Egyptian Journal of Veterinary Sciences

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Physiological Impact of an Aqueous Solution of Spirulina Algae with or without Folic Acid on Local Awassi Ewes Within Medium and Late Pregnancy Stages and Indicators of Growth in Newborn Lambs

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Abstract

THIS STUDY was carried out from September 1, 2023, to December 25, 2023, at the University of Kirkuk, Faculty of Agriculture, Department of Animal Production. The purpose of the study was to determine how folic acid and spirulina algae affected the physiological characteristics of Awassi ewes in the middle and late stages of pregnancy. A total of sixteen pregnant ewes weighing an average of 56.6 kg were selected. The animals were split up into four groups randomly, with four pregnant ewes in each group. The first treatment group was the control group, the second group received an oral dose of 0.625 mg of spirulina solution per ewe; the third group received an oral dose of 65 mg of folic acid solution per ewe; and the fourth group received an oral dose of both 0.625 mg of spirulina and 65 mg of folic acid solution per ewe. Spirulina algae and folic acid showed a significant enhancement in glucose and total protein in Awassi ewes blood serum during the medium and late pregnancy stages, with no significant impact on other physiological traits.

Keywords: Spirulina, Folic acid, Awassi, Physiological, Lambs.

Introduction

As people's awareness of nutrition grows, sheep are becoming one of the most significant agricultural animals in Iraq and a major source of meat production, which is in high demand,[1]. The expansion of this industry must therefore be the primary focus,[2]. and because consumers are becoming more aware of nutrition, there is a growing demand for sheep meat [3]. Additionally, ensuring the effective integration of natural sources into animal feeds is one of the challenges that farmers face [4]. As opposed to protein derived from high-protein crops, the amount of protein found in spirulina algae has been shown to be more valuable in terms of nutrition and productivity [5]. Fatty acids, amino acids, antioxidants, and carotenoids are all present in high concentrations in spirulina,[6]. Spirulina possesses antimicrobial, antiviral, and anti-inflammatory qualities [7]. Furthermore, it does not harm the liver, kidneys, or reproductive system, [8]. In modern livestock systems, spirulina serves a variety of functions [9]. According to certain reports, sheep productivity is increased by Spirulina,[10]. In the diets of fattening lambs, spirulina algae may also function as an immune booster, antioxidant, and growth promoter, [11]. Due to the oxidation of fat by free radicals, these oxidative factors upset the delicate balance between the body's capacity to eliminate or repair the damaging effects of free radical production, which leads to harmful damage to various body tissues [12]. Aetiology of neurodegenerative illnesses has been found to be significantly influenced by oxidative stress [13]. As a necessary nutrient for numerous vital processes in the sheep body, folic acid is also critical for the health and productivity of ewes. It can also enhance the quality and density of wool, promote fertility, improve gestational health, and increase milk production. Studies have indicated that ewes always need a sufficient amount of folic acid in their diet to maintain their productivity and health, it can reduce the abortion rate and increase the fertilization rate as well, Folic acid helps to improve milk quality and production, over and above its importance in the formation of RBC in the bone marrow and the transportation of

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(Received 23/04/2024, accepted 22/06/2024)
DOI: 10.21608/EJVS.2024.284770.2029

oxygen throughout the body, [14]. Apart from its potential to aid in the prevention of neural tube defects (NTDs) birth defects affect the fetus's brain and spinal cord, [15]. Folic acid supplementation in ruminants has been observed to play a role in increasing the speed of cell division and growth, [16]. The purpose of this research was to identify the physiological impact of spirulina algae and folic acid separately or combined on pregnant ewes and growth indicators of newborns.

