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Effect of Using the Vitamins A, E, D3 With or Without Omega3 on the Productive Performance and Some Physiological Characteristics of Local Iraqi Female Lambs

T.R. Mohammed[1], Baraa. H. A[1] and M. A. Shareef[2*]

[1]Department of animal production, College of Agriculture, University of Anbar, Iraq.

[2]Department of Accommodation Affairs, Headquarter , University of Anbar, Iraq.

*Corresponding Author: m.a.shareef@uoanbar.edu.iq

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Abstract

This study aims to investigate the effect of using vitamins A, E, and D3 with or without omega-3 on the productive performance and some physiological characteristics of local Iraqi female lambs. Twelve female Iraqi Awassi lambs with an average body weight of 16.737 ±2.08 kg and ages ranging from 90±7 days were used. Three groups, each with four lambs, were randomly selected from among the experimental animals. As the control group, (T1) had not acquired any treatment at all. The second group (T2) acquired intramuscular injections of vitamins A, D3, and E of 1.5 ml supported with omega-3 of 1.5 ml and the 3rd group (T3) acquired intramuscular injections of the same vitamins, (on the 15th of December, first of January, 15th of January, first of February and 15th February, five times with a fifteen-day gap between each injection). The animals were nourished on a concentrated diet consisting of 1.5% BW (mixture of barley grains and wheat bran) water, minerals bloke supplement, and alfalfa hay had given ad libitum. The result of the experiment showed That group 2 (T2) had significantly increased (P≤0.05) compared with group 1 (T1) in the second period (p2) of the experiment average of life body weight. group 2 (T2) had significantly superior (P≤0.01) compared with group1 (T1(and group 3 (T3) at p2 in chest girth, estrogen hormone and white blood cell (WBC), while group 2 (T2) had significantly increased (P≤0.05) compared with group1 (T1(in red blood cell (RBC) at third period (P3), whereas group1 (T1(and recorded a significantly increased (P≤0.01) as compared with group 3 (T3) at P2 in haemoglobin concentration. In conclusion, treating female lambs with omega-3-supplemented vitamins A, E, and D3 improved their body weight gain and some physiological characteristics.

Keywards: Nutrition, Ruminants, Vitamines, Omega

تأثير حقن الفيتامينات A, E, D3 المدعمة بالاوميغا3 والفيتامينات A, E, D3 (بدون الاوميغا3) في أداء النمو وبعض الصفات الفيسيولوجية للفطائم العراقية المحلية

الخلاصة

هدفت هذه الدراسة إلى دراسة تأثير استخدام فيتامينات A,E,D3 مع أو بدون أوميجا 3 على الأداء الإنتاجي وبعض الصفات الفسيولوجية للحملان العراقية المحلية. استخدمت في التجربة اثنتا عشرة فطيمة عواسية محلية عراقية، بمعدل عمر 90 ± 7 أيام ومتوسط وزن الجسم 16.737 ±2.08 كجم. تم تقسيم حيوانات التجربة عشوائياً إلى ثلاث مجموعات، كل مجموعة تتكون من أربعة حملان. اعتبرت المجموعة الأولى (T1) مجموعة السيطرة وتركت دون أي علاج، بينما عُملت المجموعة الثانية (T2) بفيتامينات A و D3و Eالمدعمة بالأوميجا 3 بمقدار 1.5 سي سي، بينما عُملت المجموعة الثالثة (T3) بالفيتامينات A و D3و Eبمقدار 1.5 سي سي عن طريق الحقن العضلي، وتم حقن الحملان 5 مرات، وكانت الفترة الزمنية بين كل جرعة 15 يومًا. تمت تغذية الفطائم على نفس العليقة المركزة (مخلوط من النخالة وحبوب الشعير) بنسبة 1.5% من وزن الجسم، اما باقات دريس الجت ومكعبات العناصر المعدنية، وماء فقد تم إعطائه بصورة حرة. أظهرت النتائج أن T2 قد تفوقت معنويا (P<0.05) مقارنة مع T1 في الفترة الثانية من التجربة في متوسط وزن الجسم الحي. في حين تفوقت T2 معنويا (P<0.01) مقارنة مع T1 و T3عند p2 في محيط الصدر وهرمون الاستروجين وخلايا الدم البيضاء(WBC) ، بينما تفوقت T2 معنويا (P<0.05) مقارنة مع T1 في خلايا الدم الحمراء (RBC) عند في الفترة الثالثة((P3 ، في حين تفوقت T1 و T2 معنوياً (P<0.01) مقارنة مع T3 عند P2 في تركيز الهيموجلوبين.

