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Effect of adding sodium citrate to water on the productive performance of broilers for different densities breeder

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Abstract

This study was conducted in the field of poultry in the Department of Animal Production - College of Agriculture - University of Diyala for the period from 1/10/2022 to 4/11/2022 in order to know the effect of adding sodium citrate to drinking water on the productive performance of broiler chicken Rose 308 raised at different densities. 405 unsexed, one-day-old 308 Rose hybrid broiler birds were used, randomly distributed to nine treatments, with three replications for each treatment, with three different densities, and the use of two different concentrations of sodium citrate. The results showed a significant superiority ($P \leq 0.05$) in the productive performance of the birds that They are fed sodium citrate and reared at different densities. compared to the control treatment (without addition). Weekly body weight, weekly weight gain, weekly feed intake and weekly feed conversion efficiency were improved compared to control treatment. ***Key words*:**different densities,Sodium citrate,productive performance**,**Rose 308.

**This research is part of M.Sc. thesis of the second researcher.

Introduction

Organic acids are weak acids containing a carboxylic acid (R-COOH) group, mediate the degradation pathways of carbohydrates, amino acids and lipids, and are used as a nutritional value and antimicrobial substance in animal feed (French, 2017; Chahardoli et al., 2020). They are classified based on chain length (Scicutella et al., 2021). The use of organic acids in animal feed started many years ago due to the ban on the use of antibiotics (Polycarpo et al., 2017). Recent studies have shown that antibiotics have better positive effects in modulating metabolism, improving weight gain, feed conversion efficiency, and reducing disease in poultry production (Mehdi et al., 2018; Gao et al., 2021). Because of this, organic acids were chosen as promising food additives in the production of poultry due to their ability to maintain the integrity of the intestinal membranes and wall, increase beneficial bacteria and create microbial balance, and improve the rate of digestion and absorption of nutrients and thus contribute to improving the productive performance of poultry (Nguyen and Kim, 2020; Dai et al., 2020). Sodium citrate (SC) is a powerful chelated hydroxycarboxylic acid food additive, capable of chelating divalent metal ions (Zn_2) (Chu et al., 2022). Sodium citrate has strong complexing ability attributed to carboxyl groups and hydroxyl groups, which can strongly chelate metal ions (Wang et al., 2018; Qin et al., 2020). Sodium citrate (SC) has antioxidant effects and can inhibit many microorganisms (Ponrajan et al., 2012; Hamed, 2020).

With the increasing demand for poultry products, poultry entrepreneurs are seeking to achieve high profitability by significantly increasing the breeding intensity of poultry production (Kiani and von Borstel, 2019). In the modern poultry industry, broilers are usually raised with a high breeding density to increase meat production by (kg) of chicken produced per square meter of unit area to reduce the cost of production and to achieve a satisfactory economic return. For example, rearing densities range from 45-54 kg/m2, 40 kg/m2, and 30-36 kg/m2 in the Netherlands, Britain, and Switzerland, respectively (Yuan, 2017; Wasman, 2022).

However, high breeding density leads to various negative effects on broilers (Sugiharto, 2022). Among them, the behaviors of broilers of bending, standing, and walking are limited according to the high breeding density, and thus lead to problems related to animal welfare (Hafez et al., 2022). In addition, it is stressful for birds because it reduces airflow at the bird level, which increases the concentration of ammonia and competition for feed and drinking water (El Garhy, 2021; Abdulalwahhab et at., 2020;).

Materials and research methods

This study was conducted in the field of poultry in the Department of Animal Production / College of Agriculture / University of Diyala for the period from 1/10/2022 to4 /11/2022 for a period of 35 days. The effect of adding sodium citrate to water on the productive and physiological performance of broilers has been studied.

In the experiment, 405 unsexed, one-day-old 308 Rose chickens were used, randomly distributed to nine treatments, with three replications for each treatment, with three different densities, and the use of two different concentrations of sodium citrate. The treatments are as follows:

T1: It was fed on a standard diet and regular water at a density of 12 fowl/m2.

T2: They were fed on a standard diet and water to which 1.5 g/l of sodium citrate was added, at a density of 12 birds/m2.

T3: They were fed on a standard diet and water to which 3 g/l of sodium citrate was added, at a density of 12 birds/m2.

T4: Control treatment and fed on standard diet and regular water at a density of 15 birds/m2.

T5: They were fed on a standard diet and water to which 1.5 g/L of sodium citrate was added, at a density of 15 birds/m2.

T6: They were fed on a standard diet and water to which 3 g/l of sodium citrate was added, at a density of 15 birds/m2.

T7: Control treatment and fed on standard diet and regular water at a density of 18 birds/m2.

T8: It was fed on a standard diet and water to which 1.5 g/l of sodium citrate was added, at a density of 18 birds/m2.

