EFFECT OF DIETARY SUPPLEMENTATION OF SOME ORGANIC ACIDS MIXTURES ON PERFORMANCE OF BROILER CHICKS

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SUMMARY

This study was carried out to investigate the effects of feeding some organic acids mixtures on broilers. Four organic acids (OAs): formic (FA) at 0.50%, acetic (AC) at 0.25%, citric (CA) at 2% and butyric (BA) at 0.2% were used as mixtures. A total number of 210 one day old male Arbor Acres broiler chicks were randomly divided into 7 treatment groups, each in three replicates of 10 chicks per replicate. The first group fed the basal diet without supplementation and served as control (T1). While, the other groups received the basal diet supplemented with the tested organic acids mixtures as follow: T2 (0.5% FA+0.25% AC), T3 (0.5%FA+2%CA), T4 (0.5% FA +0.2% BA), T5 (0.25 %AC+ 2% CA), T6 (0.25% AC+0.2%BA) and T7 (2%CA+0.2%BA). The experiment lasted up to 42 day of age. Performance, pH of feed and some GI-tract segents, cecal bacteria count, blood metabolites, acceptability and nutrients digestibility were measured. Results indicated that:

1) Most of OAs mixtures improved performance of broiler chicks measured as feed conversion ratio, protein utilization efficiency and European Production Efficiency Index (EPEI) compared with the control group.
2) Dietary OAs mixtures improved some nutrients digestibility of the experimental diets compared with the control group.
3) Blood plasma content of calcium, phosphorus, total protein and globulin were significantly increased by feeding OAs mixtures compared with the control group.
4) Relative weights of lymphoid organs (spleen and bursa of fabrics) of chicks fed OAs mixtures were mostly higher than the control.
5) The pH values were significantly reduced in crop and gizzard of the chicks fed OAs mixtures compared to chicks fed the control.
6) Most of OAs mixtures significantly increased lactobacillus count and significantly lowered the population of the anaerobic and *E. coli* count of ceca.

In conclusion, 0.5%FA, 0.25%AC, 0.2%BA and 2%CA as mixtures may improve performance and health of broiler chickens.

Keywords: *Organic acids, broiler, performance, digestibility, serum, pH and bacteria*.

INTRODUCTION

It is interested to investigate potential alternatives of antibiotic growth promoters in poultry diets to maintain good growth performance and intestinal microbial populations, particularly to control the growth of harmful bacteria. Several organic acids have been reported to improve growth performance, feed efficiency, and mineral absorption (Denil *et al* ., 2003 and Kout Elkloub *et al*., 2014).

Some researchers have suggested that organic acids can be used to control intestinal microbial growth (Ecklund, 1983). Also the addition of organic acids had statically effects regarding the decrease in the counts of mould, yeast in feed and pathogenic intestinal bacteria (i.e., total aerobic bacteria, E. coli, salmonella and staphylococci) as reported by Panda *et al*. (2009); Akyrek *et al.*(2011) and Kout Elkloub *et al*.,(2014). Their principle is to lower and supplies the pH in the stomach and intestines so that the gut environments become too acidic for normal bacterial growth. Additionally, they improve protein digestion in young animal by stimulating pancreatic enzyme secretion (Mellor, 2000). Thus, dietary OAs can suppress the growth of pathogenic bacteria, encourage the growth of beneficial microflora and ensure that the enzymes function is at maximal capacity (Ricke, 2003 and Dibner, 2004). Practically, organic acids work in poultry not only as a growth promoter but also as a meaningful tool of controlling all enteritis bacteria, both pathogenic and non-pathogenic (Naidu, 2000 and Wolfenden *et al.*, 2007)**.** Moreover, feeding OAs are believed to have several beneficial effects such as improving feed conversion ratio, growth performance, enhancing minerals absorption and accelerating recovery from fatigue (Denli *et al*., 2003; Abdel-Fattah *et al*., 2008 and Banday *et al.*, 2010) and also providing people with healthy and nutritious poultry products (Patten and Waldroup,1988). Dietary acidification increases gastric proteolysis and protein and amino acid digestibility. The acid anion of such OAs has been shown to complex with Ca, P, Mg and Zn, resulting in absorbability improvement of these minerals. Furthermore, OAs serves as substrates in the intermediary metabolism (Kirchgessner and Roth, 1988). Organic acids have beneficial effects in poultry production by reducing the gut pH and bacterial growth intolerant to pH variations (Ao *et al*., 2009), thus providing better intestinal health for the bird to obtain maximum nutrient absorption. Moreover, organic acids have been used to improve poultry performance, perhaps, by inhibiting the intestinal bacteria competing with the host animals for available nutrients (Attia *et al.*, 2012). The main action of dietary acidification is a fortification of the intestinal mucosal barrier function against adverse agents such as toxic bacterial metabolites (Smulikowska *et al.*, 2010).

