Jojoba seed oil as a feed additive to the ration of productive characteristics of Ross 308 broiler chickens.

Saif A. J. aldarraji

Department of Animal Production, College of Agriculture, Tikrit University, Tikrit, Iraq.

Corresponding author's email: Saiforg19@tu.edu.iq

Email addresses of coauthors: Saiforg19@tu.edu.iq

Abstract

The study aimed to evaluate the effect of adding levels of jojoba oil to broiler diets of Rose 308 on growth performance, feed consumption and feed conversion efficiency. The study was conducted in the poultry field at the College of Agriculture - Tikrit University for 42 days., from April 3, 2025, to May 16, 2025. A total of 192 one-day-old chicks were studied, distributed across four treatments, with four replicates per treatment (48 chicks per treatment and 12 chicks per replicate). The experiment comprised four dietary treatments: a control group fed the basal diet without supplementation, and three experimental groups receiving jojoba oil supplementation at inclusion levels of 100, 200, and 300 mg/kg of feed. The results indicated a significant improvement in body weight, weight gain, and feed conversion efficiency of birds with increasing levels of jojoba seed oil supplementation. Moreover, feed intake was significantly reduced in the fourth.

Keywords: Jojoba oil, birds' weight, feed conversion efficiency, broiler chickens.

Introduction

As is known, the use of antibiotics in animal feed as growth stimulants to enhance overall profitability and food safety is a common food strategy in the Middle East, especially in Iraq. However, the European Union has completely banned their use since 2006 (Regulation (EC) No. 2003/1831) due to the impact of antibiotics on human and animal health caused by the evolution of pathogenic bacteria and the production of antibiotic-resistant strains [1]. Therefore, there has been a need to find natural alternatives to antibiotics, such as herbs and natural oils, which have multiple health benefits and promote growth without any side effects on animal health [2, and 3]. Because they contain high levels of phenols, plant bioactive fatty compounds (PBLCs) can be used as feed additives to maintain feed quality and safety due to their antioxidant, antimicrobial, and digestive functions, which enhance digestive performance and improve meat quality and growth in poultry [4].

Jojoba oil is an unsaturated liquid wax, a unique oil because it can be easily extracted in high quantities from plant sources (52% of the total seed weight). Its structure is very similar to sperm Amber oil [5]. Unprocessed natural jojoba oil contains 22 fatty acids and can be added to turkey feed at rates of 2.5% and 5%, resulting in noticeable positive effects on birds' body weight gain, feed conversion ratio, antioxidant capacity, and immune system enhancement. Economic returns can be obtained by adding it at a rate of 2.5% to turkey feed [6]. Adding jojoba seed oil at a concentration of 150 mg/kg improved the growth performance of broiler chickens and the physical and chemical quality of their meat when used in hot climates. In a study in which jojoba oil was

ISSN 2072-3857

used at a concentration of 150 mg/kg in broiler feed, it was concluded that there was an improvement in productive performance, growth, feed conversion efficiency, and economic return [7].

The study aims to investigate the effects of adding jojoba seed oil to rations at different levels on growth performance, feed consumption, and feed conversion efficiency of Ross 308 broiler chickens.

Materials and Methods

A farm experiment was conducted at the Animal Production Farm, College of Agriculture, Tikrit University, from April 3 to May 16, 2025, to investigate the effect of dietary supplementation with jojoba oil on the productive performance of Ross 308 broiler chickens. A total of 192 unsexed, one-day-old chicks were randomly assigned to four treatments, with four replicates per treatment. Each treatment included 48 chicks, with 12 chicks per replicate. The treatments were as follows: Treatment 1: Control (no jojoba oil); Treatment 2: 100 mg/kg jojoba oil; Treatment 3: 200 mg/kg jojoba oil; and Treatment 4: 300 mg/kg jojoba oil. The measured parameters included live body weight, body weight gain, feed intake, and feed conversion ratio (FCR).

Bird Management and Care

The birds were raised in a hall designated for raising broiler chickens, measuring 40 m long, 8 m wide, and 2.4 m high. It contains three lines of iron cages measuring 2*2 m, equipped with LED ceiling lights, a feeder, and a hanging waterer for each cage. The floor was covered with bran bedding.

Feed Preparing.

The feed was prepared in the feed mill in the animal field, and a horizontal electric mixer with a capacity of 50 kg was used to mix small quantities of feed to keep it fresh. Jojoba oil was added by diluting it with sunflower oil and added to the feed to give the best homogeneity with the feed components.