Introduction:

The continued growth and transformation of the livestock production sector presents important opportunities for agricultural development and poverty reduction and Achieving gains in food security and improving human nutrition (FAO ، 2014). Scientific interest in animal production, development, and development has prompted researchers to conduct more research to shed light on reproductive techniques to improve agricultural animals productively and genetically and to overcome cases of infertility and embryonic mortality (1). Due to the economic importance of sheep in Iraq, which prompted researchers to pay attention to finding appropriate ways to improve productive performance by using hormonal treatments or nutritional supplements (2, 3 and 4). Over the last twenty years, studies have demonstrated that long chain omega-3 polyunsaturated fatty acids, such as docosahexaenoic acid (DHA) and eicosatetraenoic acid (EPA), are superior to other fatty acids found in meals in terms of supporting long-term health (5, 6 and 7). Fats in livestock body provide energy for act, serve as a medium for transferring nourishments (carotenoids and vitamins) due to their crucial influence on human health, created in response to customer demands to decrease fat accumulation in carcasses and improve the flesh content of omega-3 (8). Vitamin E functions as an intracellular antioxidant, preventing oxidative damage to cell membrane (9). Vitamin E functions as an intracellular antioxidant, scavenging reactive oxygen species to prevent oxidative damage to cell membranes (10 , 11 and 12). The body requires very little quantities of vitamins, which are essential organic food components. The physiological importins of vitamin D3 lie in; its deficiency results in disturbance of metabolic processes and vital bodily functions. It also plays a role in the action of intestinal, kidney, and bone tissues. Vitamin D3 deficiency causes rickets. It also regulates the homeostasis concentration of calcium, phosphate and magnesium. (13, 14 and 15).

So, this experiment had designed to investigation the impact of vitamin A, E and D3 supplemented with omega3, vitamins A, E, and D3 (without omega 3) injections on the productive performance and some physiological characteristics of local Iraqi female lambs.

Materials and methods

Experimental animals

From 15th of December 2021to 15th of February 2022, this experiment was carried out in the faculty of Agriculture/ Anbar University /Ramadi. Twelve Awassi female lambs with average body weight was 16.737 ±2.08 kg, and their ages ranged from 90±7 days had used in the experiment. The diet used to feed lambs was concentrated and consist of (mixture of barley grains and wheat bran, 1.5% BW) according to (16). Alfalfa hay given *ad libitum* in addition to water and minerals blokes supplement.

Experimental design:

Three equal groups of Awassi lambs (females) were divided randomly; the group consisted of four animals. First group (T1) was the control and did not receive any treatment; the second group (T2) acquired treatment consisting of omega-3 /1.5 cc supported with vitamins A, D3, and E; each 100 ml contains omega 3 as fish liver oil q.s.ad 100 ml, MICROSULES company, Spain, and vitamins A 11 g (20,000,000 IU), D3 0.125 (5,000,000 IU), and E 6 g (6000 IU). The lambs in the third group (T3) given intramuscular injections of vitamins A, D3, and E (without omega-3) at a dose of 1.5 cc, all lambs were acquired at five times of treat, separated by a period of fifteen days.

Weight and dimensions of Body:

Experimental animals were weighted twice from the start and end of the experiment (15th of December and 15th February) by using an electronic scale, body dimensions were measured by using a tape measure according to (17).

