"The Effect of Adding Malic and Acetic Acid to Feed and Drinking Water on the Production Performance and Some Physiological Traits of Broiler Chickens"

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SUMMARY

This study was conducted in the poultry field of the Animal Production Department at the College of Agriculture and Forestry, University of Mosul, over a period of 49 days. The study involved 630 one-day-old unsexed broiler chicks of the Ross 308 type. The chicks were randomly assigned to 7 treatments, with each treatment having 3 replicates and 30 chicks per replicate. The treatments were as follows: the first treatment (control) without the addition of organic acids, the second treatment (adding 0.25 g/kg of malic acid to the feed), the third treatment (adding 0.5 g/kg of malic acid to the feed), the fourth treatment (adding 0.25 ml/kg of acetic acid to the feed), the fifth treatment (adding 0.5 ml/kg of acetic acid to the feed), the sixth treatment (adding 0.25 g/liter of malic acid to the water), and the seventh treatment (adding 0.5 ml/liter of acetic acid to the water).

The results showed that adding acid to the feed or water significantly increased live body weight, total weight gain, and feed consumption compared to the control treatment. There was a significant improvement in feed conversion ratio for the second and seventh treatments compared to the control and other treatments. However, there were no significant differences in dressing percentage, glucose concentration, or the relative weights of the liver, heart, thighs, and breast among the treatments.

INTRODUCTION

Poultry farming is considered one of the profitable businesses worldwide, providing meat and eggs for human consumption in a short time (Singh, 1990; Banerjee, 1992). Antibiotics have been used as feed additives in low concentrations to enhance growth performance significantly. However, their widespread and indiscriminate use has led to their accumulation in animal tissues and products, transferring to consumers and posing a real problem causing abnormal physiological effects, including allergic reactions in humans. Moreover, it has contributed to the emergence of antibiotic-resistant microorganisms due to continued use in animal feed. Consequently, researchers in several advanced countries have moved towards banning antibiotics as growth promoters, opting instead for organic acids. Organic acids are characterized as weak acids, which does not imply lower acidification ability or effectiveness compared to stronger acids, but rather indicates that they dissociate fewer hydrogen ions (H+). This property of hydrogen ion dissociation correlates with their ability to combat microbes, making them much more effective than undissociated acids. Hence, organic acids have been intensively used in recent years in Europe as growth enhancers in poultry nutrition and to inhibit the growth of harmful bacteria such as Salmonella in raw materials and feed formulations (Radcliffe, 2000). Organic acids and their salts are considered amino acid supplements.

The aim of this study is to determine the effect of adding different proportions of organic acids (such as malic and acetic acids) on the production performance, certain qualitative characteristics of the carcass, and some biochemical blood traits of broiler chickens.

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MATERIALS AND METHODS

This study was conducted at the poultry field of the Department of Animal Resources, College of Agriculture and Forestry, University of Mosul. The objective was to investigate the impact of adding malic and acetic acids to feed and drinking water on the production performance and some physiological traits of broiler chickens. A total of 630 one-day-old broiler chicks (Ross 308 strain), with an average weight of 40 grams per chick, were used in this study. The birds were housed in a half-open hall and randomly distributed into 7 treatments, with 3 replicates per treatment and 30 chicks per replicate. Lighting was provided for 23 hours per day throughout the experiment.

Feed was manually provided using circular plastic feeders from day one until two weeks of age, then replaced with hanging cylindrical feeders with a capacity of 15 holes per feeder, each inverted plastic feeder with a capacity of 5 liters, with two feeders per replicate. Feed and water were provided ad-libitum throughout the experiment. Two diets (starter and finisher) were used, in the form of homogeneous mash feed. Table 1 shows the components of the diets used in the study, and the chemical analysis of the diets was calculated based on the National Research Council (N.R.C. 1994). Table 2 displays the calculated chemical analysis. Samples of the diets were taken and analyzed in the nutrition laboratory of the Department of Animal Resources using A.O.A.C. (1980) methods to determine their nutrient content, as shown in Table 3, which presents the actual chemical analysis of the diets.

