



Reproductive efficiency of local ewes treated with Spirulina algae powder with or without Folic acid to the early pregnancy stage in the summer months.

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ABSTRACT

This experiment was conducted in the sheep field of the Department of Animal Production - College of Agriculture -University of Kirkuk, from 15/6/2023 until 6/9/2023, for 83 days. The study targeted the role of dosing pregnant ewes with an aqueous solution of spirulina algae powder and folic acid combined and alone on reproductive efficiency during the first pregnancy phase (early pregnancy). The experiment used 16 local ewes, one and a half years old and an average weight of 40.67 \pm 0.470 kg. It was randomly distributed among four treatments, with four ewes for each treatment. The ewes of the first treatment (T1) were dosed with deionized water free of additives and considered the control treatment. The second treatment (T2) was dosed with an aqueous solution of spirulina algae powder at a concentration of (2.5 grams dissolved in 50 ml of deionized water/ewe/day). The third treatment (T3) was dosed with folic acid at a dose of (20 mg/ewe) at two doses per week. The fourth treatment (T4) was dosed with a mixture of the second and third treatments with an aqueous solution of spirulina algae powder at a concentration of (2.5 grams dissolved in 50 ml of deionized water/ewe/day) + Folic acid at a dose of (20 mg/ewe) at two doses per week. The results of the study showed that there was a significant difference (P \leq 0.05) in the Total weight gain, reproductive performance, Progesterone levels and Cortisone levels in the groups dosed with an aqueous solution of spirulina algae powder with and without folic acid compared to the control group. Spirulina algae achieved the study objectives and obtained good results compared to the control treatment.

Keywords: Awassi ewe, Spirulina, Folic acid, Early pregnancy.

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INTRODUCTION

One of the assets of the Iraqi national economy is the raising of sheep. As a result, focusing on its expansion was crucial for the agricultural sector to develop. The sheep is one of the most significant farm animals in Iraq; it is a major meat producer, and as more people become aware of nutrition concerns, the population's need for meat is rising [1]. Summer heat stress interferes with a number of reproductive processes, which leads to a marked decline in the rate of conception. Summertime body temperature increases affect the reproductive system both directly and indirectly, especially the hypothalamus-pituitaryovarian axis. The primary changes that cause ruminant fertility to decline in the summer are outlined in this section [Figure 1]. One of the most significant challenges facing sheep farmers and breeders today is rising temperatures, which will have a detrimental effect on the production of milk and meat and Reproductive [2]. Breeders may face financial difficulties as a result of oxidative stress and metabolic disruptions during pregnancy and lactation, which are common issues that endanger the health and productivity of these animals [3]. As a result, there is increasing interest in antioxidants derived from plants to prevent oxidative stress [4]. Hence, attempts are being made to discover new natural antioxidants that have a higher natural bioavailability in the environment than synthetic counterparts, both at the research and field application levels [5]. Scientists and researchers have focused on finding novel and affordable ways to improve the physiological system, particularly during the stages of pregnancy, when a female's needs for nutrition and vital parameters surpass those of other reproductive stages. They are also investigating the possibility of using functional nutritional supplements to treat diseases that compromise physical health [6]. Research and investigations conducted recently have demonstrated that every medicinal plant has chemicals that are useful in treating certain conditions [7]. Algae, which are defined as a diverse group of creatures ranging from small cells to enormous seaweeds, have so received attention [8]. The high nutritional value of spirulina, edible bluegreen microalgae, is attributed to its abundance of proteins, vital amino acids, unsaturated fatty acids, vitamins, minerals, and significant colors [9] Spirulina algae has healing qualities and is easily digested it has antiviral, detoxifying, antiinflammatory, and intestinal vitality-regulating properties [10]. Vitamin B₉, or folic acid, is a water-soluble vitamin that is necessary for many physiological processes. The production of red blood cells, DNA synthesis, and cell division depend on

folic acid, which is particularly crucial during rapid growth and development like pregnancy and lactation [11]. The current study aims to compare the physiological effects of spirulina algae powder with or without folic acid in local ewes that are in estrus and up to the early pregnancy stage in the hot summer months.

Materials and methods

There were sixteen 1.5-year-old Awassi ewes from the area, randomly divided into four groups of four ewes each, weighing an average of 40.67 ± 0.470 kg.

Group I (T1): The ewes were dosed with deionized water at the same dose approved in the experiment.

