

Research Article



Single and Combined Effect of Plant Extracts (*Ocimum sanctum* and *Silybum marianum*) on Growth Performance of Broilers

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Abstract | *Ocimum sanctum*, an annual fragrant herbaceous plant in the Lamiaceae family, is used for decoration, cooking, and medicinal purposes, particularly in ancient medicine for treating various diseases. *Silybum marianum*, another herbal supplement, is commonly used to treat stomach problems, lower blood cholesterol, and address liver issues. The present study involved 450 one-day-old Ross broiler chicks, which were employed in an experiment. The broilers were divided into six groups, each containing 75 chicks and three replicates, to examine the effects of plant extracts from *Ocimum sanctum* and *Silybum marianum*. The control group (T1) was given a basal diet, while the treatment groups (T2 and T3) were supplemented with *Ocimum sanctum* extract (5 and 10 g/kg), T4 and T5 with *Silybum marianum* extract (5 and 10 g/kg), and T6 with a combination of both extracts (5 g *Ocimum sanctum* + 5 g *Silybum marianum*). Results indicated a highly significant increase ($P \leq 0.01$) in mean live body weight during the last two weeks of rearing (weeks 4 and 5) in treatments T5 and T6, which contained 10 g/kg of *Silybum marianum* and a combination of 5 g/kg *Ocimum sanctum* + 5 g/kg *Silybum marianum*, respectively, compared to the control group (T1). Weekly weight gain was similar across all groups during the first three weeks; however, in the fourth week, all treatment groups significantly outperformed compared to the T1. In the fifth week, treatments T5 and T6 showed superior weight gain compared to T1 and the other treatments. Feed consumption was significantly lower ($P \leq 0.01$) in T5 during the third, fourth, and fifth weeks compared to T1 and the other treatments. Furthermore, there was a highly significant improvement in feed conversion ratio (FCR) in the treated groups, particularly T5 and T6, compared to T1 during the second, fourth, and fifth weeks. The best productive performance at broiler chicken marketing age was achieved by adding 10 g/kg of *Silybum marianum* and 5 g/kg of each extract of *Ocimum sanctum* and *Silybum marianum*.

Keywords | Broiler, Growth, *Ocimum saintum*, *Silybum marianum*

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INTRODUCTION

Certain therapeutic plants have gained significant attention in recent years as alternatives to antibiotics in poultry feed, which were traditionally used to enhance growth and improve digestive efficiency (Kadhim, 2023;

Ajafar *et al.*, 2024). The use of antibiotics, however, has been shown to negatively impact both animal and human health, contributing to the development of antibiotic resistance. As a result, research has increasingly focused on finding natural, plant-based alternatives (Miles *et al.*, 2006; Salman *et al.*, 2024). Among these alternatives, medicinal

plants have been incorporated into poultry feed, helping to enhance the immunity of chicks against diseases (Rahmatnejad *et al.*, 2009; Al-Jebory *et al.*, 2024).

Ocimum sanctum extract has been added to poultry feed due to its positive effects on growth (Bishnu *et al.*, 2009) and its benefits for animal and human health. This plant contains antimicrobial and antioxidant compounds, with reported properties such as antifertility, anticancer, antibacterial, antifungal, antimicrobial, hepatoprotective, and antioxidant effects (Joshi *et al.*, 2009; Subramanian *et al.*, 2005). The increased antioxidant capacity observed in broiler chickens may be due to the high levels of flavonoids found in *Ocimum sanctum* at higher inclusion rates (Swathi *et al.*, 2005).

Silybum marianum, also known as milk thistle, is another medicinal plant from the Asteraceae family, which contains a variety of bioactive compounds, including flavonoids. The key active components of *Silybum marianum* include Silybin, Silymarin, Taxifolin, and Quercetin (Fraschini *et al.*, 2002). This plant has become increasingly popular in animal nutrition (Stastnik *et al.*, 2020). The seeds of *Silybum marianum* contain variable protein levels (160–300 g/kg) and many essential amino acids (Aziz *et al.*, 2021). Additionally, the crude fat in *Silybum marianum* seeds has a beneficial fatty acid composition, particularly rich in oleic and linoleic acids (Majidi *et al.*, 2021). Studies on *Silybum marianum* in broiler feeds have shown varying results. Some researchers found a decrease in weight gain when *Silybum marianum* oil was added to feed at 5 or 15% (Štastník *et al.*, 2015). Similarly, Gharahveysi (2017) reported a decline in feed intake and body weight when 0.3% or 3% of ground *Silybum marianum* was included in the diet. However, Muhammad *et al.* (2012) observed that chickens fed with 10 g/kg of *Silybum marianum* showed improvements in body weight and feed conversion ratio.

