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# EFFECT OF ADDING PROPIONIC ACID, FORMIC ACID AND ANTIBIOTICS TO BROILER DIET ON THE PRODUCTION PERFORMANCE, SOME HISTOLOGICAL TRAITS AND MICROBIAL CHARACTERISTICS

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## Abstract

The study was conducted at the poultry field, Animal Production Department, College of Agricultural Engineering Sciences, University of Baghdad, for 42 days to study the effect of two organic acid, Propionic or Formic acid, or Antibiotics (Colistin) to the diet in production performance, pH of the Duodenum measurement, the height of villi, the depth of crypts, microorganisms numbers of broiler chicks. A 270 unsexed broiler chicks of (Ross-308) were used in this study were used at one day old with the initial weight of 40 g. The chicks were randomly distributed into six nutritional treatments with three replicates per treatment (15 chick / rep), T1 (Control) without addition, T2 (0.25 / 4 Kg feed / protective), T3, T4 (1.5 and 3 g / Kg feed) propionic acid respectively, T5, T6 (1.5 and 3 g / Kg feed ) formic acid respectively.The results showed a significant increase ($P \leq 0.05$) in the average body weight and carcass weight for T4 treatment (3 g / kg propionic acid feed) compared with T2 treatment and arithmetic improvement were occurred in the following traits: (accumulative gain weight, accumulative feed consumption and accumulative feed conversion coefficient). As well as, an arithmetic improvement for the same treatment was observed in the pH of the Duodenum, useful microorganisms numbers, the height of the villi and a significant improvement ($pd \leq 0.05$) for the depth of crypts, compared to the T1 treatment. It can be concluded from this experiment, that the addition of Propionic acid at the level of 3 g / Kg feed gave a positive effect on the improvement in the preduction and some histological, microbial characteristics of Broilers.

***Key words:*** Broiler performance, Antibiotics, Organic acids.

## Introduction

In recent years, antibiotics have been used as feed additives in poultry breeding to improve growth, disease resistance and prevention, but the World Health Organization decided at the beginning of the 21st century to prevent using the antibiotics in most countries of the world for several reasons including leaves sediment and poisons inside the animal's body from meat and eggs and their potential for transported to the consumer and the emergence of many bacteria strains resistant to antibiotics thus began to search for natural alternatives and the most important of these alternatives) (medical plants or its extracts, aromatic oils, probiotics, enzymes and organic acids, (Saleha *et al*., 20 09 and Wang *et al*., 2009). Then breeder took the addition of various organic acids to food and drinking water of poultry, where organic acid can be defined as the organic chemical compound that consisting from a carbon and hydrogen series and its functional group called a carboxyl group (COOH), which also called as carboxylic acids. The mechanism of these acids reduces the degree of pH in diet and thus, the pH reduced in the digestive tract and improving nutrient absorption as well as, a reduction in the numbers of pathogenic bacteria (Kim *et al*., 2014). Since the digestive tract health is one of the important factors that identifies the bird's productive performance and the poultry production economically dependent on intestinal flora that plays an important role in the digestive tract health, (Poul *et al*., 2007). Organic acid reduces the pH of nutrients within the digestive tract that leading to an improvement of protein digestion and enhance the melting of the feed material (Digestion and absorption of nutrients) (Adams, 1999), as well as increasing pancreatic secretion that resulting in improved protein digestion (Adil *et al*., 2010). So the aim of this

**Table 1:** Chemical composition percentages of the starter and finisher diet from (1-42) days for broilers.

| Ingredients | Starter diet (1-22) day | Finisher diet (23-42) day |
|---|---|---|
| Yellow Maize | 50 | 45 |
| Wheat | 12 | 22 |
| Protein concentrate* | 5 | 5 |
| Soybean (48%) crude protein | 30 | 24 |
| limestone | 1.5 | 1.5 |
| $CaHPO_4$ | 0.5 | 0.5 |
| Sunflower oil | 1 | 2 |
| Total | 100 | 100 |
| Calculated chemical composition ** | | |
| Crude protein | 22.09 | 19.98 |
| Dietary energy (k cal/kg feed) | 2906 | 3005.35 |
| Lysine (%) | 1.247 | 1.087 |
| Methionine, Cysteine% | 0.847 | 0.781 |
| Ca% | 0.81 | 0.81 |
| Available p% | 0.359 | 0.359 |
| C/P ratio | 131.55 | 150.41 |

