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EFFECT OF SUPPLEMENTING CERTAIN ORGANIC ACIDS TO BROILER DIETS ON SOME BLOOD PARAMETERS

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ABSTRACT

An experiment was conducted to study the effect of adding certain organic acids to broiler feed mixtures on blood parameters. The experiment lasted for 40 days, using 150 one-day-old chicks of the (ROSS 308) hybrid, distributed into five treatments. Each treatment contained 30 birds distributed into three replicates, at a rate of 10 birds per replicate. The experiment was divided into three feeding phases. The control birds were fed a conventional diet without acid additives. Organic acids were added to the feed mixtures of the treatments at the following rates per 100 kg: Treatment 1 (0.75 kg acetic acid + 0.75 kg lactic acid), Treatment 2 (0.75 kg formic acid + 0.75 kg lactic acid), Treatment 3 (0.75 kg formic acid + 0.75 kg acetic acid), and Treatment 4 (0.5 kg lactic acid + 0.5 kg formic acid + 0.5 kg acetic acid). The results indicated that the addition of organic acids had a positive effect on improving blood parameters, thereby enhancing the health status of the birds. The differences were not significant regarding blood glucose concentration. Birds in Treatment 4 achieved the lowest blood cholesterol concentration among all treatments (114 mg/dL) with significant differences compared to the control treatment, which recorded the highest cholesterol concentration (146 mg/dL). Birds in Treatment 1 recorded the highest hemoglobin concentration (10.42 g/dL) with significant differences compared to the control, whose birds recorded the lowest hemoglobin concentration (9.17 g/dL).

KEYWORDS: Organic acids, Productive performance, Broilers.

1- INTRODUCTION

Meat is considered an excellent dietary source, as it contains a high percentage of protein, a considerable amount of essential amino acids, minerals, and vitamins.[9] The consumption rate of poultry meat increased by 46% between 1961 and 2020[23], and poultry meat consumption is expected to increase by 11.9% in the next decade.[19] The search for feed additives that promote growth and increase production began; among these additives are antibiotics, which were used to prevent the outbreak of bacterial diseases and as growth-promoting agents.[4] Antibiotics are used at therapeutic and sub-therapeutic levels to improve growth performance and increase feed efficiency.[22] However, researchers concluded that the continuous use of antibiotics in animal diets would lead to the emergence of resistant bacterial strains[21], and these strains are capable of transferring from animals to humans.[10] Therefore, the European Union began imposing a ban on the use of antibiotics as growth promoters.[7] Due to this ban on antibiotics, reliance on natural substances such as plant extracts, oils, enzymes, organic acids, and others began as alternative feed additives to antibiotics.[24] Among the most important natural substances used as feed additives are organic acids, which are defined as organic compounds with acidic properties.[13] The mechanisms of action of organic acids include lowering the pH of the feed and the digestive system.[15]. [17] found that when formic acid was added at a rate of 0.25%, there were no significant differences in urea concentration, total protein, or glucose, but there was a decrease in blood cholesterol concentration compared to the control. Researchers also found that blood hemoglobin concentration increased upon the addition of all tested organic acids—formic, acetic, butyric, and citric—at a rate of 0.25% for each acid compared to the control.[1]

found that adding acetic acid at 1.5% and 3%, as well as citric acid and lactic acid at the same rates, led to a slight increase in total protein concentration compared to the control, whereas cholesterol concentration decreased significantly when acids were added at the aforementioned rates.[3] reported that the differences in serum creatinine concentration were not significant between the control group and the groups whose feed mixtures were supplemented with organic acids.

2- Research Justification: As a result of the negative effects of certain feed additives, especially antibiotics, on consumer health, researchers have resorted to other natural feed additives, including organic acids, due to their effective role in improving poultry health at lower costs, and the absence of negative impacts on humans.

3- Research Objectives: To study the effect of adding certain organic acids to feed mixtures on certain blood parameters (blood glucose concentration, blood cholesterol concentration, and hemoglobin concentration).

4- MATERIALS AND METHODS

4.1. Location and Experimental Birds

The experiment was conducted on 150 one-day-old broiler chicks of the (Ross 308) hybrid at a farm in the Al-Sathiyat region, west of Salamiyah city. A separate room was designated for rearing the chicks, where replicates and treatments were separated by barriers, ensuring a bird density of 10 birds/m². The floor of the rearing room was bedded with 5 cm deep wood shavings, and the birds were distributed randomly among the replicates without sex segregation. Each replicate was provided with a feeder and a drinker. All replicates were subjected to identical conditions regarding heating, ventilation, and all management aspects, except for the dietary treatments, which differed among the five groups of chicks according to the organic acid supplements added to each treatment. The rearing room was heated to maintain a temperature of 30-32°C during the first week, which was then gradually reduced by two degrees per week until it reached 25°C in the final week of the fattening period. Continuous lighting was provided on the first and second days, and then reduced to 22 hours.