Table 1: The proportions of nutrients included in the composition of the feed and their chemical analysis

Ingredient (%)	Startar 0-10 days	Grower 1 11-20	Grower 2 21-42
Corn	50	60	60
Soybean meal (CP 44%)	35.85	30.53	27.53
Premix (minerals&vitamins)	2.5	2.5	2.5
Sunflower oil	4.52	3.07	4.16
Limestone	4.58	2	4.12
Dicalcium phosphate	2	1.15	1
Salt (NaCl)	0.25	0.25	0.25
L-lysine HCl	0.15	0.25	0.19

ISSN 2072-3857

DL-Methionine	0.15	0.25	0.25
Total	100	100	100
***Calculated Nutrients**			
Metabolizable energy (Kcal/kg)	2975	3050	3075
Crude protein (%)	22.00	20.50	19.00
Crude fiber (%)	3.71	3.53	3.31
Calcium (%)	2.75	1.32	2.07
Available phosphorus (%)	0.44	0.27	0.26
Lysine (%)	1.28	1.26	1.12
Methionine (%)	0.61	0.69	0.67
Methionine + Cysteine (%)	0.79	0.75	0.71

*Based on the chemical analysis mentioned in [8].

Statistical Analysis

The data were analyzed using SAS [9] software version 9.2 of 2003, according to the CRD completely random design, and [10] polynomial test was applied to find significant differences between treatments at a probability level of 0.5.

Results

Table 2 shows the results of the analysis of variance for the effect of adding jojoba seed oil to the diet on the live body weight of broiler chickens. The table shows that there are no significant differences at the ages of 7, 14 and 21 days in live body weight between all experimental treatments, while the second and fourth treatments were significantly superior at the ages of 28 and 35 days compared to the control treatment, and the third and fourth treatments were significantly superior at the age of 42 days compared to the first and second treatments.

ISSN 2072-3857

Table 2: the effect of adding jojoba oil on living body weight For 1-6 weeks of broiler **(mean ± std Error).**

Ages	Treatments			
	T1: Without adding jojoba seed oil	T2: 100 mg/kg jojoba seed oil	T3: 200 mg/kg jojoba seed oil	T4: 300 mg/kg jojoba seed oil
7	194.00±6.39a	200.00±4.33a	203.50±6.60a	199.25±5.29a
14	520.50±9.04a	520.50±7.27a	524.50±15.11a	538.50±12.29a
21	1027.00±31.74a	1040.00±22.93a	1010.75±5.82a	1016.50±8.50a
28	1559.50±26.58b	1644.50±20.13a	1623.00±18.62ab	1649.50±18.86a
35	2176.75±33.46b	2152.00±16.14a	2170.25±14.44ab	2261.50±21.88a
42	2899.00±14.52b	2906.75±37.84b	2981.50±13.54a	3004.75±7.08a

*The different letters in the horizontal row indicate the significance of the means between the coefficients at a probability level 0.5%.

Table 3 shows the results of the analysis of variance (ANOVA) of the effect of adding jojoba seed oil to the diet on the weight gain of broiler chickens. There were no significant differences between the experimental treatments at 7, 14, and 21 days of age. A significant increase was recorded in the jojoba oil-supplemented treatments at 28 days of age compared to the control treatment. At 35 days of age, the weight gain of the second treatment decreased significantly compared to the first and fourth treatments. There were no significant differences between all experimental treatments at 42 days of age. When calculating the total rearing period (0-42 days), a significant advantage in total weight gain was found in the third and fourth treatments compared to the first and second treatments.

ISSN 2072-3857

Table 3: The effect of adding jojoba oil on weight gain at For 1-6 weeks of broiler **(mean ± std Error).**

Ages	Treatments			
	T1: Without adding jojoba seed oil	T2: 100 mg/kg jojoba seed oil	T3: 200 mg/kg jojoba seed oil	T4: 300 mg/kg jojoba seed oil
7	153.00±6.39a	159.00±4.33a	162.50±6.60a	158.25±5.29a
14	326.50±10.37a	320.50±9.76a	321.00±16.15a	339.25±15.49a
21	506.50±35.69a	519.50±21.01a	486.25±15.76a	478.00±19.89a
28	532.50±29.35b	604.50±9.21a	612.25±15.68a	633.00±24.93a
35	617.25±34.12a	507.50±19.92b	547.25±8.07ab	612.00±39.90a
42	722.25±47.11a	754.75±24.57a	811.25±26.47a	743.25±2963.75a
0-42	2858.00±14.52b	2865.75±37.84b	2940.50±13.54a	2963.75±0.08a

*The different letters in the horizontal row indicate the significance of the means between the coefficients at a probability level 0.5%.