Blood sample collection:

Samples were taken from the jugular vein of the lambs during three periods (at the beginning, middle and end of the experiment 15-12-2021, 15-1-2022 and 15-2-2022), by using vacuum tubes containing EDTA for the purpose of conducting a complete blood count (CBC), while the estrogen and Malondialdehyde (MDA), it was measured twice at the beginning and end of the experiment period by using a jell tube. The samples were transported to the central lab at the College of Agriculture - Anbar University by using a cooler box, all tests were performed of one hour after blood samples collecting.

Statistical Analysis:

Statistical Analysis System (SAS) was used to analyze the data to study the effect of different parameters on the studied traits according to a completely randomized design (CRD) (18). The degree of significance between the means were cariad out using multinomial test (19).

Result and discussion:

Mean of life body weight gain

The result had showed in the table (1) that there had not significant increase between treatment and control groups at first period (P1) while T2 had a significantly superior (P≤0.05) at P2 in the means of life body weight gain as compared with T1.

Tabel (1) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of live body weight gain (kg*)*

Treatments	means± standard error	
	First period (P1)	Second period (P2)
T1	16.78±2.08	22.62±1.91 b
T2	16.97±2.95	28.57 ±2.16 a
T3	16.45±0.79	23.25±1.43 ab
level of significant	NS	*
The letters with the lower case refer to the significant difference within the same column. * (P≤0.05).		

Because fats derived from animal nutrients are broken down in the rumen before being absorbed in the gut, the fat content of ruminant milk and meat differs greatly from that of the nutrients provided, for this reason, ruminants are known as "hetero-lipoid animals." The balance between fatty acid synthesis, esterification, desaturation, and ingestion ultimately establishes the FA profile in animal products. Rumen digestion has a major impact on the absorbed FAs and subsequent tissue deposition in the duodenum. (20 and 21). The current results had agreed with findings the of (22, and 23). While the current results had disagreed with (24).

Mean of body length

The result had showed in the table (2) there are non-significant differences (P≥0.05) in the means of body length (cm) between groups and periods of experiment. This result had agreed with (25) when the treated female Holstein calves with weekly injection of 1.5 CC of vitamins (A, D3, E).

Tabel (2) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of on the means of body length (cm)

Treatments	means± standard error	
	First period (P1)	Second period (P2)
T1	56.75±3.03	58.25±2.56
T2	57.75±2.01	62.50±2.32
T3	58.50±0.50	64.75±1.25
level of significant	NS	NS
The letters with the lower case refer to the significant difference within the same column. * (P≤0.05).		

Mean of body height

The result had showed in the table (3) there has not a significantly superior (P≤0.05) in mean of body height between groups and periods of experiment. This study had agreed with (25) when the treated

female Holstein calves with weekly injection of 1.5 CC of vitamins (A, D3, E).

Tabel (3) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of body height (cm)

Treatments	means± standard error	
	First period (P1)	Second period (P2)
T1	51.25±1.31	59.25±1.75
T2	53.00±3.18	60.75±2.28
T3	55.75±0.85	61.00±1.08
level of significa	NS	NS
The letters with the lower case refer to the significant difference within the same column. * (P≤0.05).		

3-4 mean of chest girth

The result of table (4) had showed T2 and T3 had a significantly superior (P≤0.01) at P2 as compared with T1. While T2 had a significantly increased (P≤0.01) at P2 as compared with T3. This study had disagreed with (25) when the treated female Holstein calves with weekly injection of 1.5 CC of vitamins (A, D3, E).

Tabel (4) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of chest girth (cm)

Treatments	means± standard error	
	First period (P1)	Second period (P2)
T1	64.25±2.62	72.00±1.47 c
T2	64.00±3.24	83.00±1.47 a
T3	65.52±1.55	76.50 ±1.19 b
level of significan	NS	**
The letters with the lower case refer to the significant difference within the same column. ** (P≤0.01).		

Estrogen hormone concentration

The result of table (5) showed that T2 and T3 had a significantly superior (P≤0.01) at P2 as compared with T1. Whilst T2 had a significantly increased (P≤0.01) at P2 as compared with T3.

