Effect of Different Levels of Folic Acid Supplementation in Drinking Water on the Productive Performance of Cobb 500 and Ross 308 Broiler Chickens

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Abstract

The research was conducted in the poultry field of the Department of Animal Production,College of Agriculture - Al-Qasim Green University, from March 20, 2026 to April 16, 2026, with the aim of studying the effect of the type of broiler chicken and the level of organic formic acid and their interaction on a number of productive traits for both Cobb 500 and Ross 308, after exposing each of them to five treatments or levels of formic acid in a factorial experiment design applied with a completely randomized design (CRD) (2 x 5 = 10) with 3 replicates for each treatment with 10 birds in each replicate. the total number of birds is 300 birds. The results showed highly significant differences (P≤0.01) between both broiler breeds, Cobb 500 and Ross 308, in weekly body weight. Cobb 500 breed excelled on the Ross 308 breed throughout all weeks of the study. Furthermore, there was a highly significant variation (P≤0.01) in body weight during weeks 1, 3, 4, and 5, and a significant variation (P≤0.05) in second week, depending on the formic acid treatment. The interaction effect between broiler breed and formic acid treatment on weekly body weight was also highly significant (P≤0.05).

There were highly significant differences (P≤0.01) between cobb 500 and Ross 308 broiler breeds in weekly weight gain rates during the first, second, and third weeks, as well as in cumulative weight gain. Cobb 500 breed excelled on the Ross 308, with weekly weight gain rates of 154.00, 392.67, 672.67, and 2318.00 g, respectively, compared to 143.13, 314.13, and 446.67 g for the Ross 308 breed. The differences between both broiler breeds were significant (P≤0.05) at Fourth week (604.27 g) and highly significant at Fifth week (692.60 g), again favoring the Ross 308 broiler breed. The highest cumulative weight gain was observed in the birds treated with 4% Formic acid. (2426.67 g) with a highly significant difference compared to all other treatments, followed by the 3% and 2% treatments, and the lowest was the control treatment. As for the results of the interaction effect between bird species and formic treatment on cumulative weight gain, the highest rate for Cobb 500 was observed in the 4% formic treatment (2541.33 g) and the 3% formic treatment (2424.67 g). There were significant differences (P≤0.05) between cobb 500 and Ross 308 broiler breeds in feed consumption during the first week (149.73 and 145.47 g, respectively) and the third week (634.93 and 622.73 g, respectively), with cobb 500 breed exhibiting the highest feed consumption. A highly significant effect (P≤0.01) of formic acid treatment was observed in feed consumption during the third week and cumulatively, with birds treated with 4% formic acid achieving the highest consumption rate. The interaction effect between breed and treatment was also highly significant for both the third week and cumulatively. The overall feed conversion ratio was better in Cobb 500 broiler chickens (1.425 kg feed/kg meat) compared to Ross 308. The treatment with 4% formic acid supplementation showed the best feed conversion ratio at five weeks of age (1.651 kg feed/kg meat) and the overall average for the trait (1.376 kg feed/kg meat). It can be concluded that Cobb 500 broiler chickens receiving 4% formic acid supplementation exhibited the best productive performance among all experimental treatments..

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Introduction

Organic acids are an important addition to poultry feed, as they improve intestinal health, promote growth, and reduce reliance on antibiotics. They also contribute to maintaining a balance of beneficial and harmful bacteria in the gut, thus improving digestion and nutrient absorption [2,4]. Organic acids, or acidifiers, are added to feed to lower the pH of the feed, the digestive tract, and the microbial cytoplasm, and to inhibit the growth of pathogenic bacteria in the intestines. They reduce microbial competition for nutrients from the host and improve bird growth and performance. They also act as antiparasitic agents. The amount of organic acids used can range from 0.05% to 0.25% of a poultry's diet. Most organic acids are effective and retain their potency as long as they do not evaporate [3]. Recently, there has been increased interest and focus on safe, natural growth promoters as an alternative to traditional antibiotic growth promoters, most of which are used as feed additives to stimulate growth and prevent infection by certain pathogenic intestinal microbes [3,5). Formic acid is an organic acid widely used in poultry feed as an acidifying agent and antimicrobial. It reduces the growth of harmful bacteria such as Salmonella, Escherichia coli, and Campylobacter, thus improving digestive health and feed utilization efficiency. Formic acid is added the growth of harmful bacteria. It is also used in feed manufacturing as a substitute for other organic acids [2,18.to drinking water or poultry feed and is used in poultry feed treatment to reduce