Table 4 shows the effect of adding jojoba seed oil to the diet on feed consumption in broiler chickens. Feed consumption was decreased at 7 days of age in the second treatment compared to the first treatment. There were no significant differences at 14, 21, and 28 days of age in all experimental treatments. Feed consumption decreased significantly at 35 days of age in the fourth treatment compared to the first treatment. Feed consumption also decreased significantly at 42 days of age in the fourth treatment compared to the first, second, and third treatments.

Table 4: Effect of adding jojoba oil on feed consumption For 1-6 weeks of broiler **(mean ± std Error).**

Ages	Treatments			
	T1: Without adding jojoba seed oil	T2: 100 mg/kg jojoba seed oil	T3: 200 mg/kg jojoba seed oil	T4: 300 mg/kg jojoba seed oil
7	163.25±1.88a	153.75.75±3.47b	161.00±2.82ab	161.75±2.95ab
14	549.50±5.57a	536.00±15.01a	536.00±10.40a	542.25±9.04a
21	1171.00±26.14a	1164.00±31.99a	1133.00±38.87a	1070.00±23.31a
28	2046.00±5.49a	2009.75±4.51a	1994.00±8.98a	1980.00±47.02a
35	3325.75±111.64a	3174.75±34.32ab	3170.25±33.80ab	3019.00±27.84b
42	4631.75±26.01a	4608.50±23.32a	4571.00±28.86a	4461.00±25.92b

*The different letters in the horizontal row indicate the significance of the means between the coefficients at a probability level 0.5%.

ISSN 2072-3857

From Table 5, the analysis of variance of the effect of adding jojoba seed oil to the diet on feed conversion efficiency of broiler chickens, the trait didn't record any significant differences at ages 7, 14, and 21 days between all experimental treatments. Feed conversion efficiency improved significantly at 28 days for the addition treatments compared to the first treatment, while it improved significantly for the fourth treatment compared to the first, second, and third treatments at 35 days. A significant improvement was obtained for the third and fourth treatments compared to the second and first treatments at 42 days.

Table 5: The effect of adding jojoba oil on feed conversion rate For 1-6 weeks of broiler **(mean ± std Error).**

Bird age in days	Treatments			
	T1: Without adding jojoba seed oil	T2: 100 mg/kg jojoba seed oil	T3: 200 mg/kg jojoba seed oil	T4: 300 mg/kg jojoba seed oil
7	0.84±0.02a	0.77±0.03a	0.79±0.03a	0.81±0.02a
14	1.05±0.02a	1.03±0.04a	1.02±0.04a	1.01±0.03a
21	1.14±0.05a	1.12±0.03a	1.12±0.03a	1.05±0.01a
28	1.31±0.02a	1.22±0.01b	1.22±0.01b	1.20±0.03b
35	1.53±0.06a	1.47±0.01a	1.46±0.01a	1.33±0.02b
42	1.59±0.01a	1.58±0.02a	1.53±0.008b	1.48.0.01b

*The different letters in the horizontal row indicate the significance of the means between the coefficients at a probability level 0.5%.

Discussion

Numerous previous studies on jojoba seed oil have indicated the significant role as an antimicrobial, antioxidant, anti-inflammatory, antifungal, and antihyperglycemic agent [10; 12]. Jojoba seed oil contains 20 types of bioactive fatty acids with important effects on the body that can stimulate growth [3].

The improved growth and feed conversion efficiency observed in treatments supplemented with 300 mg/kg of jojoba seed oil may be attributed to its chemical composition, which includes long-chain wax esters, unsaturated fatty acids such as eicosanes and erucic acids, fatty alcohols, sterols, vitamin E, and antioxidants. This formulation may contribute to increased poultry weight when used in their feed, as eicosanoid and erucic acids are high-energy sources that help increase the total energy in the feed, leading to weight gain. Vitamin E and antioxidants reduce oxidative stress and improve digestive health, and fatty alcohols support absorption, improving fat emulsification and thus facilitating the absorption of fat-soluble vitamins, thereby improving growth efficiency.