Group II (T2): Dosing the ewes with an aqueous solution of spirulina algae powder at a concentration of (2.5 g dissolved in 50 ml of deionized water/ewe/day).

Group III (T3): Dosing ewes with folic acid at a dose of (20 mg/ewe) at two doses per week.

Group IV (T4): The animals were dosed with a mixture of the second and third treatments with an aqueous solution of spirulina algae powder at a concentration of (2.5 grams dissolved in 50 ml of deionized water/ewe/day) + folic acid at a dose of (20 mg/ewe) at two doses per week.

Three physiological stages were used to split the study period. The first stage took three days during this time, the animals were given dosages of immune-boosting drugs and antibiotics for four days. Phase Two, where the manufacturer's vaginal sponges (Chronogest® CR) are applied for 14 days, followed by 24 hours before ovulation and 48 hours for fertilization. The early pregnancy stage it started after benefiting until the end of the 50-day experiment. In semi-open barns, the animals shared housing and food. As advised by the National Research Council (NRC) in 2007 regarding feeding small ruminants, they were given the concentrated fodder, animals were fed two times a day, in the morning and the evening, with roughage (hay), in addition to the green fodder that was available in animal production fields. Freely consuming water. The complete randomization design (CRD) The experiment's data were statistically analyzed using a one-way full randomization design. Duncan's polynomial test was used to assess the significance of any differences in the coefficients and Duncan's multiple range test [12]. The following mathematical model was utilized to analyze the data using the already prepared statistical analysis tool SAS (2001): **Yij = M + Ti + eij**

Y ij = The value j of the treatment i

 \mathbf{M} = The general average of the studied trait

Ti = Effect of treatment i

eij = Experimental error that is usually and independently distributed with a mean of zero and an equal variance of $\sigma^2 e$ Results

Ewe weights: The results in Table (1) indicate that there are no significant differences in the initial weight rate and final weight rate between the different treatments. As for the total weight gain, the second treatment (dosing with spirulina algae solution) increased significantly ($P \le 0.05$) in the total weight gain compared to the first treatment. At the same time, it did not differ significantly from the third and fourth treatments. **Reproductive performance:** The results in Table (2) indicate the rate of occurrence of estrus among the experimental treatments after withdrawing the vaginal sponges, as it was found that all animals experienced estrus. No significant differences were observed between the experimental treatments regarding the pregnancy rate and the number of fetuses per abdomen. **Progesterone:** It is noted in Table (3) that there are significant differences in the progesterone levels between the experimental treatments. In contrast, in the second period (the end of early pregnancy) the fourth treatment increased significantly ($P \le 0.05$) on all treatments. **Cortisone:** The results in Table (4) indicate that there are significant differences ($P \le 0.05$) between the experimental treatments, where dosing the ewes with a spirulina algae solution and folic acid led to a significant improvement in the concentration of the cortisone hormone in the fourth treatment (T4) compared to the rest of the treatments in the first period (Mid-Early pregnancy) While in the second period (the end of early pregnancy), a significant improvement was observed in the fourth treatment (T4) and the second period (the end of early pregnancy), a significant improvement was observed in the fourth treatment (T4) and the second period (the reatment (T2) compared to the rest of the other treatments

Table 1: The effect of dosing Awassi ewes with spirulina algae powder and folic acid on some growth indicators during early

pregnancy.

| Treatment | Initial weight(kg) | Final weight(kg) | Total weight gain(kg) |
|--|--------------------|------------------|-------------------------|
| T1(Control) | 50.00±2.59 | 57.00±1.52 | 7.00±1.52 ^b |
| T2(Spirulina) | 44.40±2.38 | 56.00±2.55 | 11.60±1.12 ^a |
| T3(Folic acid) | 47.00±2.35 | 56.40±2.06 | $9.40{\pm}0.40^{ab}$ |
| T4(Spirulina + folic acid) | 47.00±1.58 | 56.60±1.96 | $9.60{\pm}0.68^{ab}$ |
| *The distinct letters inside the same column signify a significant difference between the treatments at the significance level | | | |

(P≤0.05),

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*values were Mean \pm standard error.
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| early pregnancy. | | | | |
|--|---------------------------|--------------------|-----------------|--|
| Treatment | Estrus incidence rate (%) | Pregnancy rate (%) | Number of twins | |
| T1(Control) | 80 | 100 | 0 | |
| T2(Spirulina) | 100 | 100 | 2 | |
| T3(Folic acid) | 90 | 100 | 1 | |
| T4(Spirulina + folic acid) | 100 | 100 | 2 | |
| *The distinct letters inside the same column signify a significant difference between the treatments at the significance level | | | | |
| (P≤0.05), | | | | |
| *values were Mean \pm standard error. | | | | |
| | | | | |

Table 2: The effect of dosing Awassi ewes with spirulina algae powder and folic acid on reproductive performance during early pregnancy.