The reason for the significant superiority of omega-3 treatment attributed to the fact of lipids in the diet can affect production positively by improving the function of ovarian follicles and increasing follicle growth to form reproductive hormones such as prostaglandin hormone (26). Omega-3 also affects several factors related to the synthesis and metabolism of important reproductive hormones such as estradiol (E2) (27). The superiority of P2 as compared with p1 duo to the role of Omega-3 and vitamins in enhancing the animals' access to sexual maturity. This study agreed with (28) when he treated ewes with vitamin A, vitamin E, β-carotene and vitamin E on some fertility parameters. This superiority of T2 at P2 as compared with T1 is attributed to the role of vitamin A in increasing ovarian activity in releasing reproductive hormones, increasing vaginal secretions, and improving the fertility rate, or to the role of vitamin E which is considered of the best antioxidants in the body that leads to a significant improvement in the health and immune status and reproductive efficiency of animals (29). Or may be attributed to the role of antioxidants in reducing lipids oxidation, which is a source of synthesis steroid hormones such as estrogen (30)

The result had agreed with (31), as the results indicated that short- treatment (15-17 days) with omega-3 supplements could increase of hormone levels in the blood and ovarian activity during pre-mating, at mating and after mating periods in ewes. The results of the current study agreed with (25) that treatment with omega-3 and omega-6 fatty acids led to superiority of omega-3 treatment in the level of estrogen hormone concentration.

Tabel (5) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of estrogen hormone concentration (pg/ml)

Treatments	means± standard error	
	First period (P1)	Second period (P2)
T1	5.20±0.35	12.43±0.82 c
T2	5.91±0.56	32.77±1.46 a
T3	5.52±0.24	24.76±1.05 b
level of significan	NS	**

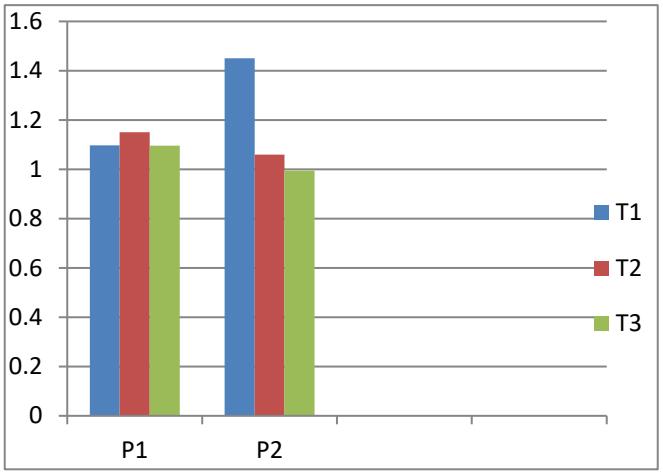
The letters with the lower case refer to the significar difference within the same column. ** (P≤0.01).

Malondialdehyde (MDA)

The result in the figure. (1) showed that T1 had a significant superior (P≤0.05) at P2 as compared with T2 and T3 in (MDA) level concentration.

A significant improvement had observed in the vitamins group in the level of MDA compared with the control group, which suggests that the control group had exposed to oxidative stress, which led to an increase in the level of MDA concentration in the blood of lambs (32). The reason for the decrease in the level of MDA concentration duo to the role of vitamins and omega-3 in suppressing oxidative stress activity (33 and 34). The results of the current study had agreed with (35), there had a significant difference in the level of MDA concentration between the control group and treatment groups when treated ewes with fatty acids and vitamin E in the level of MDA concentration.