The aim of this study was to investigate how the addition of *Ocimum sanctum* and *Silybum marianum* extracts, both separately and in combination, affected broiler chicken performance.

MATERIAL AND METHODS

EXPERIMENTAL DESIGN AND TREATMENTS

An experiment was conducted for 35 days using 450 Ross 308 broiler chickens reared at the poultry farm of the Animal Production Department at Al-Furat Al-Awsat Technical University. The aim was to examine the effects of two plant extracts—*Ocimum sanctum* and *Silybum marianum*—added to the feed on various productive traits of the chickens. The chicks were divided into six experimental treatments, with three replicates per treatment, each consisting of 25 chicks. The treatments were as follows:

- Treatment 1 (T1): Control (no additives).
- Treatment 2 (T2): *Ocimum sanctum* extract at 5 g/kg of feed.
- Treatment 3 (T3): *Ocimum sanctum* extract at 10 g/kg of feed.
- Treatment 4 (T4): *Silybum marianum* extract at 5 g/kg of feed.
- Treatment 5 (T5): *Silybum marianum* extract at 10 g/kg of feed.
- Treatment 6 (T6): Combination of Treatments 2 and 4 (5 g/kg *Ocimum sanctum* + 5 g/kg *Silybum marianum*).

The chicks were fed a starter diet with 23% protein and 3027 kcal/kg energy content from day one until week 3. After week 3, the chicks were switched to a final diet with 20% protein and 3196 kcal/kg energy content, which continued until the end of the experiment at week 5. Water and feed were provided ad libitum, and all ideal growth conditions, including temperature, ventilation, and relative humidity, were maintained.

Weekly measurements were taken for various productive parameters, including feed intake, feed conversion ratio, live body weight, and weight gain per bird (Kadhim, 2023).

DATA ANALYSIS

Data were analyzed using a completely randomized design, and the SAS (2012) program was employed to assess significant differences using the mathematical model $Y_{ij} = \mu + T_i + e_{ij}$.

RESULTS AND DISCUSSION

LIVE BODY WEIGHT

The purpose of this experiment was to investigate the effectiveness of plant extracts *Ocimum sanctum* and *Silybum marianum* as growth promoters in broiler chickens. The average live body weights (g) of the groups were recorded over the five-week experimental period, as shown in Table 1. According to the table's results, there were no significant differences ($P > 0.01$) among the treatments for body weight during the first three weeks of age. However, in the fourth week, a significant difference ($P < 0.05$) was observed among the treatments, with treatments 5 and 6 performing better and showing a significant difference ($P < 0.05$) compared to the control group. The differences between treatments 2, 3, and 4 were smaller. The control group did not differ significantly from treatments 2, 3, and 4.

In the fifth week, the treatments showed significant differences ($P < 0.05$). Treatments 5 and 6 outperformed the control group, as well as treatments 2, 3, and 4. However, there was a considerable difference between treatments 5 and 6 compared to treatments 2, 4, and the control group. The increase in body weight may be attributed to the anti-

oxidant content in the plant extracts, which enhance digestive enzymes and reduce harmful bacterial activity, leading to improved body weight in broiler chicks.

Table 1: Single and combined effect of *Ocimum sanctum* and *Silybum marianum* extracts on the broiler's live body weight (Mean $\pm$ Standard error).