Table 3: The effect of dosing Awassi ewes with spirulina algae powder and folic acid on Progesterone levels during early pregnancy (ng/ml)

| Treatment | Mid-early pregnancy | End of early pregnancy | | |
|--|---------------------|-------------------------|--|--|
| T1(Control) | $3.28{\pm}0.05^{a}$ | $3.44{\pm}0.05^{\circ}$ | | |
| T2(Spirulina) | 4.22±0.05° | 5.03 ± 0.08^{b} | | |
| T3(Folic acid) | 3.56 ± 0.10^{b} | $3.65 \pm 0.04^{\circ}$ | | |
| T4(Spirulina + folic acid) | $5.05{\pm}0.06^{d}$ | 6.65 ± 0.20^{a} | | |
| *The distinct letters inside the same column signify a significant difference between the treatments at the significance level | | | | |
| (P≤0.05), | | | | |
| *values were Mean ± standard error. | | | | |
| Table 4: The effect of dosing Awassi ewes with spirulina algae powder and folic acid on Cortisone levels during early pregnancy (ng/ml). | | | | |

| Treatment | Mid-early pregnancy | End of early pregnancy | | |
|----------------------------|-------------------------|------------------------|--|--|
| T1(Control) | $1.92{\pm}0.08^{a}$ | 3.07±0.31ª | | |
| T2(Spirulina) | 1.61 ± 0.11^{b} | $1.40\pm0.10^{\circ}$ | | |
| T3(Folic acid) | $1.81{\pm}0.10^{ m ab}$ | 2.22 ± 0.04^{b} | | |
| T4(Spirulina + folic acid) | 1.29±0.02° | $1.08\pm0.02^{\circ}$ | | |

*The distinct letters inside the same column signify a significant difference between the treatments at the significance level $(P \le 0.05)$,

*values were Mean \pm standard error.



[Figure 1]. Diagram showing how the hypothalamus-pituitary-ovarian axis is affected over time by seasonal heat stress and how this affects fertility. Adapted from [24]

Discussion

The noteworthy variations in growth performance could be ascribed to the function of spirulina algae in enhancing the body's physiological state, which could have a favourable impact on animals' growth performance and improve the body's metabolism of sugars and fats. [13]. This could be because spirulina algae powder has a high nutritional value and is easy to digest, providing the animal with the nutrients it needs to support body growth. It also contains a high percentage of protein, essential amino acids, unsaturated fatty acids, vitamins, and minerals [14]. Spirulina is beneficial for rumen microbial complex activation, boosting crude microbial protein levels, enhancing cellulose digestion, and generating volatile fatty acids that are essential for energy production [15]. Components of spirulina, including phycocyanin, carotene, tocopherol, linolenic acid, and phenolic compounds with anti-inflammatory and antioxidant qualities, may be crucial for preserving the body's normal physiological condition, which may improve growth performance [16]. The reason for the complete occurrence of estrus in

ewes treated with spirulina alone or given with folic acid is due to the chemical composition of spirulina algae containing abundant nutritional supplements that support the ovaries to mature the follicles through a synergistic action with the follicle-stimulating hormone (FSH) and the ovulation hormone (LH) on the one hand [17]. On the other