Formic acid is used in poultry feed manufacturing as an alternative to other organic acids [2,4]. Some organic acids possess a very important characteristic: they have a direct effect (killing or inhibiting) on harmful bacteria such as Salmonella, E. coli, Campylobacter, Listeria monocytogenes, Clostridium perfringens, and others, much like antibiotics. Examples of such acids include formic, acetic, propionic, and sorbic acids. These acids have the ability to disrupt the bacterial cell wall and affect bacterial reproduction by inhibiting DNA replication and disrupting various physiological functions. Therefore, these acids receive considerable attention due to their potent effects and effectiveness[3,12]. [7] demonstrated that organic acids improve poultry health, welfare, and productivity. Furthermore, organic acids have emerged as a potential alternative toc in the health and productivity of poultry. [1] observed that organic acids help maintain the optimal pH of the digestive tract and correct the function of proteolytic enzymes. [9,13] showed that they increase protein digestibility, stimulate feed intake, and inhibit the growth of pathogenic bacteria. The aim of the current research was to study the effect of the interaction between broiler breed and levels of formic acid added to the water at different ratios on some productive traits of both Cobb 500 and Ross 308 chickens.

Materials and Methods

The experiment was conducted at the poultry farm of the Animal Production Department, College of Agriculture, Al-Qasim Green University, from March 20, 2026, to April 16, 2026, to study the effect of broiler breed, formic acid level, and their interaction on several productive traits of both Cobb 500 and Ross 308 chickens, after exposing each to five water levels. Formic acid treatments or levels were administered in a completely randomized (2 x 5 = 10) factorial experiment with 3 replicates per treatment, each replicate containing 10 birds, for a total of 300 birds. The birds were reared from one day old (with an initial weight between (39-41 g) until 35 days old.

The birds were obtained from the Al-Anwar Hatchery in Babylon province. The chicks were raised in a hall measuring 3 x 10 x 45 m, equipped with air extractors divided into pens by mesh metal partitions. Each pen measured

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1.5 x 1 m and was placed on a 5 cm layer of white wood shavings. A continuous lighting system was used, providing 23 hours of light per day, with one hour of darkness daily to acclimate the chicks to the darkness and prevent them from becoming agitated during sudden power outages. Feed was provided ad libitum in plastic feeders during the first week, one per chick, which was gradually replaced with hanging round feeders. Water was also provided ad libitum in inverted 3-liter plastic waterers during the first week, one per chick, which was then replaced with inverted 5-liter plastic waterers. The birds were fed a starter diet , finisher diet the chicks were randomly assigned to treatments and replicates. The experiment included the following treatments:

Cobb 500 and Ross 308 broiler chickens, each consisting of five treatments based on the levels of formic acid.

T1: Control treatment (no adding). T2, T3, T4, and T5: Formic acid was added to the drinking water at levels of 1%, 2%, 3%, and 4%, respectively.

The chicks were A preventive program was followedThe initial weight and weekly body weights up to 5 weeks of age were recorded using a digital scale with a sensitivity of 5 g (of Chinese origin). The weekly feed consumption per bird was also recorded as the difference between the feed provided and the remaining feed. The average weekly weight gain was calculated (the difference in weight between each week and the previous week), as well as the total weight gain. The feed conversion efficiency for each week and the overall average were calculated using the following formula:

Feed Conversion Efficiency (kg feed/kg meat) = Feed Consumed per Week / Weight Gain per Week.

Statistical Analysis:

The Statistical Analysis System [17] was used to analyze the data to study the effect of broiler breed, formic acid level, and their interaction on productive traits. This was done using a 2 x 5 factorial experiment with a completely randomized design (CRD). Significant differences between means were compared using [8] multiple-choice test.

Mathematical Model of the Experiment.

$$Y_{ijk} = \mu + B_i + T_j + BT_{(ij)} + e_{ijk}$$

Given that:

Yijk: observational value k for type i and treatment j. μ: overall mean for the studied trait. Bi: effect of broiler type i (Cobb 500 and Ross 308). Tj: effect of treatment j (the experiment included five treatments for formic acid levels). BT(ij): interaction effect between type i and treatment j (2 x 5 = 10). eijk: normally distributed random error with a mean of zero and a variance of σ2e.

