected in the weight gain of newborns through increased milk production. Nano-selenium also helps in resisting diseases and increases immunity, thus improving the activity of the mammary gland and the quality of the milk produced. This is reflected in the newborns during the lactation period, which positively affects the health of the newborns and improves their weight [22]. Since increasing the number of feedings increases milk production [23,24,25]. This may be reflected in an improvement in the weight of the lambs born for their ewes.

.3Effect of feeding frequency, nano-selenium concentration, and their interaction on blood biochemical characteristics of Awassi lambs at the end of the lactation stage:

Table (3) shows that feeding frequency has significant effect on the biochemical blood characteristics of Awassi lambs at the end of

the lactation stage as significant increase was recorded at the level ($p \leq 0.05$) in the concentration of total protein and globulin for lambs whose mothers were fed three times a day, reaching values of 5.79 and 3.06 g/100 ml, respectively compared to the concentration of protein and globulin for lambs whose mothers were fed twice, reaching values of 5.42 and 2.77 g/100 ml, respectively. Likewise, the concentration of glucose and cholesterol for lambs whose mothers were fed twice was superior, reaching values of 47.94 and 103.46 mg/100 ml, respectively, over those whose mothers were fed three times, reaching values of 44.48 and 87.78 mg/100 ml, respectively. Regarding the effect of treatment with nano selenium, the treatments whose animals were dosed with 2 mg nano selenium were superior in the concentration of total protein, albumin, globulin and cholesterol, as their values reached 6.12, 2.99, 3.13 g/100 ml and 104.81 mg/100 ml, respectively, compared to the lambs whose mothers were dosed with 4 mg nano selenium, as they reached 5.10, 2.39, 2.71 g/100 ml and 86.44 mg/100 ml. The treatment whose ewes were dosed with 4 mg nano selenium was also superior in the values of glucose and triglycerides of the lambs' blood, as they reached 48.37 and 26.22 mg/100 ml, respectively, over the treatments whose animals were dosed with 2 mg nano selenium, 44.05, 23.74, respectively, and in the percentage Globulin to albumin ratio was 1.13 compared to 1.05 for lambs whose mothers were dosed twice daily at ($p \leq 0.05$). The first and third treatments also outperformed in the effect of the interaction between feeding

frequency and nano-selenium concentration on total protein concentration, as their values reached 5.98 and 6.26 g/100 ml, respectively, over the second and fourth treatments, as their values reached 4.87 and 5.32 g/100 ml, respectively, and in albumin concentration 2.99 and 2.99 g/100 ml for the first and third treatments compared to the second and fourth treatments 2.31 and 2.47 g/100 ml. The globulin concentration of the third treatment also outperformed, as it reached 3.27 g/100 ml compared to the first, second and fourth treatments, as their values reached 2.99, 2.56, 2.85 g/100 ml, respectively. As for the ratio of globulin to albumin the fourth treatment outperformed, as it reached 1.16, over the first treatment, whose value reached 1.00. In terms of glucose, the second treatment outperformed the first, third, and fourth treatments, which reached 50.42, compared to 45.46, 42.64, and 46.32 mg/100 ml. In terms of cholesterol, the first treatment outperformed the second, third, and fourth treatments, which reached 88.76, 91.45 and 84.12 mg/100 ml. In terms of triglycerides. The first and third treatments decreased, reaching 23.57 and 23.92 respectively compared to the second and fourth treatments, which reached 26.26 and 26.18 respectively.

Since selenium is transferred from mothers to offspring through milk during lactation [26]. This leads to an improvement in some biochemical characteristics of the blood serum of lambs born to mothers treated with selenium. This improvement is due to the role of selenium in improving immune function due to its important role in antioxidant activity.