The objectives of this study aimed to investigate the optimal supplementation of organic acids being formic (FA), acetic (AC),citric (CA) and butyric acids (BA) as mixtures on performance, nutrients digestibility, blood metabolites, health (small intestinal microbial flora, pH) and meat quality of broiler chickens.

MATERIALS AND METHODS

The experimental work of this study was carried out at Gezerit Elshier Poultry Research Station, AL- Kanater AL-Khairia, Egypt. A total number of 210 one-day old male Arbor Acres broiler chicks were randomly taken and divided into 7 treatment groups, each in three replicates (10 birds / replicate) as shown in Table (1). Feed and water were available all time. The study aimed to study the effective use of mixing four organic acids (OAs) FA at 0.5%, AC at 0.25%, BA at 0.2% and CA at 2.0%. These organic acids at such levels were evaluated in broiler diets through their effects on broiler performance, nutrients digestibility, some blood metabolites, pH level of some gastrointestinal tract segments, microbiological content of ceca, mortality, European Production Efficiency Index (EPEI) and overall acceptability of chicken meat.

The experimental treatments included different mixtures of four FA, AC, CA and BA which were used in different combinations in addition to the control group without OAs supplementation (Table 1). Basal diets were formulated (Table 2) to meet the nutrients requirements of Arbor Acres broiler at starter (1-14d), grower (15-28d) and finisher (29-42d) periods.

Body weights (BW), feed consumption (FC) and mortality rate were recorded biweekly and average body weight gains (BWG), feed conversion ratio (FCR) and European Production Efficiency Index (EPEI) were calculated.

At 6 weeks of age, three birds from each treatment were randomly taken and housed in individual cages to determine the digestibility coefficients of nutrients for only the experimental finisher diets. The analyses of feed and dried excreta were done according to A.O.A.C. (1990). Fecal nitrogen was determined according to Jakobsen *et al.* (1960).

At the end of the experiment (42 day), three birds / treatment were randomly taken and slaughtered to obtain the acceptability of chicken meat and lymphoid organs. Blood samples were taken to determine plasma content of total protein, albumin, globulin, cholesterol, calcium and phosphor, using commercial kits. The pH in feed and different parts of the gastrointestinal tract was determined according to Al-Natour and Alshawabkeh (2005), as well as the definition and count of the gastrointestinal tract microbial content (Quinn *et al*., 1992).

The obtained data were statistically analyzed using linear models procedure described in SAS users guide (SAS, 1990). Differences between means were tested using Duncan’s Multiple Range Test (Duncane’s, 1955). One –way analysis model was applied:

$Y_{ij} = \mu + T_i + E_{ij}$

Where: Y_{ij} =Observations

μ =the overall mean

Ti =Effect of $i^{th\ treatments}$

E_{ij} =Experimental error

RESULTS AND DISCUSSION

Productive performance:

The effect of used organic acids mixtures on growth performance are summarized in Table 3. The results indicated that at 42 days of age, the chicks fed T_2 (0.5% FA+0.25% AC) recorded the heaviest LBW (2089g) and the best BWG (1973g) compared with all treatments and control group. While those fed T_5 (0.25 %AC+ 2% CA) had significantly lower value of LBW (2002 g) and BWG (1885g) compared to T2. However, no significant differences were observed among the other mixtures of OAs. These results are in harmony with the results of Vale *et al*. (2004) who reported that giving broiler OAs (70% FA and 30% PA) at levels of 0.25, 0.50, 1.0 or 2.0% increased BW and BWG at 0.25 and 0.5% levels and decreased at 2% level compared to the control. Also, Senkoylu *et al*. (2005 and 2007) indicated that weight gain of broilers at 21 and 35 d were significantly ($p<0.001$) increased by supplementing 3g OAs/kg feed compared to the control. Also**,** Viola *et al.* (2008) found that adding mixtures of OAs increased BWG of birds at 35 days of age. In addition, Vieira *et al.* (2008) mentioned that a blend of OAs (40% LA, 7%AC, 5% phosphoric acid and 1% BA) improved BW, but did not affect BWG ($p\leq 0.05$). Samanta *et al*. (2010) found that supplementation of OAs blend (10g and 20g/kg) to the diets increased LBW linearly compared to the control. Also, Asma and Nagra (2010) reported that chicks receiving 0.6% blend of OAs as 7:3 ratio of FA and PA had better BWG than the control. On the other hand, Isabel and Santos (2009) noticed that birds fed organic acid salts (5,120 ppm of FA and 2,080 ppm of PA) had no influence on BW or BWG. Also, Smulikowska *et al*. (2010) found no significant effect on BWG in birds fed organic acid blend (6 g/kg).

The lowest values ($P < 0.01$) of cumulative feed consumption (FC) recorded by the chicks fed T_6 (0.25% AC+0.2%BA) (3436g) at 7-42d compared to the other treatments and control group, accordingly, recorded significantly the best FCR values compared toT_3 (0.5%FA+2%CA), T_7 (2%CA+0.2%BA) and control group (T_1). The best FCR occurred by T_6 (0.25% AC+0.2%BA) followed by T_2 (0.5% FA+0.25% AC) compared to the other treatments. These findings agree with those obtained by Senkoylu *et al*. (2005) who found that the addition of 3g OAs / kg to broiler diet significantly ($p<0.001$) improved FC and FCR at 21 and 35 days. Also, Senkoylu *et al*. (2007) noted significantly ($P < 0.001$) improved FCR by using combination of FA and PA at 21 days of age. Samanta *et al*. (2010) found that FCR was better in broilers fed OAs blend (10g and 20g/kg) for 35 days. Asma and Nagra (2010) found that adding 0.6% blend of OAs as 7:3 ratio of FA and PA performed better FC than the control, however no significant difference was observed in FCR. On the other hand, Alp *et al*. (1999) found that no effect was obtained on FCR when used OAs combination (LA, FUA, PA, CA and FA). Mikulski *et al*. (2008) found an inferior FCR when used blend of FA and PA (5.0 g/kg) and blend of citric, fumaric, orthophosphoric and malic acids, compared to the control. Also, Smulikowska *et al*. (2010) found that organic acid blend (6 g/kg) did not significantly affect FC compared to the control.

The addition of OAs mixtures recorded higher protein utilization efficiency and EPEI compared to the control group without significant differences between them (Table 3). Numerically, T_2 (0.5% FA+0.25% AC) gave higher EPEI compared to other treatments and the control.

The high viability of all birds during the experimental periods occurred. The mortality could have accounted to natural cases (Table 3).These results were in harmony with the result of Isabel and Santos (2009) and Samanta *et al*. (2010) who reported that adding mixtures of organic acids to broiler diet had no influence on mortality. This could be attributed to the effect of such OAs against different pathogenic microorganisms, particularly at younger age or to the protective action against diseases and reduction of mold growth which inhibits the formation of aflatoxins.

Nutrients digestibility:

Analysis of variance showed significant differences for the digestion coefficients of OM, CP, EE and NFE at 42 days of age (Table 4). The best significant digestibility of OM and NFE recorded by T_6 (0.25% AC+0.2%BA). Chicks fed OAs specially T_2 (0.5% FA+0.25% AC) and T_3 (0.5% FA + 2% CA) recorded the highest values of CP digestibility. While, the lower values recorded by chicks fed T_5 (0.25 %AC+ 2% CA). All treatments had significantly higher values of EE digestibility compared to the control except T_4. No significant differences for the digestion coefficients of CF when used OAs. Similarly, NR values were higher on all treatments but not significantly compared to the control group. These results did not agree with those obtained by Gheisari *et al*. (2007) who found that protected OAs had no significant ($p<0.05$) effect on ileal protein digestibility. Also, Mikulski *et al*. (2008) showed that dry matter concentration in the ileal digesta were unaffected by using a blend of (FA and PA) or blend of (citric, fumaric, orthophosphoric and malic acid).