Results and Discussion

Effect of Broiler Breed and Formic Acid Level on Weekly Body Weight Average:

Table (1) shows that there are highly significant differences (P≤0.01) between both broiler breeds, Cobb 500 and Ross 308, in the average weekly body weight. Cobb 500 breed excelled the Ross 308 breed in all weeks of the study. The average body weights from the first week to the fifth week were 196.00, 588.67, 1261.33, 1826.80, and 2360.00 g for cobb 500, while the averages were lower for the Ross 308 breed, reaching 181.13, 495.27, 941.93, 1546.20, and 2238.80 g respectively. The highly significant superiority of cobb 500 breed may be due to its genetic makeup and genetic makeup, and thus its ability to grow and achieve record weights [15]

The results of the current study showed a highly significant (P≤0.01) variability in average body weight during the first, third, fourth, and fifth weeks, and a significant (P≤0.05) variability in the second week of life,

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depending on the formic acid treatment. In the first (202.17 g), fourth (1754.33 g), and fifth (2466.67 g) weeks, birds treated with 4% formic acid gained the most weight. However, the highest average body weights were observed in the second (627.83 g) and third (1164.00 g) weeks for birds in the third treatment (3% formic acid). While the lowest body weights were observed in the control group and then in the group with 1% formic acid added (Table 1), the significant increase in body weight with increasing formic acid levels may be due to the fact that formic acid improves the immunity, vitality, and overall health of the birds[15, 16]which positively impacts their weight.

Table (1) shows the interaction effect between broiler breed and formic acid treatment on weekly body weight. All interactions were highly significant (P≤0.01). Cobb 500 broilers treated with 4% formic acid achieved the highest weekly body weights from week one to week five, reaching 210.67, 687.33, 1355.67, 1825.33, and 2583.33, respectively. The interaction effect between broiler breed and formic acid level, particularly the significant improvement of Cobb 500 breed with the 4% treatment, can be attributed to improved intestinal environment, inhibition of harmful bacteria, increased digestive efficiency and nutrient absorption, and promotion of beneficial bacteria growth. The acids improve protein digestion and facilitate the absorption of essential minerals such as calcium and phosphorus, which positively impacts bird weight gain [15,1].

Table 1: Effect of broiler strain breed, formic acid level, and their interaction on weekly body weight gain

Mean ± Standard Error (g)					Factors
week Fifth	week Fourth	week third	week second	week first	
					Type
2360.00 ±46.08 a	1826.80 ±19.21 a	1261.33 ±26.37 a	588.67 ±20.98 a	196.00 ±2.76 a	Cobb 500
2238.80 ±25.68 b	1546.20 ±43.15 b	941.93 ±15.31 b	495.27 ±23.51 b	181.13 ±2.34 b	Ross 308
**	**	**	**	**	significant level
					treatments
2178.67 ±31.75 c	1485.50 ±111.91 c	941.93 ±15.31 c	495.27 ±23.51 c	181.13 ±2.34 c	control
2028.67 ±158.83c	1690.00 ±62.66 b	1082.83 ±54.35 b	487.00 ±25.07 bc	186.83 ±3.21 b	1%
2350.00 ±36.51 b	1729.17 ±49.64 ab	1132.67 ±82.93 a	527.50 ±24.65 b	186.17 ±4.28 b	2%
2350.00 ±56.27 b	1773.50 ±64.60 a	1164.00 ±73.60 a	627.83 ±32.36 a	190.17 ±4.75 b	3%
2466.67 ±57.25 a	1754.33 ±36.57 a	1153.17 ±91.50 a	615.83 ±43.73 a	202.17 ±4.28 a	4%
**	**	**	*	**	significant level
					interaction
2166.67 ±33.33 f	1732.67 ±20.34 c	1110.00 ±5.77 c	472.67 ±1.76 de	183.33 ±5.69 cde	Cobb 500: control
1883.33 ±321.89 ef	1826.67 ±23.33 b	1203.67 ±9.13 b	542.67 ±6.35 cd	192.00 ±2.89 bcd	Cobb 500: 1%
2400.00	1836.67	1317.33	582.33 ±3.93	194.33 ±2.91	Cobb 500: 2%