Treatments	Live body weight g / chick					
	Day one	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week
T1	43	192.56 $\pm$ 1.07	460.2 $\pm$ 3.44	895.6 $\pm$ 14.89	1493.6 $\pm$ 22.70	2017.4 $\pm$ 31.19b
T2	43	187.48 $\pm$ 1.22	461.6 $\pm$ 2.73	916.4 $\pm$ 12.55	1589.2 $\pm$ 35.12	2061.3 $\pm$ 47.88ab
T3	43	191.96 $\pm$ 1.34	468.2 $\pm$ 4.22	920.7 $\pm$ 17.12	1597.1 $\pm$ 32.80	2178.6 $\pm$ 22.85ab
T4	43	188.44 $\pm$ 0.89	472.4 $\pm$ 5.02	915.2 $\pm$ 16.22	1575.8 $\pm$ 22.86	2049.6 $\pm$ 43.22ab
T5	43	191.8 $\pm$ 1.05	478.2 $\pm$ 3.68	937.6 $\pm$ 14.76	1614.3 $\pm$ 24.56	2240.8 $\pm$ 66.23a
T6	43	189.44 $\pm$ 1.24	474.8 $\pm$ 4.77	938.36 $\pm$ 11.59	1602.8 $\pm$ 20.45	2234.2 $\pm$ 11.49a
Significance	N.S.	N.S.	N.S.	N.S.	**	**

T1: control; **T2:** 5 g/kg of *Ocimum sanctum*; **T3:** 10 g/kg of *Ocimum sanctum*; **T4:** 5 g/kg of *Silybum marianum*; **T5:** 10 g/kg of *Silybum marianum*; **T6:** 5 g/kg of *Ocimum sanctum* + 5 g/kg of *Silybum marianum*. ** Different letters refer to differ mean from each other within the same column ($P \leq 0.01$). N.S: Not Significant.

Table 2: Single and combined effect of *Ocimum sanctum* and *Silybum marianum* extracts on weight gain of broiler chickens (Mean $\pm$ Standard error).

Treatments	Weight gain g / chick				
	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week
T1	149.56 $\pm$ 5.23	267.64 $\pm$ 20.43	435.4 $\pm$ 25.85	598 $\pm$ 50.32 b	523.8 $\pm$ 77.11b
T2	144.48 $\pm$ 3.65	274.12 $\pm$ 11.65	454.8 $\pm$ 38.95	672.8 $\pm$ 33.43 a	472.1 $\pm$ 34.59c
T3	148.96 $\pm$ 4.77	276.24 $\pm$ 18.80	452.5 $\pm$ 12.90	676.4 $\pm$ 61.82 a	581.5 $\pm$ 55.87b
T4	145.44 $\pm$ 6.18	283.96 $\pm$ 24.11	442.8 $\pm$ 11.63	660.6 $\pm$ 23.41ab	473.8 $\pm$ 67.34c
T5	148.8 $\pm$ 2.34	286.4 $\pm$ 15.45	459.4 $\pm$ 33.75	676.7 $\pm$ 20.54 a	606.2 $\pm$ 30.46a
T6	146.44 $\pm$ 3.87	285.36 $\pm$ 11.23	463.56 $\pm$ 16.44	664.44 $\pm$ 66.61ab	631.4 $\pm$ 80.65a
Significance	N.S.	N.S.	N.S.	**	**

T1: control; **T2:** 5 g/kg of *Ocimum sanctum*; **T3:** 10 g/kg of *Ocimum sanctum*; **T4:** 5 g/kg of *Silybum marianum*; **T5:** 10 g/kg of *Silybum marianum*; **T6:** 5 g/kg of *Ocimum sanctum* + 5 g/kg of *Silybum marianum*. ** Different letters refer to differ mean from each other within the same column ($P \leq 0.01$). N.S: Not Significant.

The results of this study are consistent with those of Singh *et al.* (2014), who observed an improvement in the live body weight of broiler chickens. This improvement was attributed to the antibacterial properties of flavonoids in *Ocimum sanctum*, which help maintain normal intestinal bacteria through competitive exclusion. Similarly, Alom *et al.* (2015) found that adding 2 ml/l of *Tulsi* leaf extract (*Ocimum sanctum*) to the drinking water of broiler chickens significantly increased their live body weight during the third and fourth weeks of life.

Moreover, Janocha *et al.* (2021) reported that adding 2% *Silybum marianum* seeds in the starter diet and 3% in the grower diet significantly improved body weight in broilers by day 42 of rearing compared to the control group. In contrast, the findings of Suchí *et al.* (2008) did not align with ours, as they found that adding *Silybum marianum* to broiler feeds resulted in a statistically significant reduction in body weight.