Materials and methods

This study was carried out from 1 September 1,2023, to December 25,2023, at the university of Kirkuk Faculty of Agriculture, Department of Animal Production 16-week (116-day) experiment had 16 pregnant ewes who were 22 months old on average and weighed an average of 56.6 kg. Throughout the research period, the animals were divided into four groups and given access to mineral salt molds, twice daily (in the morning and evening), as well as green feed from animal production field. All of the groups received the same type of concentrated feed. First treatment (T1) was the control group; second treatment (T2) was an oral dose of 0.625 mg spirulina solution per ewe; third treatment (T3) was an oral dose of 65 mg folic acid solution per ewe; and fourth treatment (T4) was an oral dose of both 0.625 mg spirulina and 65 mg folic acid solution per ewe. Contrarily, the folic acid solution was prepared by combining 80 mg of folic acid with 400 ml of deionized water and injecting the resulting mixture orally into each ewe using a 50 ml syringe. The spirulina solution was prepared by combining 20 mg of spirulina powder with 400 ml of deionized water. There were three phases to the experiment: the middle phase, which was the second trimester of pregnancy; the late pregnancy stage, which was the third trimester; and the first three weeks after the delivery, which was the newborn's productivity. Complete randomization design (CRD) was used for statistical analysis and Duncans polynomial test, [17] to determine the significance of variations.

Results and Discussion

There was no particular influence of spirulina and folic acid on the traits of number of embryos and number of twins, according to the Table (1) data, which shows that there were no significant differences ($P \leq 0.05$) between the distinct treatments. The results of Table (2) demonstrate that there were no significant contrasts ($P \leq 0.05$) between the distinctive treatments for pulse rate and respiratory rate, the reason for this can be that there was no impact of spirulina or folic acid on pulse rate or respiratory rate in pregnant ewes and These results are consistent with [18] and [19]. The results of Table (3) indicate that there were significant differences ($P \leq 0.05$) between the distinct treatments in blood glucose in the mid-pregnancy period, where the control treatment showed the lowest glucose percentage out of all treatments, while there were no significant differences between the second and third treatments, and in the end-pregnancy period the results showed significant differences between all treatments with the superiority of the control treatment. The results of the mid-pregnancy period showed a decrease in blood glucose in the second, third and fourth treatments respectively, while the end-pregnancy period showed a decrease in the third, second and fourth treatments respectively, This can be attributed to the role of spirulina algae where Spirulina algae can lower glucose concentration due to its role as a stimulating factor in the secretion of insulin from pancreatic β-cells as well as its potential to act as an insulin-like protein In addition, the phycocyanin protein found in spirulina has a role in inhibiting the carbohydrate-degrading enzymes alpha-amylase and alpha-glucosidase, which leads to a decrease in the absorption of glucose in the intestine. [20]. Spirulina may also reduce glucose by raising the level of hemoglobin in the blood and thus lowering the concentration of glucose in the blood [21]. As for Folic acid has been observed to have a positive effect on blood glucose and insulin resistance and The results of several studies have shown an inverse relationship between serum folic acid and insulin resistance in mammals in general, which indicates that increasing the level of folic acid is associated with improved insulin sensitivity and folic acid has been shown to have a positive effect on the rate of glucose metabolism in sheep, in addition to the positive effect of folic acid as a dietary supplement in the ewes diet on the growth performance and immunity of lambs, as well as muscle development [22] [23] [24]. The results of Table (4) indicate that there were significant differences ($P \leq 0.05$) between all treatments in blood total protein concentration at mid- and end-pregnancy periods, with the fourth treatment being superior to the other treatments and no significant difference between the second and third treatments in the two periods, This superiority can be attributed to the content of spirulina algae, which is rich in crude protein, iron and vitamin B12, in addition to several minerals and essential amino acids that are essential in the formation of blood proteins [25], the role of folic acid in increasing the activity of the liver, which is a source of body protein synthesis, as well as the role of folic acid in the synthesis of methionine, which increases the level of total blood protein [26].

Conclusions

We can conclude that adding the mentioned proportions of Spirulina algae and folic acid have no special effect on embryonic number, twins' number, pulse or respiratory rate, but dose affected the glucose and total protein of blood serum significantly.

Acknowledgment

This experimental study took a place in Iraq at Kirkuk University - College of Agriculture. Appreciation to the employees in these disciplines and the directing staff of Animal Production Department for the provided equipment, requirements, and facilities.

Conflicts of interest

There is no conflict of interest disclosed by the authors the original sponsors had no input into the study design.

Funding statement

This study was not funded.