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±28.87 bc	±26.67 b	±16.34 a	bc	bc	
2466.67 ±33.33 ab	1912.67 ±38.10 a	1320.00 ±51.31 a	685.33 ±15.89 ab	199.67 ±0.88 b	Cobb 500: 3%
2583.33 ±44.09 a	1825.33 ±40.43 b	1355.67 ±21.68 a	687.33 ±1.45 a	210.67 ±3.48 a	Cobb 500: 4%
2136.67 ±31.79 f	1238.33 ±33.45 f	841.00 ±5.19 e	430.67 ±5.21 e	171.67 ±0.88 f	Ross 308: control
2174.00 ±37.54 ef	1553.33 ±20.27 e	962.00 ±9.16 d	431.33 ±1.85 e	181.678 ±4.05 def	Ross 308: 1%
2300.00 ±57.73 cde	1621.67 ±7.26 de	948.00 ±4.04 d	472.67 ±4.25 de	178.00 ±4.04 ef	Ross 308: 2%
2233.33 ±33.33 def	1634.33 ±6.98 d	1008.00 ±12.66 d	597.33 ±63.67 abc	180.67 ±4.70 ef	Ross 308: 3%
2350.00 ±28.86 bcd	1683.33 ±3.33 cd	950.67 ±19.67 d	544.33 ±66.69 cd	193.67 ±2.73 bc	Ross 308: 4%
**	**	**	**	**	significant level
Means within the same column with different superscript letters differ significantly ($P \leq 0.05$) or highly significantly ($P \leq 0.01$)					

Effect of Broiler Breed and Formic Acid Level on Weekly and Total Weight Gain:

Table (1) shows highly significant differences (P≤0.01) between cobb 500 and Ross 308 broiler breeds in weekly weight gain rates during the first, second, and third weeks, as well as in cumulative weight gain. Cobb 500 breed excelled the Ross 308, with average weight gain rates of 154.00, 392.67, 672.67, and 2318.00 g for Cobb 500, while they were 143.13, 314.13, and 446.67 g for Ross 308. The differences between both broiler breeds were significant (P≤0.05) at week four (604.27 g) and highly significant at week five (692.60 g), favoring the Ross 308 broiler breed. 308. The significantly higher growth rate of cobb 500 in some weeks may be attributed to its genetic makeup and its resulting growth potential[10,11]. The Ross 308 superiority in weeks four and five may be due to its lower weight gain in the preceding weeks (third and fourth, respectively), which resulted in a difference in weight gain even though, as shown in Table 1, the body weight generally favored cobb 500 broiler. These values represent the overall averages for both breeds, each within a five-treatment range.

Table (2) shows that there is a highly significant effect (P≤0.01) of the treatment with formic organic acid on the rates of weekly and cumulative weight gain, except for the third week, where the variance was not significant. In the first week, the birds treated with 4% formic acid (162.17 g) were excelled. In the second week, the two treatments, 3% (437.67 g) and 4% (413.67 g), achieved the highest rates. In the fourth week, all treatments in which formic acid was used at percentages of 1, 2, 3 and 4% (607.17, 596.50, 609.50 and 601.17 g) were excelled (P≤0.01) to the control treatment (510.00 g) respectively. The 4% treatment (712.33 g) also excelled most of the other treatments studied in terms of average weight gain by the fifth week. The highest cumulative weight gain was recorded in the 4% Formic treatment (2426.67 g), significantly higher than all other treatments. This was followed by the 3% and 2% treatments, with the control treatment showing the lowest gain.

Table (2) shows the interaction effect between broiler breed and formic acid treatment on weekly and cumulative weight gain rates. All differences were highly significant (P≤0.01). Cobb 500 broilers treated with 4% formic acid achieved the highest rates in the first week (168.67 g), the second week (476.67 g), and the cumulative rate (2541.33 g). In the third week, Cobb 500 birds treated with 2% formic

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acid achieved the highest weight gain (735.00 g), followed by the 4% formic acid treatment for the same birds (668.33 g). The results in the fourth week favored Ross 308 broilers treated with 4% formic acid (732.67 g). In the fifth week, the highest weight gain was observed in Ross 308 birds compared to the control treatments (898.33 g). The cumulative weight gain resulting from the interaction between bird breed and formic acid treatment was highest for Cobb 500 at both the 4% formic acid treatment (2541.33 g) and the 3% formic acid treatment (2424.67 g).

The interaction between broiler breed and formic acid level, particularly the significant advantage of Cobb 500 at the 4% treatment, can be explained by the fact that formic acid improves the immunity, vitality, and health of birds[14,16] , which positively impacts their weight. Furthermore, Cobb 500 broiler chicks already outweighed Ross 308 in weight, thus demonstrating a highly significant interaction effect.