Table 1. Mean $\pm$ standard error of the effect of feeding frequency, nano-selenium concentration and their interaction on body weight (kg) during the different weeks of growth of Awassi lambs

treatment s	birth weight	2 nd week	4 th week	6 th week	8 th week	10 th week	12 th week
Effect of feeding frequency							
twice	4.61 $\pm$	7.25 $\pm$	11.93 $\pm$	16.40 $\pm$	20.31 $\pm$	21.68 $\pm$	23.12 $\pm$
	0.14 a	0.23 a	0.24 b	0.30 b	0.36 b	0.51 b	0.51 b
three times	4.66 $\pm$	6.37 $\pm$	12.86 $\pm$	18.50 $\pm$	22.75 $\pm$	24.16 $\pm$	26.08 $\pm$
	0.12 a	0.16 b	0.23 a	0.29 a	0.36 a	0.37 a	0.19 a
Effect of nano-selenium concentration							
2mg/day	4.63 $\pm$	6.75 $\pm$	12.50 $\pm$	17.00 $\pm$	20.87 $\pm$	21.85 $\pm$	23.83 $\pm$
	0.11 a	0.30a	0.32 a	0.37 b	0.48 b	0.58 b	0.73 b
4 mg/day	4.65 $\pm$	6.87 $\pm$	12.30 $\pm$	17.90 $\pm$	22.18 $\pm$	24.00 $\pm$	25.37 $\pm$
	0.15 a	0.20 a	0.25 a	0.54 a	0.53 a	0.42 a	0.46 a
Feeding frequency and nano-selenium concentration interaction							
T1	4.56 $\pm$	7.37 $\pm$	12.00 $\pm$	16.12 $\pm$	19.75 $\pm$	20.37 $\pm$	22.00 $\pm$
	0.21 a	0.37 a	0.40 a	0.16 c	0.23 d	0.26 c	0.54 c
T2	4.67 $\pm$	7.12 $\pm$	11.87 $\pm$	16.68 $\pm$	20.87 $\pm$	23.00 $\pm$	24.25 $\pm$
	0.22 a	0.31 a	0.33 a	0.60 c	0.35 c	0.20 b	0.32 b
T3	4.70 $\pm$	6.12 $\pm$	13.00 $\pm$	17.87 $\pm$	22.00 $\pm$	23.33 $\pm$	25.00 $\pm$
	0.11 a	0.16 b	0.40 a	0.33 b	0.45 b	0.25 b	0.35 a
T4	4.62 $\pm$	6.62 $\pm$	12.73 $\pm$	19.12 $\pm$	23.50 $\pm$	25.00 $\pm$	26.50 $\pm$
	0.23 a	0.23 ab	0.27 a	0.17 a	0.22 a	0.35 a	0.20 a

Different letters vertically indicate significant differences at the probability level ($P \leq 0.05$).
Treatments: T1: Feeding frequency twice daily + 2 mg nano-selenium. T2: Feeding frequency twice daily + 4 mg nano-selenium. T3: Feeding frequency three times daily + 2 mg nano-selenium. T4: Feeding frequency three times daily + 4 mg nano-selenium. (Treatments for Awassi ewes during the lactation period.)

Table 2. Mean $\pm$ standard error of the effect of feeding frequency, nano-selenium concentration, and their interaction on the weight gain of Awassi lambs (kg) in different weeks of growth.