WEIGHT GAIN

The weekly weight gain of the broiler chickens for each treatment is shown in Table 2. There were no significant differences in weight gain during the first, second, or third weeks. However, in the fourth week, significant differences ($P \leq 0.01$) were observed in weight gain. Specifically, treatments 2, 5, and 3 outperformed the control group and the other treatments, while treatments 4 and 6 did not differ significantly from the other treatments. There was no noticeable difference between treatments 4 and 6 and the control group.

In the fifth week, treatments 6 and 5 showed the highest weight gain, followed by treatment 3. Treatments 2 and 4 exhibited the lowest weekly weight gain rates. The improvement in weight gain may be attributed to the presence of a variety of compounds in *Silybum marianum* leaves, including terpenes, flavonoids, saponins, resins, oils, and essential elements such as calcium, selenium, and phosphate, in addition to chlorophyll (Duke, 2004).

These results are consistent with those of Biswas *et al.* (2017), who found that broilers given 1 ml/liter of *Ocimum sanctum* extract in their drinking water showed numerically higher weight gain compared to the control group. Similarly, the findings align with Gawel *et al.* (2003), who administered a commercial preparation containing 80% silymarin at a dose of 0.5 kg/ton of feed to broilers. Their study revealed that the experimental groups had 4.8% higher final body weights than the control group.

FEED INTAKE

From Table 3, it is evident that weekly feed intake did not show significant differences between the first and second weeks of the trial. However, meaningful differences ($P \leq$

0.05) were observed in the third week. In this week, treatment 5 had the lowest feed intake, followed by treatment 3, which did not differ significantly from the control treatment or the other treatments. Treatment 6 had the highest feed intake. A similar pattern was observed in the fourth and fifth weeks, where treatment 4 consumed the most feed, and treatment 5 had the lowest feed intake.

Table 3: Single and combined effect of *Ocimum sanctum* and *Silybum marianum* extracts on feed intake of broiler chickens (Mean $\pm$ Standard error).

Treatments	Feed intake g / chick				
	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week
T1	214 $\pm$ 8.32	367.4 $\pm$ 13.63	546 $\pm$ 18.86a	710 $\pm$ 16.20 a	903 $\pm$ 54.32ab
T2	216 $\pm$ 5.45	362.4 $\pm$ 24.81	552 $\pm$ 27.75a	734 $\pm$ 32.12 a	912 $\pm$ 66.91ab
T3	211 $\pm$ 3.66	359.2 $\pm$ 20.45	522 $\pm$ 32.56ab	696 $\pm$ 15.74ab	884 $\pm$ 18.37b
T4	214 $\pm$ 7.23	365.2 $\pm$ 11.40	565 $\pm$ 16.74a	731 $\pm$ 70.21 a	1001 $\pm$ 32.41a
T5	212 $\pm$ 6.23	355.4 $\pm$ 18.22	497 $\pm$ 30.33 b	685 $\pm$ 22.34 b	869 $\pm$ 16.44b
T6	210 $\pm$ 4.55	366.7 $\pm$ 9.98	571 $\pm$ 42.15 a	722 $\pm$ 33.18 a	995 $\pm$ 51.64a
Significance	N.S	N.S	*	*	*

T1: control; **T2:** 5 g/kg of *Ocimum sanctum*; **T3:** 10 g/kg of *Ocimum sanctum*; **T4:** 5 g/kg of *Silybum marianum*; **T5:** 10 g/kg of *Silybum marianum*; **T6:** 5 g/kg of *Ocimum sanctum* + 5 g/kg of *Silybum marianum*. * Different letters refer to differ mean from each other within the same column ($P \leq 0.05$). N.S: Not Significant.

The improved weight gain in birds fed rations containing *Ocimum sanctum* and *Silybum marianum* extracts can be attributed to better feed utilization efficiency, which resulted in enhanced growth and better feed intake. Vasanthakumar *et al.* (2013) reported a significant increase in feed intake at 42 days of age when 0.1% *Ocimum sanctum* extract was added to the diet compared to the control group, which is consistent with the findings of our study. Similarly, Slyranda *et al.* (2011) reported that chicks receiving 100 mg of onion consumed more feed than the other groups during the 21-day experiment. This aligns with our results when 5 and 10 g/kg of *Ocimum sanctum* were added from 21 to 35 days of age.