* The protein concentrate was used of a Wafi sign, manufactured in the Netherlands with 40% crude protein, 2157.12 Dietary energy (kcal/kg feed) and fat 5%, crude fiber 3.2%, calcium 3.04%, available phosphorus 5.39%, Methionine 3.7%, Methionine+ Cysteine 4.13%, Lysine 3.85% Sodium 2.4%. It also contains a range of vitamins including vitamin B160 mg, vitamin B2, 140 mg, vitamin B6, 80 mg, vitamin B12, 80 mg, vitamin B12, 700 mg, vitamin A 200000IU, vitamin D3 80000IU, vitamin E 600 mg, vitamin K3 50 mg, Niacin 800 mg, Butane 2 mg, folic acid 20 mg and Choline chloride 7000 mg It also contains copper 200 mg, manganese 1600 zinc 1200 mg, iron 1000 mg and Iodine 20 mg and Selenium 5 mg as antioxidants; ** Chemical composition of the diet ingredients according to NRC (1994).

study was to know the effect of the organic acid addition (propionic or Formic) or the antibiotic (Colistin) to the diet in production performance and some histological, microbial characteristics of broilers.

## Materials and Methods

This study was carried out in the poultry field/ Animal Production Department / College of Agricultural Engineering Sciences / University of Baghdad, from the period 9/9/2018 to 20/10/2018. To study the effect of adding the two organic acids (propionic or Formic) or the antibiotic (Colistin) to the diet in production performance and some histological, microbial characteristics of broilers (Ross-308), A 270 unsexed broiler chicks were used in this study, chicks were distributed from one day old with the initial weight of 40 g/chick into six nutritional treatments, T1 (Control) without addition, T2 (0.25 / 4 Kg feed), T3, (1.5 g / Kg feed) propionic acid, T4 (3 g / Kg feed ) propionic acid, T5 (1.5 g / Kg feed ) formic acid, T6 (3 g / Kg feed ) formic acid. The chicks were fed from age one day old till 42 days old, each treatment included three replicates (15 chick / rep) and were fed on the starter diet containing 22.09% of crude protein, 2906 (k cal represented energy /kg feed) and the growth diet from 23 to 42 days of age, which contained 19.98% of crude protein and 3005 (k cal represented energy /kg feed) (NRC, 1994) as shown in table 1.

The organic acids or antibiotic were mixed with the diet gradually, the chicks had bred on a 5-7 cm sawdust. Feed and water were freely provided for the whole duration of the experiment. The preventive health program in the region has been introduced (Newcastle and Gumboro vaccine), the live body weight, gain weight, feed consumption,and feed conversion coefficient at 14, 28 and 42 days of age, at the end of the experiment, two birds were selected from each replicator randomly. Experimental data were analyzed according to the complete randomized design (CRD) and the significant differences between averages were compared using Duncan's multiple range test (Duncan's, 1955) and Statistical Analysis Software (SAS 2010) in statistical analysis.

**Table 2:** The effect of adding two organic acids (propionic or formic ) or antibiotics Colistin) to the broiler diets in the average live body weight (g/bird).

| Treatments | Average body weight (g/bird) for weeks± standard error | | |
|---|---|---|---|
| | 2 | 4 | 6 |
| T1 | [ab] 6.593 ±272.086 | 13.402 ± 1053.97 | [ab] 29.349 ±2035.51 |
| T2 | [b]11.144 ±255.933 | 14.012 ± 1018.17 | 28.913 ± 2013.62 [b] |
| T3 | [a] 6.887 ±283.663 | 53.490 ± 1031.94 | 39.418 ± 2071.97 [ab] |
| T4 | [a] 1.245 ±287.533 | 19.467 ± 1075.56 | 55.863 ± 2128.98 [a] |
| T5 | [ab] 6.123 ±281.933 | 42.420 ± 1061.11 | 6.323 ± 2098.16 [ab] |
| T6 | [ab] 10.916 ±273.556 | 38.172 ± 1023.66 | 7.931 ± 2024.08 [ab] |
| Significant levels | * | N.S | * |

Note: N.S Means no significant difference; * Different letters within the same column, there are significant differences at the probability level 0.05; (1) treatments T1 (Control), T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed), T3: adding propionic acid (1.5 g / Kg feed), T4: adding propionic acid (3 g / Kg feed ), T5: adding formic acid (1.5 g / Kg feed ), T6: adding formic acid (3 g / Kg feed ).