A preventive vaccination program was followed to protect the birds from some important and prevalent diseases according to the following schedule.

- 7 days old: Combined vaccine (Newcastle + Infectious Bronchitis) via drinking water.
- 21 days old: Newcastle disease (Clone 30) vaccine via drinking water.
- 30 days old: Newcastle disease (Clone 30) vaccine via drinking water. Starting from the first day, the birds were distributed into five treatments at a rate of 30 birds per treatment. Each treatment included three replicates at a rate of 10 chicks per replicate. These chicks were fed until they reached 40 days of age. A three-phase feeding system was adopted based on age as follows.
- Phase 1: From one day old to 10 days old.
- Phase 2: From 11 days old to 23 days old.
- Phase 3: From 24 days old to 40 days old.

The nutritional values of all tested mixtures across all rearing phases for the experimental birds were similar in terms of energy, protein, minerals, and vitamins, and differed only in the type of organic acid added as follows.

- **Control treatment:** Birds in this treatment were fed a conventional diet.
- **Treatment 1:** Birds were fed the control diet supplemented with 0.75 kg lactic acid + 0.75 kg acetic acid per 100 kg of feed.
- **Treatment 2:** Birds were fed the control diet supplemented with 0.75 kg formic acid + 0.75 kg lactic acid per 100 kg of feed.
- **Treatment 3:** Birds were fed the control diet supplemented with 0.75 kg formic acid + 0.75 kg acetic acid per 100 kg of feed.
- **Treatment 4:** Birds were fed the control diet supplemented with 1.5 kg of the previous three acids (formic, acetic, and lactic) per 100 kg of feed (0.5 kg of each acid). The nutritional values of the feed mixtures used in the experiment were calculated according to the chemical analysis tables of feed ingredients (NRC, 1994). Tables 1 and 2 illustrate the composition of the feed mixtures during the experimental phases.

Table 1: Ingredients of the control feed mixture used in feeding the (ROSS 308) birds.

Feed Ingredient	Phase 1 (1-10 days) %	Phase 2 (11-23 days) %	Phase 3 (24-40 days) %
Yellow corn	54.11	60.64	65.68
Soybean meal 44%	38.09	32.84	27.23
Vegetable oil	4.37	3.17	3.74
Limestone	1.11	1.06	1.02
Dicalcium phosphate	1.00	1.00	1.00
Salt	0.40	0.40	0.40
Methionine	0.21	0.24	0.25
Lysine	0.31	0.25	0.28
Vitamin premix	0.20	0.20	0.20
Mineral premix	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**

Table 2: Calculated nutritional values of the feed mixtures used in feeding the experimental birds according to the feeding phases.

Calculated Values	Phase 1 %	Phase 2 %	Phase 3 %
Crude Protein (CP)	22.00	20.00	18.00
Metabolizable Energy (kcal/kg)	3100	3100	3200
ME/CP Ratio	140.91	155.00	177.78
Crude Fiber (CF)	3.37	3.19	2.95
Ether Extract (EE) / Crude Fat	6.92	5.92	6.64
Calcium (Ca)	0.72	0.70	0.67
Available Phosphorus (AP)	0.34	0.34	0.32
Lysine	1.33	1.17	1.00
Methionine	0.38	0.35	0.32
Methionine + Cysteine	0.79	0.73	0.66
Sodium (Na)	0.25	0.24	0.22
Chlorine (Cl)	0.28	0.28	0.28

4.2. Studied Parameters

-Blood Indicators

Blood samples were randomly taken from the birds at the end of the fattening period (40 days), with two samples drawn from each replicate. Blood was drawn using a 5 ml syringe from the wing vein and immediately transferred to tubes containing an anticoagulant (10% EDTA), with the replicate code written on each tube. The following laboratory analyses were conducted:

- **Hemoglobin (g/dl):** Measured using the Drabkin method with a spectrophotometer.
- **Blood Sugar (mg/dl):** Measured using a spectrophotometer after calibrating serum with a ready-made kit from Coral Clinical Systems, following the manufacturer's instructions.
- **Cholesterol (mg/dl):** Measured using a spectrophotometer after calibrating serum with a ready-made kit from MONLAB, following the manufacturer's instructions.

4.3. Statistical analysis

The results were statistically analyzed using One Way ANOVA, the mean values ($\bar{X}$) and standard deviation (SD) were calculated. Tukey's multiple range test was used to determine significant differences among treatment means, using Minitab22 statistical analysis program.