Overall Acceptability:

No significant differences between chicks fed diets supplemented with OAs mixture and the control group for dressing, thigh, gizzard, abdominal fat, liver, heart and total edible parts percentages (Table 5). Breast percentages was significantly increased ($p<0.01$) byT_7 (2% CA+0.2%BA) compared to those of toT_3 (0.5%FA+2%CA), while, no significant differences were observed between the other treatments. These results are in agreement with those obtained by Alp *et al*. (1999) who found that carcass weight and dressing percentage were not affected by OAs combination (LA, FuA, PA, CA and FA) added to the broiler feed. Vieira *et al*. (2008) found that the yield of carcass and commercial cuts were not improved by OAs (40% LA, 7% AC, 5% phosphoric and 1% BA) supplemented to the broiler feed. Also, Isabel and Santos (2009) noticed that carcass weight was not influenced by supplementation of OAs mixture. Samanta *et al*. (2010) declared that no effect was observed on the dressing percentage, but breast and thigh weights increased linearly with adding OAs blend (1or 2g/kg OAB). Asma and Nagra (2010) noted that receiving 0.6% blend of OAs as 7:3 ratio of FA and PA had no adverse effect on dressing percentage, however abdominal fat was decreased with OAs blend compared to the control group.

Blood constituents:

The results of the estimated blood plasma parameters and lymphoid organs of broiler at 42 days old as affected by dietary mixture of OAs are presented in Table 6. Generally, dietary mixture of OAs had significant effects on all blood plasma parameters. All treatments had significantly high levels of plasma calcium and phosphorus compared to control group. The highest concentration of plasma calcium and phosphorus occurred by T_2 (0.5% FA+0.25% AC) compared with other treatments and control group. Chicks of T2 recorded significantly lower ALT values compared to control group. While, no significant differences were observed among the other treatments. The current results demonstrated that dietary OAs significantly affected AST. Chicks fed the control diet recorded significantly the lowest value (36.67), however T_6 (0.25% AC+0.2%BA) recorded highest value (60) of AST.

The results also showed that chicks of T_7 (2%CA+0.2%BA) recorded significantly the lowest value of cholesterol than the other treatments and control group. In this connection, Asma and Nagra (2010) reported that by supplementing OAs into diet at the level of 0.8% FA, 0.4% PA, or 0.6% blend of FA and PA as 7:3 ratio, plasma alkaline phosphatase, AST and ALT levels were within the normal range.

Supplementation of OAs mixtures to all treatments significantly increased plasma total protein and globulin compared to control group. Broiler chicks supplemented with organic acid mixtures recorded lower values of A/G ratio compared to control group, except T_3 (0.5% FA + 2%CA) which recorded significantly higher value.

These results indicated that mixture of OAs may improve the immune response. Globulin level has been used as an indicator of immune responses and source of antibody production. Griminger (1986) stated that high globulin level and low A/G ratio signified better disease resistance and immune response. This result is in harmony with those of Asma and Nagra (2010) who reported that formic acid supplementation into diet at blend of formic and propionic acids as 7:3 ratio, tended to increase significantly antibody titer against NDV and IBD compared to the control.

It is well known that spleen, bursa and thymus are involved in the immune system (Sturkie, 1986) and this system is responsible for producing cells and chemicals that protect the birds from the invaded microorganisms. It was clearly observed that T_2 (0.5% FA+0.25% AC) and T_5 (0.25 %AC+ 2% CA) had significantly higher relative weights of spleen (Table 6). The results explained that chicks fed all OAs mixture had significantly higher relative weights of bursa than the control group which recorded the lowest weight. The broilers of T_2 (0.5% FA+0.25% AC) had significantly higher relative thymus weights compared to other treatments except T_3 (0.5%FA+2%CA). These results indicate that broiler chicks fed on acidifiers had better immune organs and disease resistance. In this respect, Katanbaf *et al*. (1989) reported that the increase in the relative organ weight is considered as an indication of the immunological advances.