Jojoba oil is considered a natural feed additive rich in bioactive compounds, primarily composed of long-chain wax esters in addition to phenolic compounds and tocopherols, which collectively contribute to improving the productive

ISSN 2072-3857

performance of broiler chickens through integrated physiological and nutritional mechanisms. Jojoba oil enhances digestive efficiency and nutrient absorption by improving digestive enzyme activity and maintaining intestinal mucosal integrity, thereby increasing the utilization of dietary energy and nutrients and resulting in improved growth rate and feed conversion efficiency. Moreover, its antioxidant properties play a crucial role in mitigating oxidative stress and protecting muscle cells from free-radical damage, which positively affects metabolic efficiency and meat quality. Jojoba oil also exhibits antimicrobial activity within the gastrointestinal tract, supporting gut microbial balance and intestinal health, and consequently enhancing nutrient absorption. In addition, it contributes to immune modulation by reducing inflammatory responses and strengthening immune function, thereby minimizing energy diversion toward immune defense and directing it toward growth and productivity. Collectively, these synergistic effects lead to improved overall productive performance and health status of broiler chickens, highlighting jojoba oil as a promising natural feed additive in modern poultry production systems.

Conclusions

Our study results indicate that adding jojoba seed oil to broiler chicken feed in small amounts (300 mg/kg) can improve growth, feed conversion efficiency, and reduce feed consumption in 42-day-old broiler chicks. The effect of jojoba oil began gradually and became more pronounced after the 35th day of the birds' age.

REFERENCES

[1

] MacLean, R. C.,&San Millan, A. (2019). The evolution of antibiotic resistance. *Science*, *365*(6458), 1082-1083. https://doi.org/10.1126/science.aax3879

[2] Abdel-Wareth, A. A. A., Ahmed, A. E., Hassan, H. A., Abd El-Sadek, M. S., Ghazalah, A. A., & Lohakare, J. (2019). Nutritional impact of nano-selenium, garlic oil, and their combination on growth and reproductive performance of male Californian rabbits. *Animal Feed Science and Technology*, *249*, 37-45. https://doi.org/10.1016/j.anifeedsci.2019.01.016

[3] Abdel-Wareth, A. A., Mobashar, M., Shah, A.,&Sadiq, A. B. (2022). Jojoba seed oil as feed additive for sustainable broiler meat production under hot climatic conditions. *Animals*, *12*(3), 273. https://doi.org/10.3390/ani12030273

[4] Stevanović, Z. D., Bošnjak-Neumüller, J., Pajić-Lijaković, I., Raj, J.,&Vasiljević, M. (2018). Essential oils as feed additives—Future perspectives. *Molecules*, *23*(7), 1717. https://doi.org/10.3390/molecules23071717

[5] Spencer, G. F., Plattner, R. D.,&Miwa, T. (1977). Jojoba oil analysis by high pressure liquid chromatography and gas chromatography/mass spectrometry. *Journal of the American Oil Chemists' Society*, *54*(5), 187-189. https://doi.org/10.1007/BF02676270

[6] Sobhy, H. M., Khallaf, R. M.,&Elmahdy, A. M. (2024). Effect of Jojoba Oil as a Growth Promoter on Body Weight, Protein Profile, and Biochemical Parameters in Turkey. *Alexandria Journal of Veterinary Sciences*, *81*(1). http://dx.doi.org/10.5455/ajvs.187991

[7] Abdelsalam, M. M., Hassan, H. A., Ismail, Z. S. H., Salem, W. M., El-Sayed, H. G. M.,&Abdel-Wareth, A. A. A. (2021).

ISSN 2072-3857

Response of broiler chickens to jojoba oil and silver nanoparticles dietary supplementation. *SVU-International Journal of Agricultural Sciences*, *3*(3), 122-130. https://doi.org/10.21608/svuijas.2021.78354.1111

[8] NRC, National Research Council. 1994. Nutrient Requirements of Poultry. 9th Rev. Ed. National academy press. Washington, DC, U.S.A. p176. https://doi.org/10.1093/japr/3.1.101

[9] Statistical Analysis System Institute. 1999. SAS/STAT user's guide (Vol. 3). SAS Publ.

[10] Duncan DB (1955). Multiple rang and multiple F-test. Biometrics, 11: 4-42. https://doi.org/10.2307/3001478

[11] Gad, H. A., Roberts, A., Hamzi, S. H., Gad, H. A., Touiss, I., Altyar, A. E., ...&Ashour, M. L. (2021). Jojoba oil: an updated comprehensive review on chemistry, pharmaceutical uses, and toxicity. *Polymers*, *13*(11), 1711. https://doi.org/10.3390/polym13111711

[12] Wisniak, J. (1994). Potential uses of jojoba oil and meal—A review. *Industrial Crops and products*, *3*(1-2), 43-68. https://doi.org/10.1016/0926-6690(94)90077-9

ISSN 2072-3857