T9: They were fed on a standard diet and water to which 3 g/l of sodium citrate was added, at a density of 18 birds/m2.

Chicks were obtained from Al-Baraka Hatchery - Canaan District, with an average weight of 41 gm / one-day-old unsexed chick, and they were raised in a semi-closed room, where the treatments were randomly distributed into three treatments (T1, T2, and T3) and each treatment had three replications, and the chicks were reared on a litter. of sawdust with a thickness of 5 cm. Ready paper was placed over the litter to prevent contamination of the feeders and manholes and to prevent the chicks from picking up from the litter at the beginning of their landing in the coops. Circular diameter of 45 cm and an automatic plastic drain for the end of the experiment at the age of 5 weeks, and the light program was used 23 hours of light and 1 hour of darkness during the first three days, and then a program of 20 hours of light and 4 hours of darkness was applied until the age of marketing 5 weeks, and rearing was done at a temperature during the first week 30-33 pm, in the second week 28-29 pm, during the third week 25-27, and then 21-24 until marketing at the age of 5 weeks. The birds were fed a starter ration from the age of 1-14 days, a growth ration from the age of 15-28 days, and a final ration from the age of 29-35 days.

Table 1. Components and chemical analysis of the diets used in the experiment

fodder material	starter bush	Growing ration	final ration

	(1_14 days) (%)	(15-28 days) (%)	(29_35 days) (%)
yellow corn	52	55	57.5
Soybean meal*	41	36	33
premix**	2.5	2.5	2.5
Sun flower oil	3	4.5	5
dicalcium phosphate	1.5	1	1
total summation	100	100	100
Computed Chemical Analysis * **			
Crude protein (%)	23.16	21.25	20.1
Represented energy (kcal/kg)	2983	3095	3168
methionine(%)	0.56	0.58	0.52
Methionine and cysteine(%)	0.94	0.92	0.86
Lysine (%)	1.39	1.40	1.19
Calcium(%)	0.87	0.87	0.8
Available phosphorus (%)	0.44	0.49	0.38

* Soybean meal of Argentine origin contained 44% crude protein and 2230 kilocalories/kg represented energy. ** Ingredients of the AGRO HEALTH 2.5 premix produced by WAFI International Company, containing protein 29.50%, energy 1817 Kcal/kg, lysine 11.70%, methionine 10.40%, methionine + cysteine 10.46%, available phosphorus 12.90%, sodium 5.30%, calcium 6.40% With a range of vitamins and mineral elements. ***According to the chemical composition according to the analyzes of the feed materials included in the reports of the US National Research Council N.R.C (1994).

Sodium citrate powder was obtained from HI-SKY CHEMICALS CO., LTD. It is of clay origin and has a purity of 99.8%.A factorial experiment using Complete Randomize Design (CRD) in analyzing the data between the treatments. Significant differences between the means of the treatments were measured using the Duncan test at the level of significance of 0.05. The ready-made statistical program SAS (2001) was used to analyze the data.

Results and Discussion

Body weight (g)

Table 2 shows the effect of adding sodium citrate on Ross 308 broilers for a period of 1-35 days in weekly body weight, as it was observed that there were no significant differences between the first, second, third and fourth weeks, respectively, while significant differences were observed in the fifth week, as the treatment excelled The third recorded the highest weekly body weight of 2372.89 gm over the first treatment, which recorded 2180.33 gm, while the second treatment did not differ from the first and third treatment.

Table 2. Effect of adding sodium citrate at different levels on Ross 308 broilers for the period from 1-35 days in weekly body weight (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
Control	±163.46 1.72	±509.22 4.84	±935.48 8.72	±1539.36 23.82	±2180.33 b 64.41
15 gm.	±164.11 1.13	±509.20 7.45	±924.77 12.53	±1544.85 22.85	±2305.00 ab 47.81
30 gm.	±164.88 0.69	±501.60 5.59	±910.64 15.41	±1540.53 18.22	±2372.89 a28.18

Moral level	0.705	0.533	0.243	0.975	0.044

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

It is noted from Table 3. There are significant differences for the effect of breeding density on Ross 308 broilers for the period from 1-35 days in the weekly body weight, as the density treatment was superior to 12 fowl/m in the second, third and fourth week and recorded the highest weekly body weight of 518.16, 957.02 and 1576. .64 gm, respectively. The density treatment of 15 fowl/m also excelled in the fourth week and recorded the highest weekly body weight of 1553.17 g, which did not differ significantly from the second week when the density of 15 fowl/m was treated, which amounted to 502.57 compared to the second, third and fourth weeks of the density treatment. 18 fowl/m and the third week when the density was 15 fowl/m, while no significant differences were observed in the first and fifth week for all treatments.