4.4. RESULTS AND DISCUSSION

Table 3 shows the average concentrations of blood sugar, hemoglobin, and cholesterol for the experimental birds at the age of 40 days. The results indicate that the values of all studied blood indicators were within the normal range according to reference values: blood sugar concentration (104.4 – 271.6 mg/dl), cholesterol concentration (88.94 – 158.54 mg/dl) according to.[27] The reference values for hemoglobin concentration were (7 – 13 g/dl) according to.[11]

Table 3: Average Values of Some Blood Indicators for Experimental Birds at 40 Days Old.

Blood Indicators Studied	Control	Group 1 (Lactic + Acetic)	Group 2 (Lactic + Formic)	Group 3 (Formic + Acetic)	Group 4 (Lactic + Formic + Acetic)
Blood Sugar (mg/dl)	207 ± 3.12 a	197.5 ± 6.61 a	204.5 ± 1.8 a	204.3 ± 1.61 a	200 ± 2.5 a
Cholesterol (mg/dl)	146 ± 3.28 c	123.8 ± 2.31 b	115.8 ± 3.82 ab	116.7 ± 3.82 ab	114 ± 1.32 A
Hemoglobin (g/dl)	9.17 ± 0.14 b	10.42 ± 0.14 a	9.83 ± 0.76 ab	10 ± 0.25 ab	10.33±0.38 A

Similar letters (a, b, c, d) within the same row indicate no significant differences ($p > 0.05$), while different letters indicate significant differences ($p \leq 0.05$).

Results from Table 7 indicate that blood sugar levels in all groups that had organic acids added to their diets were lower than those in the control group, although the differences did not reach significance ($p > 0.05$). These results agree with[26] and [16], who found that adding organic acids to broiler diets did not lead to a significant change in blood sugar concentration.

Table 3 also shows that groups one and four recorded the highest hemoglobin concentrations, reaching (10.42) and (10.33) g/dl respectively, significantly surpassing the control group (9.17) with significance ($p \leq 0.05$). Meanwhile, the superiority of groups two and three over the control group was not significant.

These results are consistent with[6], [18], and [25], who indicated that adding organic acids to broiler diets led to an increase in hemoglobin concentration.[8] explained the increase in hemoglobin concentration by stating that adding organic acids to feed increases the acidity level of the feed, thus enhancing the availability of nutrients and certain minerals such as Zn, Ca, P, and Mg.

According to[5], the increase in the availability of zinc plays a significant role in maintaining the integrity of red blood cell membranes, reducing their susceptibility to lysis, and consequently increasing the amount of hemoglobin carried on the surfaces of red blood cell membranes.

It is noted from Table 7 that the cholesterol concentration in the blood of the groups that had organic acids added to their feed decreased significantly compared to the control group, with the lowest cholesterol concentration recorded in group four (114 mg/dl), followed by group one (123 mg/dl), while the control group had the highest cholesterol concentration at (146 mg/dl).

Our results align with[1], [12], and [2], who found that adding organic acids to broiler diets leads to a significant reduction in blood cholesterol and total fat concentrations. The decrease in blood cholesterol concentration is explained by the addition of organic acids to the feed, which increases the acidity level in the intestine and reduces the solubility of unconjugated bile acids, thus decreasing their absorption in the intestine and increasing their excretion in feces[14] Consequently, the liver reactivates the bile acids cycle by converting more cholesterol into tissues, thereby reducing its concentration in the blood.[20]

According to[1], organic acids enhance thyroid gland activity and increase T3 hormone levels, which stimulates energy metabolism and reduces fat deposition, thereby decreasing blood cholesterol levels.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

- The addition of (0.75 kg acetic acid + 0.75 kg lactic acid / 100 kg of feed) to broiler diets resulted in a superior blood hemoglobin concentration in the fed birds compared to the control group and all other groups treated with different types of organic acids.
- The addition of (0.5 kg acetic acid + 0.5 kg lactic acid + 0.5 kg formic acid / 100 kg of feed) led to a decrease in blood cholesterol concentration, with significant differences compared to all other groups.
- The supplementation of various types of organic acids promoted growth in broiler chickens through their physiological effect in stimulating certain internal mechanisms responsible for improving performance (increased hemoglobin levels, and decreased blood glucose and cholesterol concentrations). Healthy birds grow better and yield better production.

Recommendations

- It is recommended to supplement various types of organic acids to broiler feed mixtures due to their positive impact on improving blood parameters, thereby enhancing the health status of the birds.
- Further research is recommended to test different types and inclusion rates of organic acids, and to study their effects on the blood parameters of broilers.

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