## Results and Discussion

Table 2, shows the effect of adding organic acids or Antibiotics in the average live body weight broiler for the duration 1-42 days. At 14 days, the results showed a significant differences ($p \leq 0.05$) in the average body weight for T3 and T4 compared with T2. While at the age of 28 days, no significant differences were observed in the average body weight between the treatments and at 42 days, T4 treatment were significantly exceeded ($p \leq 0.05$) by 2128.98 g on the T2 treatment which amounted 2013.62 g at the average live body weight.

**Table 3:** The effect of adding two organic acids (propionic or formic ) or antibiotics Colistin to the broiler diets in the gain weight (g).

| Treatments (1) | Average gain weight (g) for weeks± standard error | | | Accumulative gain weight (0-6) week |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| T1 | 6.553 ±233.866 [ab] | 13.889 ± 781.886 | 31.17 ±981.540 | 29.325 ±1997.29 |
| T2 | 11.144 ±217.933 [b] | 5.510 ± 762.236 | 16.989 ± 995.453 | 28.913 ±1975.62 |
| T3 | 6.887 ±245.663 [a] | 56.231 ± 748.036 | 92.907 ± 1039.83 | 334.891 ±2033.73 |
| T4 | 1.245 ±249.533 [a] | 18.777 ± 788.023 | 39.276 ± 1053.42 | 55.861 ±2090.98 |
| T5 | 74.961±244.133 [a] | 37.050 ± 778.976 | 37.863± 1037.11 | 6.326 ±2060.15 |
| T6 | 10.916 ±235.556 [ab] | 31.824 ± 750.103 | 31.221 ± 1000.43 | 7.930 ±1986.09 |
| Significant levels | * | N.S | N.S | N.S |

Note: N.S Means no significant difference; * Different letters within the same column, there are significant differences at the probability level 0.05; (1) treatments T1 (Control), T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed), T3: adding propionic acid (1.5 g / Kg feed), T4: adding propionic acid (3 g / Kg feed ), T5: adding formic acid (1.5 g / Kg feed ), T6: adding formic acid (3 g / Kg feed ).

Table 3, shows the average gain weight (g) of experimental treatments birds, the results of statistical analysis showed a significant superiority ($p \leq 0.05$) in T3, T4, T5 in the average gain weight when adding organic acids or antibiotic to the broiler diet, compared with the antibiotic T2 treatment at age 14 days, while at ages 28 and 42 days there was no significant effect. The addition of two organic acids or antibiotic, showed an arithmetic improvement for T3, T4, T5 compared with the other experimental treatments, while no significant differences were observed in the accumulative gain weight at (0-6) week.

The results of statistical analysis in table 4, showed there was no significant differences was observed in feed consumption trait at ages (14, 28, 42) days and no significant improvement was recorded in the average accumulative feed consumption at (0-6) weeks for all experimental treatments.

The results of statistical analysis showed a significant differences ($p \leq 0.05$) in the feed conversion coefficient at age of 14 days between the experimental treatments as shown in table 5. While at ages (28 and 42) days and the cumulative (0-6) weeks did not showed any significant differences.