Effect of organic acids mixture on pH in feed and different parts of the gastrointestinal Tract:

Feed pH:

The pH values of starter, grower and finisher diets declined as dietary mixture of organic acids was mixed. The present results showed significant ($p<0.01$) reduction in the pH values of different treatments compared to the control (Table 7).

pH values of gastrointestinal Tract:

The results indicated that OAs mixture supplementation in all treatments significantly reduced crop and gizzard pH values compared to the control. While, the broiler fed the control showed significantly lower duodenum pH compared with T_5 (0.25 %AC+ 2% CA), T_6 (0.25% AC+0.2%BA) and T_7 (2%CA+0.2%BA). However, no differences were observed among other dietary treatments. The results showed that jejunum pH was significantly lower in chicks of T_1 compared to T_5 (0.25 %AC+ 2% CA) and T_6 (0.25% AC+0.2%BA). The lower pH in the ileum was recorded by T_4 (0.5% FA +0.2% BA), compared to T_2 (0.5% FA+0.25% AC), T3 (0.5% FA + 2% CA), T_6 (0.25% AC+0.2%BA) and T_7 (2%CA+0.2%BA). On the other hand, ceca was significantly lower in chicks of T_1 and T_7compared to T_4. While, rectum pH was significantly higher in chicks of T_7 compared to the other treatments. The present results are in agreement with those of AL-Tarazi and Alshawabkeh (2003) who reported that dietary mixture of both FA and PA at concentrations of 0.5 to 1.5%, significantly ($P < 0.05$) lowered the pH of the crop and cecal contents in all groups, except the group treated with (0.5 %FA and 0.5% PA) compared to the control. Alp *et al*. (1999) found that mean ileal pH was significantly ($p<0.05$) lower in chickens fed OAs combination (LA, FUA, PA, CA and FA) at 3g/kg diet compared to the control.

Similarly, Gheisari *et al*. (2007) found that pH of digest in ileum was significantly ($p<0.05$) decreased with increasing the levels (0.0, 0.2 and 0.4%) of protected organic acid mixtures (formic and propionic). On the other hand, Paul *et al*. (2007) found no significant difference in pH of different segments of the GIT due to OAs salts compared with the antibiotic group. However, Mikulski *et al*. (2008) noted that AOs blend (5.0g FA and PA/kg) significantly decreased the pH of the broiler crop contents, but had no effect on the pH of the caecal digesta compared to the control. Also, Samanta *et al.* (2010) found that organic acid blend (10g and 20g/kg OAB) had little effect on pH of the crop, proventriculus, duodenum and ileum. Also, Smulikowska *et al*. (2010) found that OAs blend (6g/kg) had no influence on the pH of gut digesta of birds.

Effect of organic acids mixture on ceca microbial content of broiler:

Data in Table 8 showed the effect of OAs mixture on microbial contents. The *Lactobacillus* bacterial counts per gram of ceca content of chicks fed dietary OAs mixture were significantly higher than the control group except T_3 (0.5%FA+2%CA) and T_4 (0.5% FA +0.2% BA). the coliform bacterial counts were significantly increased in T_2 (0.5% FA+0.25% AC) than the other treatments. On the other hand, anaerobes bacterial numbers and the population of *E. coli* were significantly ($p<0.01$) lower in chicks fed all mixtures of OAs compared to control group. In this respect, Alp *et al.* (1999) used OAs mixtures (LA, FUA, PA, CA and FA) and/or zinc bacitracin in 4 treatments, T1 (control), T2 (3gm OAs mixture/ kg), T3 (0.1gm zinc bacitracin/kg) and T4 (T2 and T3) and found that T4 had the lowest number of *Enterobacteriaceae* in the intestinal material compared to the other treatments. AL- Tarazi & Alshawabkeh (2003) found that addition of OAs mixture significantly ($P < 0.05$) decreased the crop and caecal *S. pullorum*.