Fig. (1) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of MDA concentration (mmol/L)



White Blood Cells (WBC)

Tabel (6) showed that T2 and T3 had a significant increased (P≤0.01) in WBC count at P2 and P3 as compared with T1, while T2 had a significant superior (P≤0.01) in WBC count at P2 and P3 as compared with T3, that significant increased had within the normal level of white blood cell count. The reason for the superiority of the vitamins enriched with Omega-3 group may be to action of omega-3 which enhance the immune response in lambs. Studies had showed that treatment with omega-3 fatty acid improves the immune response and reduces inflammation in sheep and other ruminants (36). Or duo to the role of vitamins A, E and D3 to stimulating the action of the immune system (37), or enhancing the functioning of the immune system and its direct effect on the proliferation and differentiation of lymphocytes B and T cells

Tabel (6) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of WBC (cell×10^3/ml)

Treatments	means± standard error		
	First period (P	Second period (P2)	Third period (P
T1	4.40±0.25	5.99±0.16 c	7.21±0.08 c
T2	4.56±0.24	9.45±0.27 a	11.43±0.33 a
T3	4.44±0.29	6.99±0.27 b	8.34±0.12 b
level of significant	NS	**	**

The letters with the lower case refer to the significa difference within the same column. ** (P≤0.01).

Red Blood Cells (RBC)

The result of table (7) show T3 has a significantly increase (P≤0.05) at P1 as compare with T1, whereas T2 has a significantly superior (P≤0.05) at P3 as compared with T1.

The reason of this superiority due to the role of vitamin E activity as an antioxidant, it had an important role in preventing the oxidation of lipids in cellular membranes by reducing free radicals and other oxidizing oxidation state and preventing the formation of peroxides, (38) The results of this study agree with (39) that red blood cells count had improved when treated with different levels of omega-3 fatty acid.

Tabel (7) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of RBC (cell×10^6/ml)

Treatments	means± standard error		
	First period (P1)	Second period (P2)	Third period (P3)
T1	3.57±0.07 b	6.70±0.41	6.57±0.85 b
T2	4.07±0.21 ab	7.42±0.39	8.01±0.76 a
T3	4.61±0.48 a	6.58±0.51	7.77±0.42 ab
level of significant	*	NS	*

The letters with the lower case refer to the significant difference within the same column. * (P≤0.05).

Hemoglobin concentration

Tabel (8) showed that T1 and T2 had significantly increase (P≤0.01) at P2 as compared with T3, whereas T2 had significantly superior (P≤0.05) at P3 as compared with T1. The reason for the superiority of T1 and T2 during P2 and T2 during P3 attributed to the role of vitamins E, A, and D, or antioxidants which is protect the cell and cell membrane from decomposition (38 and 39).

Tabel (8) The impact of vitamin A, E and D3 with omega3. vitamins A, E, and D3 (without omega 3) injections on the means of hemoglobin concentration (g/dl)

Treatments	means± standard error		
	First period (P1)	Second period (P2)	Third period (P3
T1	7.80±0.52	9.30±0.18 a	8.30±0.98 b
T2	7.60±0.44	9.70±0.23 a	10.15±0.72 a
T3	8.00±052	7.72±0.29 b	9.85±0.35 ab
level of significant	NS	**	*
The letters with the lower case refer to the significant difference within the same column. * (P≤0.05) **(P≤0.01			

Conclusion

From this study it can be concluded that treat the female lambs with vitamin A, E, D3 supplemented with omega3 led to enhance growth and productive performance, antioxidant state, blood state and public health of lambs.

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References

1- NAGY, Bernadett, et al. Follicular fluid progesterone concentration is associated with fertilization outcome after IVF: a systematic review and meta-analysis. *Reproductive biomedicine online*, 2019, 38.6: 871-882.

2- AL-AUBAEDY, A. H. A.; AL-SALMANI, Th RM. Effect of using some reproductive hormonal treatment on reproductive performance, blood characteristic of Iraqi ewes out breeding season. *Al-Anbar Journal of Veterinary Sciences*, 2013, 6.2.

3- MOHAMMED, Thair, et al. Effect of arginine on physiological and reproductive performance of Awassi ewes. Iraqi Journal of Veterinary Sciences, 2019, 33.2: 213-220.

4- DE MARZO, Davide, et al. Enrichment of dairy-type lamb diet with microencapsulated omega-3 fish oil: Effects on growth, carcass quality and meat fatty acids. *Life*, 2023, 13.2: 275. PONNAMPALAM, Eric N., et al. Sources of variation of health claimable long chain omega-3 fatty acids in meat from Australian lamb slaughtered at similar weights. Meat Science, 2014, 96.2: 1095-1103.