Table 3. Effect of different breeding densities on Ross 308 broilers for the period from 1-35 days on weekly body weight (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
12 birds/m	±162.22 1.62	±518.60 a4.95	±957.02 a7.12	±1576.64 a23.27	±2345.78 56.37
15 birds/m	±165.06 0.98	±502.57 ab6.52	±912.28 b12.49	±1553.17 a14.45	±2307.33 53.13
18 birds/m	0.74 ±165.17	±498.86 b4.54	±901.59 b9.30	±1494.92 b15.19	±2205.11 47.86
Moral level	0.170	0.045	0.002	0.014	0.155

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

Weight gain (gm)

Table 4.shows the effect of different additions of sodium citrate on Ross 308 broilers for a period of 1-35 days in weekly weight gain, as the treatment of adding sodium citrate excelled by 30 gm in the fifth week and recorded the highest weight gain of 832.36 compared to the control treatment, which recorded the lowest. Weight gain of 640.97 gm, which did not differ significantly when adding 15 gm of sodium citrate, which amounted to 760.15 gm, while no significant differences were observed in the first, second, third and fourth weeks for all additions.

Table 4. The effect of adding sodium citrate at several levels on Ross 308 broilers for the period from 1-35 days on weekly weight gain (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
Control	±122.46 1.73	±345.69 5.64	±426.26 6.08	±603.88 18.66	±640.97 b 53.50
15 gm.	±123.11 1.16	±346.09 7.41	±415.57 6.94	±620.08 12.65	±760.15 ab 39.76
30 gm.	±123.88 0.69	±336.76 5.82	±409.04 12.52	±629.89 12.96	±832.36 a 17.46
Moral level	0.723	0.411	0.333	0.372	0.014

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

It is noted from Table 5. For the effect of different breeding densities on weight gain on Ross 308 broilers for the period from 1-35 days in weekly weight gain, there is a significant superiority at the breeding density 12 fowl/m in the second and third week and at the density 15 fowl/m there is a significant superiority In the fourth week, as the highest weight gain was recorded, reaching 356.38, 438.42, and 640.89 g, respectively, compared to the treatment. The rearing density was 15 birds for the second and third weeks, and the rearing density was 18 birds / m. , 402.73 and 593.34 g, respectively, which did not differ significantly when treating the density of 12 fowl/m in the fourth week, while no significant differences were observed in the first and fifth week for all densities.

Table 5. Effect of different breeding densities on Ross 308 broilers for the period from 1-35 days on weekly weight gain (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
12 birds/m	±121.22 1.62	±356.38 a5.68	±438.42 a3.86	±619.62 ab17.52	±769.14 40.91
15 birds/m	±124.06 0.99	±337.51 b5.71	±409.71 b9.98	±640.89 a8.05	±754.16 58.39
18 birds/m	±124.27 0.77	±333.69 b4.71	±402.73 b7.55	±593.34 b14.34	±710.19 42.03
Moral level	0.160	0.014	0.013	0.054	0.588

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

Feed Intake (g/bird)

It appears from Table 6. The effect of adding sodium citrate at several levels on Ross 308 broilers for the period from 1-35 days for the characteristic of weekly feed intake, there is a significant superiority in the control treatment for the third week and when treating 30 mg of the addition for the fifth week, as the highest feed intakewas recorded at 603.33 and 1345 00 gm, respectively, compared to the treatment of addition 15 and 30 mg sodium citrate for the third week and the control treatment for the fifth week, as the lowest feed intake was recorded at 577.33, 575.89 and 1224.16 gm, respectively, which did not differ significantly from the treatment of addition 15 mg for the fifth week, while it was not observed There are significant differences for the first, second and fourth week and for all additions.

Table 6. Effect of adding sodium citrate at several levels on Ross 308 broilers for the period from 1-35 days of weekly feed intake (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
Control	±175.06 1.73	±381.45 1.62	±603.33 a6.13	±956.74 30.20	±1224.16 b35.56
15 gm.	±177.27 1.30	±376.98 1.87	±577.33 b7.96	±949.26 24.90	±1267.22 ab37.20
30 gm.	±177.26 0.99	±374.76 6.20	±575.89 b9.16	±966.25 24.59	±1345.00 a14.15

Moral level	0.383	0.469	0.023	0.767	0.030

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

It is noted from Table 7. The effect of different breeding densities on weight gain on Ross 308 broilers for the period from 1-35 days for the characteristic of feed intake, as a significant superiority was observed at the breeding density of 12 fowl/m in the third, fourth and fifth week and at the density of 15 fowl/m observed Significant superiority in the fourth week, as the highest feed intake was recorded at 602.33, 1003.52, 1322.94, and 1000.38 g, compared to the treatment.The rearing density was 15 birds for the third week, and the rearing density was 18 birds / m in the fourth and fifth weeks, as the lowest feed intake was recorded at 573.00, 868.35, and 1215.67 g, which It did not differ significantly when treating the density of 15 fowl/m in the fifth week and treating the density of 18 fowl/m in the third week, while no significant differences were observed in the first and second weeks for all densities.