Moreover, Gunal *et al.* (2006) found that antibiotics or OAs mixture significantly decreased total bacterial count compared to the control group. Paul *et al*. (2007) found that the total viable number of *E. coli* and *clostridium* in gut contents varied numerically among treatments, the values were statistically non-significant by feeding broilers on antibiotics or OAs. Gheisari *et al.* (2007) observed that supplementation of organic acid mixture (FA and PA) had significantly ($p<0.05$) increased colony count of lactobacillus and decreased coliforms in digesta at 24 and 42 days. *Lactobacillus* and coliforms were higher on 42 days compared to that at 24 days. Samanta *et al*. (2010) found that OAs (10 or 20g/kg) did not affect *E. coli* and other coliform in the small intestine. *Lactobacillus* was quadratically higher in the OAs (10g) group than in the control. However, Hassan *et al.* (2010) found that the organic acid mixture (FA, calcium formate, calcium propionate and potassium sorbate or CA, calcium formate, calcium butyrate and calcium lactate) supplemented to the broiler diets significantly decreased *E. coli* and *salmonella* bacteria counts compared to the basal diet.

It could be concluded that 0.5%FA, 0.25%AC, 0.2%BA and 2%CA as mixtures may improve performance and health of broiler chickens.

Table (1). Design of experiment.

Treat. No	Treatment
T1 (Control)	The basal diet
T2	The basal diet + 0.5% FA + 0.25% AC
T3	The basal diet + 0.5% FA + 2%CA
T4	The basal diet + 0.5% FA + 0.2% BA
T5	The basal diet + 0.25% AC+ 2%CA
T6	The basal diet + 0.25%AC + 0.2%BA
T7	The basal diet + 2 % CA + 0.2% BA

Table (2). Composition and calculated analysis of basal diets.

Ingredients %	Starter (1-14d)	Grower(15-28d)	Finisher(29-42d)
Yellow corn	59.38	65.15	71.80
Soybean meal 44%	24.25	19.00	13.00
Corn Gluten meal 60%	10.00	10.00	10.00
Corn oil	1.80	1.70	1.10
Limestone	1.18	1.09	1.06
Di-Calcium phosphate	1.98	1.75	1.65
Vit & min. premix *	0.25	0.25	0.25
DL-Methionine	0.16	0.10	0.09
L-lysine HCL	0.50	0.46	0.55
Salt (Na Cl)	0.50	0.50	0.50
Total	100.0	100.0	100.0
Calculated analysis ** :			
CP %	22.00	20.07	18.02
ME (kcal/kg)	3096	3159	3192
Calcium %	1.00	0.90	0.848
Available Phosphorus %	0.499	0.45	0.42
Lysine %	1.349	1.176	1.086
Methionine %	0.60	0.52	0.485
Methionine & cystine %	0.967	0.86	0.79
Sodium %	0.21	0.21	0.21

* *Each 2.5 kg contains: Vit A12.000.000IU,Vit D_3 2.000.000IU, Vit E 10g, Vit K_3 2g, Vit B_1 1gm,Vit B_2 5g, Vit B_6 1.5g, Vit B_{12} 10mg , Nicotinic acid 30g, Pantothenic acid 10g, Folic acid 1g, Biotin 50mg, Choline chloride (50) 250g, Iron 30g, Copper 10g, Zinc 50g, Manganese 60g, Iodine 1g, Selenium 0.1g, Cobalt 0.1g, Carrier ($CaCO_3$) to 2.5 kg.*
** *According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).*

Table (3). Effect of organic acid mixtures on performance of broiler chicks at 42 days of age.