treatment s	2 nd week	4 th week	6 th week	8 th week	10 th week	12 th week	Total weight gain	Daily weight gain
Effect of feeding frequency								
twice	2.63 $\pm$	4.68 $\pm$	4.46 $\pm$	3.90 $\pm$	1.37 $\pm$	1.43 $\pm$	18.50 $\pm$	0.27 $\pm$
	0.17 a	0.18 b	0.30 b	0.37 a	0.33 a	0.24 a	0.50 b	0.006 b
three times	1.71 $\pm$	6.49 $\pm$	5.63 $\pm$	4.25 $\pm$	1.41 $\pm$	1.91 $\pm$	21.42 $\pm$	0.31 $\pm$
	0.21 b	0.20 a	0.36 a	0.19 a	0.18 a	0.31 a	0.19 a	0.002 a
Effect of nano-selenium concentration								
2mg/day	2.11 $\pm$	5.75 $\pm$	4.50 $\pm$	4.28 $\pm$	0.97 $\pm$	1.98 $\pm$	19.20 $\pm$	0.28 $\pm$
	0.30 a	0.45 a	0.29 b	0.14 a	0.22 b	0.29 a	0.73 b	0.009 b
4 mg/day	2.22 $\pm$	5.43 $\pm$	5.60 $\pm$	3.87 $\pm$	1.81 $\pm$	1.37 $\pm$	29.72 $\pm$	0.30 $\pm$
	0.20 a	0.30 a	0.38 a	0.38 a	0.20 a	0.24 a	0.44 a	0.005 a
Feeding frequency and nano-selenium concentration interaction								
T1	2.81 $\pm$	4.62 $\pm$	4.12 $\pm$	3.62 $\pm$	0.62 $\pm$	1.62 $\pm$	17.43 $\pm$	0.26 $\pm$
	0.27 a	0.23 b	0.38 b	0.09 a	0.31 b	0.43 a	0.63 c	0.007 c
T2	2.45 $\pm$	4.75 $\pm$	4.81 $\pm$	4.18 $\pm$	2.12 $\pm$	1.25 $\pm$	19.57 $\pm$	0.29 $\pm$
	0.19 a	0.30 b	0.44 b	0.76 a	0.20 a	0.25 a	0.10 b	0.004 b
T3	1.42 $\pm$	6.87 $\pm$	4.87 $\pm$	4.12 $\pm$	1.33 $\pm$	2.33 $\pm$	20.96 $\pm$	0.30 $\pm$
	0.19 b	0.26 a	0.38 b	0.38 a	0.24 ab	0.35 a	0.44 a	0.005 a
T4	2.00 $\pm$	6.11 $\pm$	6.38 $\pm$	4.37 $\pm$	2.12 $\pm$	1.50 $\pm$	21.87 $\pm$	0.31 $\pm$
	0.35 ab	0.17 a	0.30 a	0.33 a	0.25 a	0.30 a	0.19 a	0.005 a

Different letters vertically indicate significant differences at the probability level ($P \leq 0.05$). Treatments: T1: Feeding frequency twice daily + 2 mg nano-selenium. T2: Feeding frequency twice daily + 4 mg nano-selenium. T3: Feeding frequency three times daily + 2 mg nano-selenium. T4: Feeding frequency three times daily + 4 mg nano-selenium. (Treatments for Awassi ewes during the lactation period.)

Table 3. Mean $\pm$ standard error of the effect of feeding frequency, nano selenium concentration and their interaction on the blood biochemical characteristics of Awassi lambs at the end of the lactation stage.