Table 7. Effect of different breeding densities on Ross 308 broilers for the period from 1-35 days on weekly Feed intake(mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
12 birds/m	2.18±175.58	1.71±379.78	a3.84±602.33	a22.61±1003.52	a33.08±1322.94
15 birds/m	±178.09 0.68	±377.03 1.67	b10.47±573.00	a7.74±1000.38	ab28.73±1297.77
18 birds/m	±175.92 0.63	±376.38 6.40	±581.22 ab7.93	±868.35 b9.76	b32.86±1215.67
Moral level	0.335	0.803	0.026	0.000	0.048

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

Feed conversion efficiency

Table 8.shows the effect of the effect of adding sodium citrate at several levels on Ross 308 broilers for a period of 1-35 days in terms of weekly feed conversion efficiency. There is a significant superiority in the control treatment for the fifth week, as it recorded the best feed conversion efficiency of 1.75 g compared to the addition treatments 15 and 30. mg, which amounted to 1.67 and 1.62 gm, respectively, for the same week, while no significant differences were observed in the first, second, third, and fourth weeks for all additions.

Table 8. The effect of adding sodium citrate at several levels on Ross 308 broilers for the period from 1-35 days on weekly feed conversion efficiency (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
Control	±1.43 0.01	±1.10 0.01	±1.42 0.01	±1.68 0.02	±1.75 b 0.06
15 gm.	±1.44 0.01	±1.09 0.02	±1.39 0.02	±1.53 0.01	±1.67 a 0.15
30 gm.	±1.43 0.00	±1.11 0.02	±1.41 0.02	±1.53 0.03	±1.62 a 0.07

Moral level	0.596	0.283	0.739	0.184	0.033

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

It appears from Table 9. For the effect of different breeding densities on Ross 308 broilers for the period from 1-35 days in terms of weekly feed conversion efficiency, there is a significant superiority at the breeding density of 18 birds/m for the first week and at the breeding density of 12 birds/m for the second week and at the breeding density of 12 Birds/m for the third week, and at the breeding density of 18 birds/m for the fourth week, as the highest efficiency of weekly feeding was recorded, which reached 1.42, 1.06, 1.37, and 1.46 g on the treatment of breeding densities of 12 and 15 birds/m for the first week, and the density was 15 and 18 birds/m for the second week.And a density of 18 for the third week and a density of 12 birds / m for the fourth week, as it recorded the lowest feed conversion efficiency of 1.44, 1.44, 1.12, 1.13, 1.44 and 1.62 g, which did not differ significantly from the rest of the breeding densities for the weeks, and it was noted that there were no significant differences due to the effect of breeding densities On the fifth week.

Table 9. Effect of different breeding densities on Ross 308 broilers for the period from 1-35 days on weekly feed conversion efficiency (mean ± standard error).

Add	the first week	second week	the third week	fourth week	The fifth week
12 birds/m	±1.44 b0.01	±1.06 a0.01	±1.37 a0.01	±1.62 b0.02	±1.72 0.06
15 birds/m	±1.44 b0.01	±1.12 b0.02	±1.40 ab0.02	±1.56 ab0.01	±1.72 0.15
18 birds/m	±1.42 a0.00	±1.13 b0.02	±1.44 b0.02	±1.46 a0.03	±1.71 0.07
Moral level	0.011	0.004	0.009	0.000	0.813

The different letters within one column indicate that there are significant differences between the means at the level of P≤0.05.

We note that the effects of supplementation led to a significant superiority in body weight, weight gain, feed intake and feed conversion efficiency due to its ability to maintain the integrity of the intestinal cellular membrane, reduce the numbers of harmful bacteria, increase beneficial bacteria and maintain the microbial balance of the intestine and thus improve the rate of digestion and food absorption (Nguyen and Kim, 2020, Dai et al., 2020).As it improved productive performance in addition to its work as an antibacterial and its effect in reducing the pH while supplying the body with energy and greatly affecting the biological functions of harmful bacteria and thus works as an improver of intestinal health and as a main source of energy to stimulate metabolism and reduce the pathogenic bacterial load in the digestive system of birds (Melaku et al., 2021).

Many studies indicated that the addition of organic acids such as citric acid to drinking water gave positive effects on the digestion of nutrients, growth and production in poultry (Melaku et al., 2021). CA causes lower gut pH in poultry, reduces pathogenic bacteria and improves gut morphology (Demirel et al., 2012). Sodium is required for the maintenance of plasma volume, acid balance, transmission of nerve impulses, and normal cell function, and

almost has a function related to maintaining fluid homeostasis (WHO, 2012). Sodium excretion as a biomarker is regulated by hormones in the body, which alter sodium metabolism, absorption and excretion (WHO, 2010).

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