Table 2: Effect of Formic Acid Supplementation Levels and Broiler Strain on Weekly and Total Weight Gain

Mean ± Standard Error (g)						
total	week Fifth	week Fourth	week third	week second	week first	Factors
						Type
2318.00 ±46.08 a	533.20 ±40.67 b	565.47 ±20.79 b	672.67 ±14.15 a	392.67 ±18.76 a	154.00 ±2.75 a	Cobb 500
2200.80 ±25.68 b	692.60 ±321.87 a	604.27 ±31.52 a	446.67 ±20.99 b	314.13 ±23.33 b	143.13 ±2.34 b	Ross 308
**	**	*	**	**	**	significant level
						treatments
2111.67 ±21.40 c	666.17 ±105.14 ab	510.00 ±53.61 b	523.83 ±50.91	274.17 ±7.39 b	137.50 ±3.09 c	control
2138.67 31.71 c	488.67 ±62.03 c	607.17 ±11.38 a	595.83 ±29.63	300.17 ±22.87 b	146.83 ±22.86 b	1%
2310.00 ±35.97 b	620.83 ±39.34 ab	596.50 ±38.39 a	605.17 ±58.80	341.33 ±21.23 b	146.17 ±3.54 b	2%
2310.01 ±55.44 b	576.50 ±26.90 bc	609.50 ±26.90 a	536.17 ±66.7	437.67 ±32.81 a	150.17 ±3.98 b	3%
2426.67 ±56.43 a	712.33 ±44.24 a	601.17 ±63.08 a	537.33 ±68.77	413.67 ±41.41 a	162.17 ±3.51 a	4%
**	**	**	N.S	**	**	significant level
						interaction
2124.67 ±33.33 f	434.00 ±37.00 de	622.67 ±14.62 b	637.33 ±7.51 ab	289.33 ±4.37 cd	141.33 ±5.69 cde	Cobb 500: control
2141.33 ±60.09 f	356.67 ±37.11 e	623.00 ±14.22 b	661.00 ±5.51 a	350.67 ±6.74 bcd	150.00 ±2.89 bcd	Cobb 500: 1%
2358.00 ±28.87 c	563.33 ±14.53 cd	519.33 ±37.24 cd	735.00 ±19.13 a	388.00 ±6.81 abc	152.33 ±2.91 bc	Cobb 500: 2%
2424.67 ±33.33 a	554.00 ±40.51 cd	592.67 ±43.38 bc	661.67 ±57.76 a	458.67 ±16.45 a	157.67 ±0.88 b	Cobb 500: 3%
2541.33 ±44.09 a	758.00 ±82.80 b	469.67 ±46.21 de	668.33 ±22.63 a	476.67 ±2.03 a	168.67 ±3.48 a	Cobb 500: 4%

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2098.67 ±31.79 f	898.33 ±1.67 a	397.33 ±38.23 e	410.33 ±4.91 d	259.00 ±4.93 d	133.67 ±0.88 e	Ross 308: control
2136.00 ±37.54 f	620.67 ±20.98 c	591.33 ±13.98 bc	530.67 ±10.65 bc	249.67 ±4.33 d	143.67 ±4.05 cde	Ross 308: 1%
2262.00 ±57.73 c	678.33 ±64.95 bc	673.67 ±5.24 ab	475.33 ±8.17 cd	294.67 ±5.33 cd	140.00 ±4.04 de	Ross 308: 2%
2195.33 ±33.33 df	599.00 ±38.35 c	626.33 ±15.37 b	410.67 ±56.42 d	416.67 ±68.33 ab	142.67 ±4.70 cde	Ross 308: 3%
2312.00 ±28.86 cd	666.67 ±29.06 bc	732.67 ±21.61 a	406.33 ±77.29 d	350.67 ±67.84 bcd	155.67 ±2.73 b	Ross 308: 4%
**	**	**	**	**	**	significant level
The means with different letters within one column/factor differ significantly from each other. *(P≤0.05), **(P≤0.01), n.s. significant.						

Effect of Broiler Breed and Formic Acid Level on Weekly Feed Consumption:

Table (3) shows significant differences (P≤0.05) between cobb 500 and Ross 308 broiler breeds in feed consumption during the first week (149.73 and 145.47 g/bird, respectively) and the third week (634.93 and 622.73 g/bird, respectively). Cobb 500 breed excelled the Ross 308. However, no significant differences were found between the two breeds for the second, fourth, fifth, and cumulative weeks. The significant difference in feed consumption between cobb 500 broiler breeds may sometimes be due to their higher body weight, resulting in higher feed consumption. Table (3) shows that there is a highly significant effect (P≤0.01) of the treatment with formic organic acid on the rate of feed consumption at the third week and cumulatively. In the third week, the birds in the 4% formic treatment achieved the highest rate (655.33 g/bird) with a clear difference from the birds of the rest of the treatments, whose rates reached 611.50, 621.17, 635.17 and 621.00 g/bird for the control treatments and 1%, 2% and 3% formic respectively. The cumulative feed consumption rate was highest in birds treated with 4% formic acid (3330.33 g/bird), followed by the 3% formic acid treatment (3299.00 g/bird), then the 2% formic acid treatment (3284.17 g/bird), and lowest in birds in the control group (3235.50 g/bird) and the 1% formic acid treatment (3250.17 g/bird). The highly significant differences in feed consumption at week 3 and cumulatively between treatments, particularly those with increased formic acid content and especially the treatment with 4% formic acid, may be attributed to the fact that organic acids, including formic acid, increase protein digestibility [6] stimulate feed intake, inhibit the growth of pathogenic bacteria, and activate pepsin, the enzyme responsible for protein digestion, thus maximizing nutrient utilization in the feed [9,(Mohmoud et al., 2020;). Table (3) shows the effect of the interaction between the type of broiler chicken and the treatment with formic on the rate of feed consumed, as it was significant (P≤0.05) at the first week, and the birds Cobb 500 control group (151.33 g/bird), Cobb 500 with 2% formic (151.00 g/bird), Ross 308 with 3% formic (150.00 g/bird), and Ross 308 with 4% formic (151.00 g/bird) achieved the highest rates. Furthermore, the interaction between breed and treatment in feed consumption was highly significant (P≤0.01) in the third week, with the highest feed consumption recorded in Cobb 500 broilers treated with 4% formic acid (664.00 g/bird(Highly significant differences (P≤0.01) were also found in cumulative feed consumption, with the highest consumption recorded in Ross 308 broilers with the addition of 4% formic acid (3354.67 g/bird) and the lowest in Ross 308 broilers in the control treatment (3165.00 g/bird). The increased feed consumption in certain types of broiler chickens with the addition of organic acids, including formic acid, is due to the fact that organic acids increase the length of the intestinal villi, which increases the surface

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area for nutrient absorption. Consequently, the bird feels a continuous need to meet its nutritional requirements[9,16] .

Table 3: Effect of Formic Acid Supplementation Levels and Broiler Strain on Weekl, and their interaction on weekly and total feed intake y and Total Weight.

Average ± Standard Error (g/bird)						Factors
total	week Fifth	week Fourth	week third	week second	week first	
						Type
3286.73 ±6.41	1160.47 ±6.56	942.73 ±2.25	634.93 ±4.85 a	398.87 ±6.11	149.73 ±0.68 a	Cobb 500
3272.93 ±20.36	1173.87 ±12.42	933.67 ±9.45	622.73 ±5.84 b	397.20 ±12.33	145.47 ±1.82 b	Ross 308
N.S	N.S	N.S	*	N.S	*	significant level
						Formic acid level
3235.50 ±34.89 c	1157.67 ±22.63	930.83 ±11.89	611.50 ±10.32 c	389.83 ±16.63	145.67 ±3.92	control
3250.17 ±15.14 bc	1176.00 ±7.35	936.00 ±6.51	621.17 ±2.54 bc	371.00 ±18.45	146.00 ±1.91	1%
3284.17 ±12.80 ab	1164.00 ±16.31	931.00 ±14.77	635.17 ±6.33 b	406.83 ±15.29	147.17 ±2.28	2%
3299.00 ±17.34 a	1186.00 ±12.69	935.00 ±11.35	621.00 ±4.52 bc	407.67 ±14.07	149.33 ±1.68	3%
3330.33 ±13.04 a	1152.17 ±16.78	958.17 ±6.83	655.33 ±5.92 a	414.83 ±5.21	149.83 ±1.07	4%
**	N.S	N.S	**	N.S	N.S	significant level
						interaction
3306.00 ±5.13 ab	1176.67 ±0.33	951.00 ±0.58	620.67 ±0.67 bcd	406.33 ±0.67	151.33 ±3.38 a	Cobb 500: control
3248.33 ±15.49 b	1176.00 ±0.58	944.67 ±2.33	619.67 ±1.20 cd	359.00 ±13.79	149.00 ±0.57 ab	Cobb 500: 1%
3280.00 ±1.53 b	1144.00 ±2.08	933.00 ±1.73	648.33 ±2.18 ab	403.67 ±1.45	151.00 ±0.58 a	Cobb 500: 2%
3293.33 ±3.71 ab	1185.33 ±1.67	933.67 ±2.72	622.00 ±1.15 bcd	403.67 ±3.17	148.67 ±0.88 ab	Cobb 500: 3%
3306.00 ±1.52 ab	1120.33 ±0.88	951.33 ±0.67	664.00 ±2.00 a	421.67 ±0.33	148.67 ±0.33 ab	Cobb 500: 4%
3165.00 ±33.06 c	1138.67 ±46.90	910.67 ±17.33	602.33 ±21.18 d	373.33 ±33.33	140.00 ±5.77 b	Ross 308: control
3252.00 ±30.04 b	1176.00 ±16.44	927.33 ±11.46	622.67 ±5.36 bcd	383.00 ±37.00	143.00 ±3.00 ab	Ross 308: 1%
3288.33 ±28.28 ab	1184.00 ±30.44	929.00 ±32.92	622.00 ±4.72 bcd	410.00 ±34.01	143.33 ±3.33 ab	Ross 308: 2%
3304.67 ±38.19 ab	1186.67 ±28.33	936.33 ±25.20	620.00 ±10.00 cd	411.67 ±31.06	150.00 ±3.60 a	Ross 308: 3%
3354.67 ±16.02 a	1184.00 ±19.85	965.00 ±13.65	646.67 ±9.82 abc	408.00 ±9.45	151.00 ±2.08 a	Ross 308: 4%
**	N.S	N.S	**	N.S	*	significant level