Tr.No.	Live body weight (g)	Body weight gain (g)	Feed consumption(g)	Feed conversion ratio(gfeed/g gain)	Protein utilization efficiency%	EPEI	No.of dead birds
T1	2053^{ab}	1937^{ab}	3827^{a}	2.00^{a}	2.51	220.61	0
T2	2089^{a}	1973^{a}	3706^{a}	1.87^{ab}	2.73	245.17	0
T3	2059^{ab}	1943^{ab}	3806^{a}	1.97^{a}	2.73	238.19	1
T4	2038^{ab}	1922^{ab}	3635^{a}	1.90^{ab}	2.76	241.50	0
T5	2002^{b}	1885^{b}	3647^{a}	1.93^{ab}	2.66	225.60	1
T6	2016^{ab}	1900^{ab}	3436^{b}	1.80^{b}	2.70	234.19	0
T7	2022^{ab}	1906^{ab}	3816^{a}	2.00^{a}	2.53	219.46	0
MSE	± 21.78	± 21.77	± 57.28	±0.04	±0.09	±8.93	

a, b Means in the same row with different superscripts are significantly different (P<0.01).
T1 (control), T2 (0.5%FA+0.25%AC), T3 (0.5%FA+2%CA), T4 (0.5%FA+0.2%BA, T5 (0.25%AC+2%CA), T6 (0.25%AC+0.2%BA) and T7 (2%CA+0.2%BA).

Table (4). Effect of dietary organic acid mixtures on nutrients digestibility and nitrogen retention of experimental finisher diets.

Treatments	OM	CP	EE	CF	NFE	NR
T1	81.86^{b}	93.90^{ab}	76.79^{b}	31.17	82.44^{bc}	55.54
T2	81.42^{b}	94.67^{a}	84.15^{a}	31.17	80.13^{c}	58.85
T3	81.82^{b}	94.62^{a}	82.71^{a}	32.40	80.60^{bc}	56.13
T4	82.17^{b}	93.94^{ab}	80.38^{ab}	29.26	82.16^{bc}	55.86
T5	82.78^{ab}	93.03^{b}	81.60^{a}	29.18	82.92^{abc}	59.56
T6	85.25^{a}	93.71^{ab}	82.40^{a}	30.53	85.90^{a}	61.69
T7	83.84^{ab}	93.71^{ab}	83.27^{a}	29.68	83.82^{ab}	62.09
MSE	±0.81	±0.30	±1.39	±2.12	±0.99	±2.77

$^{a, b, c}$ Means in the same row with different superscripts are significantly different (P<0.01)
T1(control),T2(0.5%FA+0.25%AC),T3(0.5%FA+2%CA),T4(0.5%FA+0.2%BA, T5(0.25%AC+2%CA), T6(0.25% AC+0.2%BA) andT7(2%CA+0.2%BA).

Table (5). Effect of dietary organic acid mixtures on acceptability of broiler chicks at 42 days old.

Treatments	Live weight(g)	Dressing	Breast	Thigh	Abdominal Fat	Gizzard	Liver	Heart	T.edible parts*
T1	2634	68.32	37.96^{ab}	30.36	1.62	2.50	2.18	0.48	73.48
T2	2400	67.58	36.50^{ab}	31.08	1.74	2.41	2.07	0.48	72.53
T3	2300	65.80	35.02^{b}	30.75	2.24	2.02	2.39	0.51	70.72
T4	2473	67.56	37.83^{ab}	29.72	1.99	2.44	2.18	0.54	72.71
T5	2541	68.52	37.55^{ab}	30.95	1.88	2.25	2.25	0.47	73.49
T6	2682	66.12	36.06^{ab}	30.06	1.55	2.48	2.46	0.50	71.57
T7	2404	68.40	38.57^{a}	29.79	1.90	2.59	1.87	0.52	73.38
SME	±100.53	±0.92	±0.88	±0.79	±0.31	±0.19	±0.18	±0.5	±0.89

$^{a, b}$ Means in the same row with different superscripts are significantly different (P<0.01)
**Total edible parts (dressing+ gizzard+ liver+ heart).*
T1(control),T2(0.5%FA+0.25%AC),T3(0.5%FA+2%CA),T4(0.5%FA+0.2%BA, T5(0.25%AC+2%CA), T6(0.25% AC+0.2%BA) andT7(2%CA+0.2%BA).

Table (6). Effect of organic acid mixtures on some blood constituents and lymphoid organs of broiler at 42 days.