The improvement of some of the production traits, such as live body weight and gain weight, this means that organic acids can retain nitrogen, increase absorption and take advantage of nutrients in the diet components, as well as its inhibitory for the negative pathogenesis bacterial growth *Salmonnella*, *E. coli* this will improve the digestive tract environment which has a positive impact on the health and production performance, (Philipsen, 2006 and Desai *et al*., 2007) and effect of adding the two organic acids propionic or formic or the antibiotics Colistin to the diet in pH of the Duodenum measurement, the height of villi, the depth of crypts. Table 6 shows significant differences in pH of the Duodenum and the height of villi traits, while for the depth of crypts there was a significant improvement ($p \leq 0.05$) was observed for the treatment T4 (3 g / kg feed) propionic acid, compared to the control treatment and the ratio was (15.966 and 12.433) µm respectively.

From the results of current study can be concluded that the addition of organic acids (propionic or formic) to the broiler diet and because they are from the short-chain fatty acids that it has a role in increasing the growth of the mucous layer in the Intestine, which is a defensive line to reduce the growth of harmful bacteria and toxic

**Table 4:** The effect of adding two organic acids (propionic or formic ) or antibiotics Colistin to the broiler diets in the average feed consumption (g).

| Treatments (1) | Average feed consumption (g) for weeks± standard error | | | Accumulative feed consumption (0-6) week |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| T1 | 11.096 ±223.536 | 16.537 ± 1201.33 | 45.751 ±1794.69 | 39.208 ±3219.56 |
| T2 | 8.280 ±223.863 | 57.924 ± 1211.91 | 16.189 ± 1706.87 | 73.028 ±3142.64 |
| T3 | 5.983 ±229.576 | 47.781 ± 1295.31 | 11.116± 1734.97 | 48.939 ±3259.85 |
| T4 | 4.452±224.173 | 3.236 ± 1219.33 | 29.778 ± 1781.45 | 24.238 ±3225.71 |
| T5 | 1.704±236.400 | 39.593 ± 1263.0 | 38.046± 1728.66 | 72.847 ±3228.06 |
| T6 | 14.405 ±223.266 | 63.184 ± 1243.30 | 55.159± 1712.56 | 98.660 ±3179.13 |
| Significant levels | N.S | N.S | N.S | N.S |

Note: N.S Means no significant difference; (1) treatments T1 (Control), T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed), T3: adding propionic acid (1.5 g / Kg feed), T4: adding propionic acid (3 g / Kg feed ), T5: adding formic acid (1.5 g / Kg feed ), T6: adding formic acid (3 g / Kg feed).

**Table 5:** The effect of adding two organic acids (propionic or formic) or antibiotics Colistin to the broiler diets in the feed conversion coefficient (g) for experiment weeks.

| Treatments (1) | Feed conversion coefficient (g) for weeks± standard error | | | Accumulative feed conve. coeffic. (0-6) week |
|---|---|---|---|---|
| | 2 | 4 | 6 | |
| T1 | 0.018 ± 0.952 [b] | 0.017 ± 1.533 | 0.021 ±1.826 | 0.012 ±1.433 |
| T2 | 0.081 ± 1.026 [a] | 0.081 ± 1.586 | 0.020 ± 1.713 | 0.015 ±1.440 |
| T3 | 0.005 ± 0.930 [b] | 0.204 ± 1.760 | 0.102 ± 1.760 | 0.024 ±1.463 |
| T4 | 0.014 ± 0.893 [b] | 0.040 ± 1.550 | 0.040 ± 1.693 | 0.029 ±1.376 |
| T5 | 0.014± 0.966 [ab] | 0.123 ± 1.630 | 0.042 ± 1.673 | 0.038 ±1.416 |
| T6 | 0.017 ± 0.943 [b] | 0.090 ± 1.643 | 0.113 ± 1.713 | 0.029 ±1.426 |
| Significant levels | * | N.S | N.S | N.S |

Note: N.S Means no significant difference; * Different letters within the same column, there are significant differences at the probability level 0.05; (1) treatments T1 (Control), T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed), T3: adding propionic acid (1.5 g / Kg feed), T4: adding propionic acid (3 g / Kg feed ), T5: adding formic acid (1.5 g / Kg feed ), T6: adding formic acid (3 g / Kg feed).