TABLE 1. **The effect of spirulina and folic acid supplementation on Single and twin lambs**

Treatment	Single lambs	twin lambs
T1 (Control)	1.00±0.00*a**	0.00±0.00 a
T2 (Spirulina)	1.00±0.00 a	0.00±0.00a
T3 (Folic Acid)	1.25±0.00a	0.25±0.25a
T4 (Spirulina + Folic Acid)	1.00±0.00a	0.00±0.00a

*Values were Mean ± standard error
** Different letters within the same column refer to significant differences between the treatments at significance level (P≤ 0.05).

TABLE 2. The effect of spirulina and folic acid supplementation on pulse and respiratory rate in middle and late pregnancy

Treatment	Pulse rate	Respiratory rate
T1 (Control)	85.00±2.48*a**	14.50±0.65a
T2 (Spirulina)	88.00±2.48a	14.75±1.11a
T3 (Folic Acid)	90.25±1.65a	15.50±0.65a
T4 (Spirulina + Folic Acid)	87.75±2.39a	14.75±1.38a

*Values were Mean ± standard error
** Different letters within the same column refer to significant differences between the treatments at significance level (P≤ 0.05).

TABLE 3. The effect of spirulina and folic acid supplementation on blood serum glucose concentration in middle and late pregnancy (mg /100 ml)

Treatment	Medium pregnancy stage	Late pregnancy stage
T1 (Control)	7.41±0.27*a**	8.77±0.12a
T2 (Spirulina)	5.79±0.11b	6.10±0.36b
T3 (Folic Acid)	6.11±0.12b	6.97±0.35b
T4 (Spirulina + Folic Acid)	5.04±0.10c	4.78±0.29c

*Values were Mean ± standard error
** Different letters within the same column refer to significant differences between the treatments at significance level (P≤ 0.05).

TABLE 4. **The effect of spirulina and folic acid supplementation on blood serum total protein concentration in middle and late pregnancy (g/100 ml)**

Treatment	Medium pregnancy stage	Late pregnancy stage
T1 (Control)	54.84±1.66*c**	47.74±1.81d
T2 (Spirulina)	63.01±0.83b	55.24±1.44c
T3 (Folic Acid)	64.81±1.58b	69.69±1.45b
T4 (Spirulina + Folic Acid)	76.01±1.90a	83.39±0.92a

*Values were Mean ± standard error
** Different letters within the same column refer to significant differences between the treatments at significance level (P≤ 0.05).

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التأثير الفسيولوجي للمحلول المائي لطحالب السبيرولينا مع أو بدون حمض الفوليك على نعاج العواسي المحلية في مراحل الحمل المتوسطة والمتأخرة ومؤشرات النمو عند الحملان حديثي الولادة

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الملخص

جريت هذه الدراسة في الفترة من 1 سبتمبر 2023 إلى 25 ديسمبر 2023، في جامعة كركوك، كلية الزراعة، قسم الإنتاج الحيواني. كان الغرض من الدراسة هو تحديد كيفية تأثير حمض الفوليك وطحالب السبيرولينا على الخصائص الفسيولوجية لنعاج العواسي في المراحل الوسطى والمتأخرة من الحمل. تم اختيار ستة عشر نعجة حامل تزن في المتوسط 56.6 كجم. تم تقسيم الحيوانات إلى أربع مجموعات بشكل عشوائي، بواقع أربع نعاج حامل في كل مجموعة. تمثلت المجموعة الأولى بمجموعة السيطرة، وتلقت المجموعة الثانية جرعة فموية قدرها 0.625 مجم من محلول سبيرولينا لكل نعجة ؛ بينما تلقت المجموعة الثالثة جرعة فموية قدرها 65 مجم من محلول حمض الفوليك لكل نعجة؛ وتلقت المجموعة الرابعة جرعة فموية قدرها 0.625 مجم من سبيرولينا و 65 مجم من محلول حمض الفوليك لكل نعجة. أظهرت المجموعة المعاملة بطحالب السبيرولينا وحمض الفوليك زيادة معنوية في تراكيز الجلوكوز والبروتين الكلي في مصل دم النعاج العواسية خلال مراحل الحمل المتوسطة والمتأخرة، مع عدم وجود تأثير معنوي على الصفات الفسيولوجية الأخرى.

الكلمات الدالة: العواسي، السبيرولينا، حمض الفوليك، الفسلجية، الحملان.