FEED CONVERSION RATIO

The amount of meat stored in the body is influenced by the feed conversion rate of the feed provided to the broilers. Table 4 shows that there were no significant differences in feed conversion during the first and fourth weeks of life. However, in the second week, significant differences ($P \leq$

0.01) were observed, with the best feed conversion ratio found in the treatments supplemented with plant extracts, particularly in treatments 4, 5, and 6. The control treatment had the poorest feed conversion ratio, and there were no significant differences between treatments 2 and 3.

Table 4: Single and combined effect of *Ocimum sanctum* and *Silybum marianum* extracts on the broiler's feed conversion ratio (Mean $\pm$ Standard error).

Treatments	Feed conversion ratio / chick				
	1 st Week	2 nd Week	3 rd Week	4 th Week	5 th Week
T1	1.43 $\pm$ 0.7	1.4 $\pm$ 0.18 a	1.25 $\pm$ 0.14 a	1.18 $\pm$ 0.20	1.72 $\pm$ 0.15 b
T2	1.49 $\pm$ 0.4	1.32 $\pm$ 0.6 ab	1.21 $\pm$ 0.14 a	1.09 $\pm$ 0.22	1.93 $\pm$ 0.14 b
T3	1.41 $\pm$ 0.5	1.3 $\pm$ 0.11 ab	1.15 $\pm$ 0.18 ab	1.02 $\pm$ 0.32	1.52 $\pm$ 0.15 c
T4	1.47 $\pm$ 0.5	1.28 $\pm$ 0.11 b	1.27 $\pm$ 0.14 a	1.1 $\pm$ 0.31	2.11 $\pm$ 0.14 a
T5	1.42 $\pm$ 0.3	1.24 $\pm$ 0.6 b	1.08 $\pm$ 0.16 b	1.01 $\pm$ 0.17	1.43 $\pm$ 0.18 c
T6	1.43 $\pm$ 0.4	1.28 $\pm$ 0.7 b	1.23 $\pm$ 0.22 a	1.08 $\pm$ 0.14	1.57 $\pm$ 0.16 c
Significance	N.S	**	**	N.S	**

T1: control; **T2:** 5 g/kg of *Ocimum sanctum*; **T3:** 10 g/kg of *Ocimum sanctum*; **T4:** 5 g/kg of *Silybum marianum*; **T5:** 10 g/kg of *Silybum marianum*; **T6:** 5 g/kg of *Ocimum sanctum* + 5 g/kg of *Silybum marianum*. ** Different letters refer to differ mean from each other within the same column ($P \leq 0.01$). N.S: Not Significant.

In the third week, a notable difference in feed conversion was observed, with treatment 5 showing the best feed conversion, followed by treatment 3. The control, treatments 2, 4, and 6 had the worst feed conversion ratios. By the fifth week, treatments 5, 3, and 6 demonstrated superior feed conversion compared to the control and other treatments, which had the lowest feed conversion ratios.

These results are consistent with those of Janocha *et al.* (2021), who found that adding *Silybum marianum* at 2% and 3% in feed rations led to the highest body weight and the best feed conversion ratio. Similarly, Ahmad *et al.* (2020) reported that a feed conversion ratio and final body weight were significantly ($P < 0.05$) better in rations containing 15 g/kg of *Silybum marianum* compared to other experimental groups. Furthermore, Alina *et al.* (2021) found that incorporating *Silybum marianum* into the feed during the rearing period resulted in a significant increase in body weight on the 42nd day ($P < 0.05$) and a marked improvement in feed conversion ratio ($P < 0.05$) when compared to the control group.

The single application of *Silybum marianum* at 10 g/kg of feed and the combined application of *Ocimum sanctum* and *Silybum marianum* at 5 g/kg of each extract resulted in the best production performance at the marketing age of broiler chickens.

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NOVELTY STATEMENT

Most previous studies have focused on the supplementation of plant extracts (*Ocimum sanctum* and *Silybum marianum*) on the growth performance of broilers. However, our study is novel in that it only focuses on the effects of Single and combined effects of plant extracts (*Ocimum sanctum* and *Silybum marianum*)

AUTHOR'S CONTRIBUTIONS

Mohammed Jard Kadhim: Research design; Data analysis; Methodology; Validation; Investigation; Mohanad K. Ulsagheer: Writing- original draft preparation; Writing—review and editing. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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