**Table 6:** The effect of adding two organic acids (propionic or formic) or antibiotics Colistin to the broiler diets in the pH of duodenum measure, the lengths of villi and the depth of crypts of micro flora (µm).

| Treatments (1) | pH of the duodenum | Average± standard error | |
|---|---|---|---|
| | | lengths of the villi | depth of the crypts |
| T1 | 5.7 | 1.007 ± 123.07 | [b] 0.868 ±12.433 |
| T2 | 5.4 | 5.350 ± 118.30 | [ab] 1.534 ± 12.833 |
| T3 | 5.5 | 131.733± 8.441 | [ab] 1.134 ± 14.533 |
| T4 | 5.3 | 15.415 ± 153.30 | [a] 0.202 ± 15.966 |
| T5 | 5.6 | 8.819 ± 133.33 | [ab] 0.375 ± 12.966 |
| T6 | 5.36 | 19.694 ± 140.63 | [ab] 1.250 ± 14.300 |
| Significant levels | N.S | N.S | * |

Note: N.S Means no significant difference; * Different letters within the same column, there are significant differences at the probability level 0.05; (1) treatments T1 (Control), T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed), T3: adding propionic acid (1.5 g / Kg feed), T4: adding propionic acid (3 g / Kg feed ), T5: adding formic acid (1.5 g / Kg feed ), T6: adding formic acid (3 g / Kg feed ).

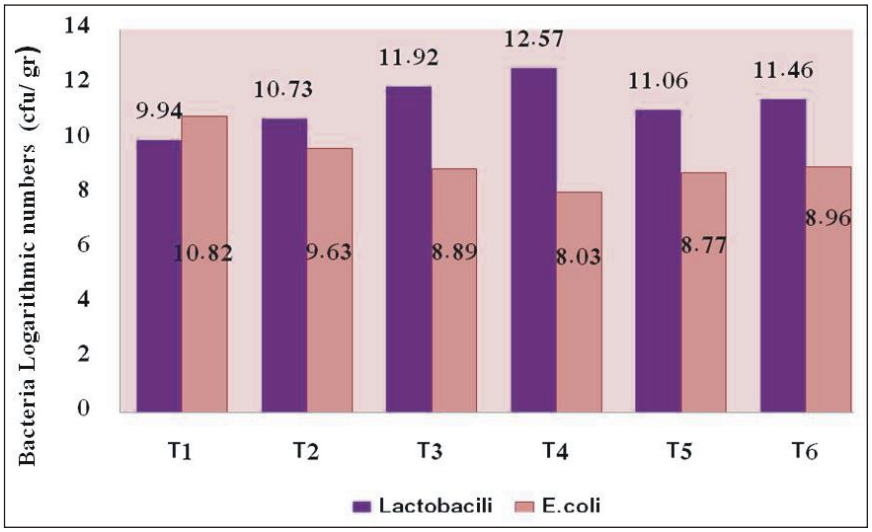


**Fig. 1:** The effect of adding two organic acids (propionic or formic ) or antibiotics Colistin to the broiler diets in the bacterial count of (*Lactobacili, E. coli*) in the micro flora at age 42 days (cfu / gr). (1) treatments T1 (Control); T2: adding the antibiotic (Colistin) (0.25 / 4 Kg feed); T3: adding propionic acid (1.5 g / Kg feed); T4: adding propionic acid (3 g / Kg feed ); T5: adding formic acid (1.5 g / Kg feed ); T6: adding formic acid (3 g / Kg feed ).

substances in the intestinal cavity which reduces the diseases and inflammation thus increases in the depth of crypts, the lengths of villi (Xia *et al*., 2004).

Fig. 1, showed the effect of adding two organic acid, propionic or formic or antibiotics that there was no significant differences in the E.coli and Lactobacillus numbers. The using of organic acid in the form non-ionized leads to its entry into the Gram negative bacteria cell, which leading to an imbalance in its metabolism occurred and therefore death. This occurs when an acidic medium is available and the mucous cells lining the intestine, which is a suitable medium for the growth and proliferation of beneficial bacteria and the most important it is Lactobacillus, which considered to be not sensitive to acid and in turn are also important in not increasing the numbers of E. coli bacteria (Cherrington *et al*., 1990; Naidu, 2000; Wolfenden *et al*., 2007; Biggs and Parsons, 2008).

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