Table 1: Shows the percentage composition of the starter and finisher diets used in the study as follows:

Primary Feed stuff	Starter Diet % 1- 21 days	Finisher Diet % 22- 49 days
Crushed Yellow Corn	45	56
Crushed Wheat	15	15
Soybean Meal (44% Protein)	30	20
Protein Concentrate (40% Protein)*	9	8
Limestone Powder	0,5	0,5
Table Salt	0,4	0,4
Vitamins	0.1	0.1
Total	100	100

Table (2): Calculated Chemical Analysis of the Starter and Finisher Diets Used in the Study

Nutrient Composition	Percentage in Starter Diet	Percentage in Finisher Diet
Total Energy (kcal/kg feed)	2826	2959
Crude Protein (%)	22,88	19.04
Ether Extract (%)	2.69	2.97
Crude Fiber (%)	3,72	3,21

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Table (3): Estimated Chemical Analysis of the Starter and Finisher Diets Used in the Study

Nutrient Composition (%)	Percentage in Starter Diet	Percentage in Finisher Diet
Moisture Content	9	10
Dry Matter	91	90
Crude Protein	23	21
Ether Extract	3.53	4.5
Crude Fiber	2.55	0.018
Ash	6.88	2.14

* Analyzed at the nutrition laboratory affiliated with the Department of Animal Production, College of Agriculture and Forestry, University of Mosul.

And the experimental treatments were as follows:

Treatment 1: (Control) Without addition of organic acids.

Treatment 2: Addition of 0.25 g/kg feed (malic acid) as powder.

Treatment 3: Addition of 0.5 g/kg feed (malic acid) as powder.

Treatment 4: Addition of 0.25 ml/kg feed (acetic acid) as liquid.

Treatment 5: Addition of 0.5 ml/kg feed (acetic acid) as liquid.

Treatment 6: Addition of 0.25 g/l water (malic acid) as powder.

Treatment 7: Addition of 0.5 ml/l water (acetic acid) as liquid.

A completely randomized design was utilized following the methodology outlined by (Steel and Torrie 1960). To assess the significance of differences between means, Duncan's multiple range test (Duncan, 1955) was employed at a probability level of ($P \leq 0.05$). Statistical analysis of the data was conducted using the SAS software (2005). The chicks were under veterinary care throughout the rearing period.

RESULTS AND DISCUSSION

From Table (4), it is observed that the control treatment showed significant superiority compared to the treatments involving the addition of organic acids (malic and acetic) to either the feed or drinking water, except for treatment three (addition of 0.5 g/kg feed of malic acid) where the differences were not significant. It can also be noted that adding organic acids to drinking water had a negative effect on the live body weight compared to the treatments where the acid was added to the feed, such as in treatment two. These results are consistent with the findings of Fascina et al. (2012), Abdel-Fattah et al. (2008), Levic et al. (2007), and Vale et al. (2004).

Regarding weight gain, it is observed that all treatments with the addition of organic acids resulted in a significant decrease in weight gain compared to the control treatment. To observe the overall impact of the treatments on weight gain, it is noted that adding organic acids to either feed or drinking water resulted in a significant decrease in weight gain compared to the control. The addition of malic acid at proportions (0.25, 0.5 g/kg feed) showed significant superiority in weight gain compared to treatments where the organic acid was added to drinking water or treatments where acetic acid was added.

In terms of feed consumption, the control treatment showed a significant increase compared to the other treatments. Overall, the amounts of feed consumed by the birds in the treatments where the organic acid was added to the water were significantly lower compared to those where the organic acid was added to the feed. As for the feed conversion ratio, a significant decrease was observed in favor of the second treatment (addition of 0.25 g/kg feed of malic acid) and the seventh treatment (addition of 0.5 ml/l water of acetic acid) compared to the control and the other treatments.

Table (4): The Effect of Adding Different Concentrations of Malic and Acetic Acids to Broiler Chicken Feed and Drinking Water on Live Body Weight, Total Weight Gain, Feed Consumption, and Feed Conversion Ratio.

Treatments	Live Body Weight (g)	Total Weight Gain (g)	Feed Consumption (g/bird)	Feed Conversion Ratio (kg feed/kg weight gain)
T1	2751 a ± 66,60	2615 a ± 33,78	4625 a ± 22,96	1,84 b ± 0,03
T2	2667,6 b ± 38,16	2535 c ± 45,30	4324 f ± 21,33	1,87 a ± 0,07
T3	2689,6 a b ± 58,20	2557 b ± 29,60	4468 d ± 14,08	1,79 b ± 0,06
T4	2644,6 b c ± 42,49	2512 d ± 35,15	4583,5 e ± 19,88	1,78 b ± 0,005
T5	2607,3 b c ± 38,01	2476 e ± 27,80	4494,2 n ± 12,76	1,83 a b ± 0,10
T6	2555 c ± 29,54	2418 j ± 37,81	4617,9 b ± 15,40	1,91 b ± 0,01
T7	2562,6 c ± 30,33	2428 f ± 39,05	4611.2 c ± 11,66	1,87 a ± 0,01

The values bearing different letters vertically indicate significant differences at the probability level (a ≤ 0.05).