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Means within the same column with different superscript letters differ significantly ($P \leq 0.05$) or highly significantly ($P \leq 0.01$)

Effect of Broiler Breed and Formic Acid Level on Weekly Feed Conversion:

Table (4) shows that there are significant differences ($P \leq 0.05$) between both broiler breeds, Cobb 500 and Ross 308, in feed conversion efficiency during the first week, reaching 0.976 and 1.019 kg feed/kg meat, respectively, indicating better performance in Cobb 500. During the second and third weeks, the differences between the two breeds were highly significant, with continued improvement in Cobb 500 (1.048 and 0.949 kg feed/kg meat) compared to Ross 308 (1.338 and 1.455 kg feed/kg meat). However, the differences between the two breeds were not significant during the fourth week of age. In the fifth week, Ross 308 (1.744 kg feed/kg meat) excelled Cobb 500. (2.365 kg feed/kg meat), and the overall feed conversion efficiency for Cobb 500 broiler chickens was (1.425 kg feed/kg meat). The reason for the better feed conversion efficiency of cobb 500 is attributed to its overall superiority in body weight and therefore overall weight gain rate, as well as in the amount of feed consumed, as shown in Tables (1, 2, and 3).

Table (4) shows a highly significant effect ($P \leq 0.01$) of formic acid treatment on weekly and cumulative feed conversion ratios, except in the second week where the variance was significant ($P \leq 0.05$). In the third week, there were no significant differences between treatments. In the first week, the birds treated with 4% formic acid (0.926 kg feed/kg meat) were excelled. In the second week, the 3% (0.978) and 4% (1.061) formic acid treatments were excelled. In the fourth week, all treatments using formic acid were better than the control treatment. However, the treatment with 4% formic acid was the best in feed conversion efficiency at the fifth week, with an average feed conversion ratio of 1.651 kg feed/kg meat and an overall average feed conversion ratio of 1.376 kg feed/kg meat.

Table (4) shows the effect of the interaction between broiler breed and formic acid treatment on weekly and cumulative feed conversion efficiency. All differences were highly significant ($P \leq 0.01$). In the first week, Ross 308 broilers treated with 4% formic acid achieved the best feed conversion efficiency (0.970 kg feed/kg meat). In the second week, Cobb 500 broilers achieved the best feed conversion efficiency with the 3% and 4% formic acid treatments, at 0.882 and 0.884 kg feed/kg meat, respectively. In the third week, the best feed conversion efficiency (0.883 kg feed/kg meat) was achieved by Cobb 500 broilers treated with 2% formic acid. In the fourth week, Ross 308 broilers showed the most improvement with the 4% formic acid treatment (1.320 kg feed/kg meat). In the fifth week, Ross 308 broilers... In the control treatment (1.267 kg feed/kg meat), the best feed conversion ratio was observed in Cobb 500 broiler chickens treated with 4% formic acid (1.302 kg feed/kg meat).

The improved feed conversion ratio in birds with the addition of organic acids, including formic acid, can be due to the reduction of pH in the digestive tract. This, in turn, the enzyme responsible for protein digestion, thus maximizing nutrient utilization in the feed [9].