hand, the role of spirulina and folic acid in increasing the numbers of receptors for the two aforementioned hormones, which consequently led to improving the process of laying sponges, regulating reproductive hormones in ewes, showing regular oestrus, and ovulation occurring within a regular and uniform pattern, and then benefiting [18]. The elevated progesterone level could potentially be attributed to the elevated concentration of sterol-like compounds, also known as steroid alcohols, found in spirulina algae powder. These compounds serve as a primary source of substances that influence the production of steroid hormones and, consequently, alter blood levels of reproductive hormones [19]. Furthermore, the preservation of the luteinizing granulosa cells' integrity and growth in size in the corpus callosum due to the high calibre of blood nourishment is another of spirulina's antioxidant qualities [20]. Progesterone levels are directly affected by folic acid. The main functions of folic acid are in red blood cell production, DNA synthesis, and cell division. In heat-stressed animals, a positive correlation has been seen between plasma progesterone levels and pregnancy protection, although it is crucial for general reproductive health, including conception and pregnancy. Supplementing with folic acid reduces oxidative stress responses in the developing embryos and increases the blastocyst's cell count. Blastocytosis [21]. Studies have shown that giving ewes folic acid at a dose of 16 mg/ewe has led to twin births in those ewes. The study attributed the reason to folic acid stimulating the fertilized egg in the first stages of embryonic division to double the meiotic fission in the fertilized egg, thus doubling the strands of genetic material DNA and forming More than one embryo within one fertilization of the egg. The increase in the number of twins also occurred in the treatments of spirulina algae powder Consistent with the results of the study [22]. About folic acid's influence on cortisone levels, corticosteroid substances like cortisone have the ability to deplete the body's supply of folic acid, potentially resulting in a deficit. Furthermore, folic acid and corticosteroids like prednisolone may interact with other medications, reducing the efficacy of both [23].

Conclusion

The data show that the treatments dosed with an aqueous solution of spirulina algae alone and in combination with folic acid showed a significant improvement.

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الكفاءة التناسلية للنعاج المحلية المعاملة بمسحوق طحالب سبير ولينا مع أو بدون حمض الفوليك

إلى مرحلة الحمل المبكر في أشهر الصيف.

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الخلاصة

أجريت هذه التجربة في حقل الأغنام التابع لقسم الإنتاج الحيواني – كلية الزراعة – جامعة كركوك للفترة من 2023/67 ولغاية 2023/66 ولغاية 2023/66 ولغاية 2023/66 ولغاية 2023/66 ولغاية 2023/66 ولغاية 2023/66 ولعاية 2023/66 ولعاية قدرها 83 يوماً. استهدفت الدراسة تجريع النعاج الحوامل بالمحلول المائي لمسحوق طحالب السبيرولينا وحمض الفوليك مجتمعين ومنفردين في الكفاءة التناسلية خلال مرحلة الحمل المبكرة. استخدمت في التجرية 16 نعجة عواسية محلية بعمر سنة ونصف ومتوسط وزن 40.67 ± 0.470 كغم. تم توزيعها عشوائياً على أربع معاملات بواقع أربع نعاج لكل معاملة. تمت تجريع نعاج المعاملة الأولى بالماء منزوع الأيونات الخالي من المواد المضافة واعتبرت معاملة عشوائياً على أربع معاملات بواقع أربع نعاج لكل معاملة. تمت تجريع نعاج المعاملة الأولى بالماء منزوع الأيونات الخالي من المواد المضافة واعتبرت معاملة السيطرة. تمت تجريع المعاملة الثانية بمحلول مائي من مسحوق طحالب السبيرولينا بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم). السيطرة. تمت تجريع المعاملة الثانية بمحلول مائي من مسحوق طحالب السبيرولينا بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم). معاملة تمت تجريع المعاملة الثانية بمحلول مائي من مسحوق طحالب السبيرولينا بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم). من متحريع المعاملة الثانية بحمض الفوليك بجرعة (20 ملغم/نعجة) بواقع جرعتين أسبوعياً، والمعاملة الرابعة بخليط المعاملتين الثانية والثالثة بمحلول مائي من مسحوق طحالب السبيرولينا بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم). من مسحوق طحالب السبيرولين بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم) + حمض الفوليك بجرعة (20 ملغم / نعجة) بجرعتين من مسحوق طحالب السبيرولينا بتركيز (2.5 غرام مذاب في 50 مل ماء منزوع الأيونات / نعجة / يوم) + حمض الفوليك بجرعة (20 ملغم / نعجة) بجرعتين من مسحوق طحالب السبيرولينا رائيوة الكونية الكلية والأداء التناسلي ومستوى هرمون البروجسترون ومستوى الكورتيزون الكورتيزون في الموييك منوليك مرمن الفوليك مومن البوليك مرمان المروين ومستوى الكورتيزون في مامريزون المروين ومستوى المروين البروجسترون ومستوى الكورتيزون الكورتيزون في مامويل ألويرت مرما الفرليل المروي وليول وو مرمل وليل موليك م

الكلمات المفتاحية : نعاج العواسية، السبيرولينا، الحمل المبكر، حمض الفوليك.