5- PONNAMPALAM, Eric N., et al. Sources of variation of health claimable long chain omega-3 fatty acids in meat from Australian lamb slaughtered at similar weights. Meat Science, 2014, 96.2: 1095-1103.

6- PALMQUIST, D. L. Omega-3 fatty acids in metabolism, health, and nutrition and for modified animal product foods. *The Professional Animal Scientist*, 2009, 25.3: 207-249.

7- SCOLLAN, Nigel D., et al. Enhancing the nutritional and health value of beef lipids and their relationship with meat quality. *Meat Science*, 2014, 97.3: 384-394.

8- SURAI, P. F. Vitamin E and avian reproduction/Poultry and avian biology reviews. *V*, 1999, 10: 3-60.

9- GABRYSZUK, M.; KLEWIEC, J. Effect of injecting 2-and 3-year-old ewes with selenium and selenium–vitamin E on reproduction and rearing of lambs. *Small Ruminant Research*, 2002, 43.2: 127-132.

10- SEGERSON, E. C.; GANAPATHY, S. N. Fertilization of ova in selenium/vitamin E-treated ewes maintained on two planes of nutrition. *Journal of Animal Science*, 1980, 51.2: 386-394.

11- SHAREEF, M. A., et al. Effect of Vitamins A, E, D3 Supplemented with Omega3 and Vitamins A, E, D3 (without Omega-3) on Biochemical Blood Parameters of Females Awassi Lamb. In: *IOP Conference Series: Earth and Environmental Science*. IOP Publishing, 2023. p. 012083.

12- JARUSRIWANNA, Atthakorn, et al. High-dose versus low-dose ergocalciferol for correcting hypovitaminosis D after fragility hip fracture: a

randomized controlled trial. BMC geriatrics, 2021, 21.1: 1-10.

13- MAIER, Gerrit S., et al. The role of vitamin D and vitamin D deficiency in orthopaedics and traumatology—a narrative overview of the literature. *Annals of translational medicine*, 2021, 9.11.

14- CIANCIOLO, Giuseppe, et al. Vitamin D effects on bone homeostasis and cardiovascular system in patients with chronic kidney disease and renal transplant recipients. Nutrients, 2021, 13.5: 1453.

15- NATIONAL RESEARCH COUNCIL, et al. *Mineral tolerance of domestic animals*. National Academies Press, 1980.

16- SAS, S., et al. Statistical Analysis System, User's Guide. Statistical. Version 9. *SAS. Inst. Inc. Cary. NC USA*, 2012.

17- JEFFERIES, B. C. Body condition scoring and its use in management. Tasmanian journal of agriculture, 1961, 32: 19-21.

18- DUNCAN, David B. Multiple range and multiple F tests. *biometrics*, 1955, 11.1: 1-42.

19- DE MARZO, Davide, et al. Enrichment of dairy-type lamb diet with microencapsulated omega-3 fish oil: Effects on growth, carcass quality and meat fatty acids. Life, 2023, 13.2: 275.

20- BIAŁEK, Małgorzata; CZAUDERNA, Marian; BIAŁEK, Agnieszka. Partial replacement of rapeseed oil with fish oil, and dietary antioxidants supplementation affects concentrations of biohydrogenation products and conjugated fatty acids in rumen and selected lamb tissues. *Animal Feed Science and Technology*, 2018, 241: 63-74.

21- HERNÁNDEZ-GARCÍA, Pedro Abel, et al. Effects of increasing dietary concentrations of fish oil on lamb performance, ruminal fermentation, and leptin gene expression in perirenal fat. *Revista Brasileira de Zootecnia*, 2017, 46: 521-526.

22- HAFEZ, Y. H., et al. The effect of omega-3 on productive and reproductive performance of sheep 1-ewes and ewe lambs. Journal of Animal and Poultry Production, 2015, 6.2: 85-97.