Table (5) shows the percentage of purification and the relative weight of the liver, heart, and gizzard, where statistical analysis results indicate no significant differences in purification percentage among experimental birds, whether organic acids were added to the feed or to the water, compared to control birds. These results are consistent with findings reported by Abdel-Fattah et al. (2008), Nuh et al. (2009), Mohamed (2009), Aldouri and Al-Hamdani (2012), and Moharrery (2005), who also found no significant differences in purification percentage for treatments supplemented with acid.

Similarly, in the relative weight ratio of the liver and heart, no significant differences were observed among all treatments. However, a significant superiority of the control birds was noted in the relative weight of the gizzard compared to birds in the seventh treatment group (addition of 0.5 ml/liter of acetic acid), with no significant differences observed among the remaining treatments.

The table also shows no significant superiority of the control treatment and the fifth treatment (addition of 0.5 ml/kg feed of acetic acid) in the gizzard ratio compared to treatments where acid was added, whether to feed or drinking water.

Table (5): Shows the effect of adding different concentrations of malic and acetic acids to broiler diets and drinking water on the relative weight ratio of the heart, liver, and gizzard.

The treatments	%Percentage of Purification	% Relative Weight of Heart	% Relative Weight of Liver	% Relative Weight of Gizzard
T1	74.64 a ± 3,49	0,72 a ± 0,03	3,22 a ± 0,16	2,51 a d ± 0,10
T2	74.55 a ± 2,86	0,61 a ± 0,02	3,18 a ± ,016	2,41 a b ± 0,09
T3	74.67 a ± 1,36	0,60 a ± 0,06	3,26 a ± 0,13	2,17 a b ± 0,10
T4	74.63 a ± 2,96	0,65 a ± 0,01	3,18 a ± 0,12	2,42 a b ± 0,04
T5	72.78 a ± 1,02	0,66 a ± 0,04	2,94 a ± ,012	2,54 a ± 0,18
T6	73.81 a ± 1,87	0,62 a ± 0,03	3,45 a ± ,026	2,49 a b ± 0,12
T7	74.01 a ± 2,58	0,67 a ± 0,04	3,06 a ± 0,07	2,10 b ± 0,15

Values bearing different letters vertically indicate significant differences at a probability level ($p \leq 0.05$).

Table (6) demonstrates the impact of study treatments on the biochemical characteristics of serum. No significant differences were observed for all treatments of organic acid supplementation compared to the control treatment regarding total protein concentration, except for the fourth treatment (addition of 0.25 ml/kg feed of acetic acid), which showed a decrease in total protein concentration. Additionally, all treatments of organic acid supplementation showed no significant differences compared to the control treatment in terms of cholesterol concentration. However, adding malic acid at all concentrations to the diet or drinking water had an effect in reducing serum cholesterol concentration compared to adding acetic acid at a concentration of 0.25 ml/kg feed. Regarding albumin, the effects of adding organic acids to broiler diets varied in albumin levels. It was noted that adding malic acid at a concentration of 0.25 g/kg feed or adding it to drinking water at 0.25 g/liter resulted in a significant decrease in albumin concentration compared to the control treatment. On the other hand, adding acetic acid at 0.25 ml/kg feed caused a significant decrease compared to the control treatment, while other additions of acetic acid did not reach significant levels compared to the control treatment.

It is noted that adding organic acids (malic and acetic) did not show any significant difference in albumin concentration between them. No significant differences were observed in glucose concentration among all treatments.

Table (6): Shows the effect of adding different concentrations of malic and acetic acids to broiler diets and drinking water on the biochemical indicators of serum (total protein, cholesterol, albumin, glucose, packed cell volume).

The treatments	Total Protein g/100 ml	Cholesterol g/100 ml	Albumin g/100 ml	Glucose mg/100 ml
T1	5,48 a ± 0,24	182 a b ± 7,76	3,53 a ± 0,06	174 a ± 3,56
T2	5,05 a b ± 0,18	173 b ± 16,41	2,92 b ± 0,23	173 a ± 5,26
T3	4,82 a b ± 0,32	169 b ± 7,85	3,11 a b ± 0,14	178 a ± 6,04
T4	4,78 b ± 0,23	215 a ± 10,15	2,95 a b ± 0,26	185 a ± 9,72
T5	5,17 a b ± 0,17	173 b ± 11,60	2,73 b ± 0,14	182 a ± 10,25
T6	4,93 a b ± 0,11	176 b ± 12,01	2,77 b ± 0,23	169 a ± 9,44
T7	5,03 a b ± 0,10	203 a b ± 10,28	3,10 a b ± 0,17	182 a ± 6,11

Values bearing different letters vertically indicate significant differences at a probability level of ($p \leq 0.05$).

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