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Table 4: Effect of Formic Acid Supplementation Levels and Broiler Strain on Weekl, and their interaction on weekly and total feed conversion ratio

((kg feed/kg meatMean ± Standard Error						
Total	week Fifth	week Fourth	week third	week second	week first	Factors
						Type
1.425 ±0.03 b	2.365 ±0.18 a	1.704 ±0.07	0.949 ±0.02 b	1.048 ±0.05 b	0.976 ±0.02 b	Cobb 500
1.489 ±0.01 a	1.744 ±0.08 b	1.618 ±0.10	1.455 ±0.09 a	1.338 ±0.08 a	1.019 ±0.02 a	Ross 308
**	**	N.S	**	**	*	significant level
						treatments
1.532 ±0.02 a	2.009 ±0.34 bc	1.929 ±0.20 a	1.221 ±0.11	1.426 ±0.07 a	1.061 ±0.03 a	control
1.521 ±0.02 a	2.630 ±0.35 a	1.543 ±0.02 b	1.056 ±0.05	1.283 ±0.14 ab	0.996 ±0.02 a	1%
1.423 ±0.093 b	1.902 ±0.08 bc	1.596 ±0.11 b	1.096 ±0.09	1.217 ±0.09 ab	1.008 ±0.02 a	2%
1.432 ±0.04 b	2.081 ±0.10 b	1.543 ±0.06 b	1.261 ±0.17	0.978 ±0.13 b	0.998 ±0.03 a	3%
1.376 ±0.04 b	1.651 ±0.11 c	1.693 ±0.19 b	1.376 ±0.26	1.061 ±0.12 b	0.926 ±0.02 b	4%
**	**	**	N.S	*	**	significant level
						interaction
1.557 ±0.03 a	2.751 ±0.23 b	1.528 ±0.03 cd	0.974 ±0.01 cd	1.405 ±0.02 ab	1.073 ±0.04 a	Cobb 500: control
1.519 ±0.04 ab	3.364 ±0.32 a	1.518 ±0.03 cd	0.937 ±0.01 d	1.025 ±0.05 bc	0.994 ±0.02 ab	Cobb 500: 1%
1.391 ±0.02 cd	2.034 ±0.06 cd	1.814 ±0.12 bc	0.883 ±0.02 d	1.041 ±0.02 bc	0.992 ±0.02 ab	Cobb 500: 2%
1.358 ±0.02 d	2.161 ±0.15 c	1.592 ±0.11 cd	0.954 ±0.08 cd	0.882 ±0.04 c	0.943 ±0.01 bc	Cobb 500: 3%
1.302 ±0.02 d	1.518 ±0.18 de	2.066 ±0.21 ab	0.995 ±0.03 cd	0.884 ±0.004 c	0.882 ±0.02 c	Cobb 500: 4%
1.508 ±0.02 ab	1.267 ±0.05 e	2.329 ±0.20 a	1.468 ±0.06 abc	1.447 ±0.16 ab	1.048 ±0.05 a	Ross 308: control
1.523 ±0.04 ab	1.897 ±0.04 cd	1.569 ±0.04 cd	1.174 ±0.01 bcd	1.540 ±0.18 a	0.998 ±0.04 ab	Ross 308: 1%
1.456 ±0.05 bc	1.771 ±0.13 cde	1.378 ±0.04 d	1.309 ±0.03 abcd	1.394 ±0.12 ab	1.025 ±0.02 ab	Ross 308: 2%
1.506 ±0.03 ab	2.001 ±0.16 cd	1.494 ±0.01 cd	1.568 ±0.21 ab	1.075 ±0.27 bc	1.053 ±0.03 a	Ross 308: 3%
1.451 ±0.02 bc	1.785 ±0.11 cde	1.320 ±0.06 d	1.757 ±0.44 a	1.237 ±0.9 abc	0.970 ±0.023 abc	Ross 308: 4%
**	**	**	**	**	**	significant level
Means within the same column with different superscript letters differ significantly ($P \leq 0.05$) or highly significantly ($P \leq 0.01$)						

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Conclusion:

The results of the study show that the Cobb 500 broiler chickens excelled the Ross 308 in most productive traits, and that the two treatments of 4% and then 3% formic acid achieved the best performance. The interaction gave a clear and accurate picture of the best type and level, and that applying a 4% or increasing percentage of formic organic acid can achieve an important economic return in broiler chicken breeding projects.

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