23- SKIBA, Grzegorz, et al. Effects of Fish Oil and Dietary Antioxidant Supplementation on Bone Health of Growing Lambs. *Animals*, 2021, 11.1: 230.

24- MOVAHEDNASAB, Mehrdad, et al. The Effect of Flaxseed Oil Supplementation and Injection of Vitamins (A, D3, E) on the Performance and Blood Metabolites of Suckling Calves. Iranian Journal of Animal Science Research, 2022, 14.3: 305-315.

25- WONNACOTT, K. E., et al. Dietary omega-3 and-6 polyunsaturated fatty acids affect the composition and development of sheep granulosa cells, oocytes and embryos. *Reproduction*, 2010, 139.1: 57.

26- GULLIVER, C. E., et al. The role of omega-3 polyunsaturated fatty acids in reproduction of sheep and cattle. *Animal Reproduction Science*, 2012, 131.1-2: 9-22.

27- MOSTAFA, M. M. M., et al. Puberty and fertility of ewe lambs fed on by-products of palm and olive oil. *Arab Journal of Nuclear Sciences and Applications*, 2017, 50.3: 137-150.

28- ATAMAN, Mehmet Bozkurt, et al. The investigation of the effects of vitamin A, vitamin E, and β-carotene plus vitamin E on some fertility parameters in ewes. *Tropical Animal Health and Production*, 2023, 55.3: 175.

29- SHAREEF, M. A.; MOHAMMED, T. R.; ALRAWI, H. M. Impact of Saccharomyces cerevisiae enriched with Selenium or Zinc on reproductive performance, estrogen and progesterone hormone in local Iraqi female goats. In: *IOP Conference Series: Earth and Environmental Science*. IOP Publishing, 2021. p. 012095.

30- SOYDAN, Ercan, et al. Effects of omega-3 and omega-6 fatty acids on some reproductive parameters in ewes. *Large Animal Review*, 2020, 26.6: 329-336.

31- AKTAS, Mustafa Sinan, et al. Evaluation of oxidative stress in sheep infected with using total antioxidant capacity, total oxidant status, and malondialdehyde level. *Journal of Veterinary Research*, 2017, 61.2: 197-201.

32- CHAUHAN, Surinder S., et al. Dietary antioxidants at supranutritional doses improve oxidative status and reduce the negative effects of heat stress in sheep. *Journal of Animal Science*, 2014, 92.8: 3364-3374.

33- MUGA, Miriam Adoyo; CHAO, Jane CJ. Effects of fish oil and spirulina on oxidative stress and inflammation in hypercholesterolemic hamsters. *BMC complementary and alternative medicine*, 2014, 14.1: 1-10.

34- FASSAH, Dilla Mareistia, et al. Blood malondialdehyde, reproductive, and lactation performances of ewes fed high PUFA rations supplemented with different antioxidant sources. *Media Peternakan*, 2015, 38.1: 48-56.

35- WALL, Rebecca, et al. Fatty acids from fish: the anti-inflammatory potential of long-chain omega-3 fatty acids. Nutrition reviews, 2010, 68.5: 280-289.

36- CUTOLO, M.; OTSA, K. Vitamin D, immunity and lupus. *lupus*, 2008, 17.1: 6-10.

37- GEORGIOU, Christos D. Oxidative stress-induced biological damage by low-level EMFs: mechanism of free radical pair electron spin-polarization and biochemical amplification. *Non-thermal effects and mechanisms of interaction between electromagnetic fields and living matter. Bologna (IT): Ramazzini institute*, 2010, 63-113.

38- WITTE, Theodore R., et al. RBC and WBC fatty acid composition following consumption of an omega 3 supplement: lessons for future clinical trials. *Lipids in health and disease*, 2010, 9: 1-7.

39- SHAREEF, Amir, et al. Effect of Saccharomyces cerevisiae Fortified with Selenium on the Hematological and Some Biochemical Traits of Local Iraqi Goat. *Archives of Razi Institute*, 2023, 78.4: 1213.