treatments	Total protein gm/100ml	Albumin g/100ml	Globulin g/100 ml	Globulin/ Albumin	Glucose mg/100ml	Cholesterol mg/100ml	Triglycerides mg/100ml
Effect of feeding frequency							
twice	5.42 $\pm$ 0.22 b	2.65 $\pm$ 0.13 a	2.77 $\pm$ 0.10 b	1.05 $\pm$ 0.02 a	47.94 $\pm$ 0.98 a	103.46 $\pm$ 5.64 a	24.91 $\pm$ 0.57 a
three times	5.79 $\pm$ 0.18 a	2.73 $\pm$ 0.10 a	3.06 $\pm$ 0.09 a	1.13 $\pm$ 0.03 a	44.48 $\pm$ 0.09 b	87.78 $\pm$ 1.99 b	25.05 $\pm$ 0.44 a
Effect of nano-selenium concentration							
2mg/day	6.12 $\pm$ 0.09 a	2.99 $\pm$ 0.04 a	3.13 $\pm$ 0.07 a	1.05 $\pm$ 0.02 b	44.05 $\pm$ 0.83 b	104.81 $\pm$ 5.22 a	23.74 $\pm$ 0.50 b
4 mg/day	5.10 $\pm$ 0.16 b	2.39 $\pm$ 0.04 b	2.71 $\pm$ 0.08 b	1.13 $\pm$ 0.03 a	48.37 $\pm$ 0.89 a	86.44 $\pm$ 1.38 b	26.22 $\pm$ 0.21 a
Feeding frequency and nano-selenium concentration interaction							
T1	5.98 $\pm$ 0.16 a	2.99 $\pm$ 0.05 a	2.99 $\pm$ 0.10 b	1.00 $\pm$ 0.02 b	45.46 $\pm$ 0.65 b	118.17 $\pm$ 1.55 a	23.57 $\pm$ 0.31 b
T2	4.87 $\pm$ 0.12 c	2.31 $\pm$ 0.04 b	2.56 $\pm$ 0.07 c	1.11 $\pm$ 0.01 ab	50.42 $\pm$ 0.12 a	88.76 $\pm$ 1.45 bc	26.26 $\pm$ 0.45 a
T3	6.26 $\pm$ 0.07 a	2.99 $\pm$ 0.10 a	3.27 $\pm$ 0.02 a	1.10 $\pm$ 0.02 ab	42.64 $\pm$ 1.21 c	91.45 $\pm$ 2.49 b	23.92 $\pm$ 0.26 b
T4	5.32 $\pm$ 0.09 b	2.47 $\pm$ 0.04 b	2.85 $\pm$ 0.10 b	1.16 $\pm$ 0.06 a	46.32 $\pm$ 0.96 b	84.12 $\pm$ 0.96 c	26.18 $\pm$ 0.11 a

Different letters vertically indicate significant differences at the probability level ($P \leq 0.05$). Treatments: T1: Feeding frequency twice daily + 2 mg nano-selenium. T2: Feeding frequency twice daily + 4 mg nano-selenium. T3: Feeding frequency three times daily + 2 mg nano-selenium. T4: Feeding frequency three times daily + 4 mg nano-selenium. (Treatments for Awassi ewes during the lactation period.)

Conclusion

The results of the current study showed that the body weight of lambs in the two groups whose mothers were fed three times daily during the fourth, sixth, eighth, tenth, and twelfth weeks of the treatment (12.86, 18.50, 22.75, 24.16, and 26.08 kg) respectively, was higher than that of lambs whose mothers were fed twice daily (11.93, 16.40, 20.31, 21.68 and 23.12 kg) respectively. Furthermore, the treatment whose mothers were fed twice daily during the second week outperformed in terms of daily weight gain, which amounted to 2.63

kg. Regarding the effect of Nano selenium levels on lamb body weight, it was observed that lambs whose mothers were fed 4 mg of Nano selenium during the sixth, eighth, tenth, and twelfth weeks outweighed those whose mothers were fed 2 mg of Nano selenium. However, there was no significant difference during the second and fourth weeks. Lambs whose mothers were fed 4 mg/day significantly outperformed their mothers in the sixth week of treatment, achieving the highest weight gain of 5.60 kg compared to the treatment that was fed 2 mg nano-selenium, which reached 4.50 kg. The results also

showed that both treatments (two feedings with 2 mg/day selenium and three feedings with 2mg/day) were superior in total protein concentration (5.98 and 6.26 g/100 ml) and albumin (2.99 and 2.99 gm/100 ml). Triglyceride values decreased in both treatments, reaching 23.57 and 23.92 mg/100 ml, respectively. The third treatment (three feedings with a 2 mg/day dose) also outperformed the globulin concentration,

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reaching 3.27 g/100 ml. The treatment (two feedings with 4 mg/day) also outperformed the glucose level, reaching 50.42 mg/100 ml. The first treatment (two feedings with 2 mg/day) outperformed the cholesterol level, reaching 118.17 mg/100 ml. As a result, the study concluded that it is preferable to feed three times daily and add 2 mg of Nano selenium daily.

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