Items	Treatments							MSE
	T1	T2	T3	T4	T5	T6	T7	
Blood constituents								
Calcium	7.70^{d}	10.79^{a}	9.55^{bc}	10.37^{ab}	9.54^{bc}	8.70^{cd}	9.37^{bc}	±0.37
Phosphorus	1.11^{d}	3.38^{a}	3.23^{b}	1.95^{c}	1.83^{c}	1.95^{cd}	2.44^{ab}	±0.08
ALT	87.0^{a}	75.67^{b}	79.67^{ab}	76.67^{ab}	82.67^{ab}	83.67^{ab}	81.00^{a}	±3.30
AST	36.67^{c}	49.67^{b}	46.33^{b}	47.00^{b}	43.00^{bc}	60.00^{a}	46.33^{b}	±2.31
Cholesterol	88.63^{a}	92.33^{a}	86.36^{a}	89.52^{a}	77.06^{ab}	82.12^{ab}	69.71^{b}	±5.08
T. protein	3.36^{e}	4.24^{d}	7.36^{a}	5.53^{b}	5.25^{bc}	4.42^{cd}	5.24^{bc}	±0.27
Albumin(A)	0.56^{b}	0.53^{b}	1.62^{a}	0.80^{b}	0.84^{b}	0.77^{b}	0.82^{b}	±0.11
Globulin(G)	2.80^{e}	3.71^{cd}	5.74^{a}	4.72^{b}	4.41^{bc}	3.65^{d}	4.42^{bc}	±0.22
A/G ratio	0.20^{b}	0.14^{b}	0.29^{a}	0.17^{b}	0.19^{b}	0.20^{b}	0.19^{b}	±0.026
Lymphoid organs %								
Spleen	0.14 c	0.21 a	0.16 b	0.14 c	0.20 a	0.13 c	0.13 c	±0.005
Bursa	0.16 c	0.39 a	0.40 a	0.37 a	0.26 b	0.28 b	0.38 a	±0.014
Thymus	0.40 cd	0.56 a	0.53 ab	0.47 bc	0.47 bc	0.36 d	0.48 b	±0.023

a,b…e Means in the same row with different superscripts are significantly different (P<0.01).
**Ca, P and cholesterol (mg/dl), total protein, albumin and globulin (g/dl).*
T1 (control), T2 (0.5%FA+0.25%AC), T3 (0.5%FA+2%CA), T4 (0.5%FA+0.2%BA, T5 (0.25%AC+2%CA), T6 (0.25% AC+0.2%BA) and T7 (2%CA+0.2%BA).

Table (7). Effect of organic acid mixtures on measurement of pH in feed and different parts of the gastrointestinal tract.

Items	Treatments							
	T1	T2	T3	T4	T5	T6	T7	MSE
Starter diet	5.28 [a]	4.95 [b]	4.25 [d]	4.94 [b]	3.69 [f]	4.64 [c]	4.94 [e]	±0.01
Grower diet	4.62 [a]	4.23 [b]	3.50 [e]	4.19 [c]	3.67 [d]	4.20 [c]	3.46 [f]	±0.01
Finisher diet	5.05 [a]	4.16 [c]	3.49 [f]	4.10 [d]	3.49 [f]	4.23 [a]	3.58 [e]	±0.01
Crop	4.77 [a]	4.31 [b]	4.44 [b]	4.51 [b]	4.31 [b]	4.41 [b]	4.47 [b]	±0.07
Gizzard	4.48 [a]	3.62 [bc]	3.75 [c]	3.64 [bc]	3.59 [bc]	3.80 [bc]	3.91 [b]	±0.11
Duodenum	5.75 [c]	5.93 [bc]	5.86 [bc]	5.82 [bc]	6.33 [a]	6.20 [a]	6.10 [ab]	±0.12
Jejunum	5.86 [c]	6.12 [abc]	6.12 [abc]	5.99 [bc]	6.33 [ab]	6.55 [a]	6.19 [abc]	±0.07
Ileum	6.54 [b]	6.71 [a]	6.83 [a]	6.25 [b]	6.51 [ab]	6.85 [a]	6.78 [a]	±0.10
Ceca	6.07 [b]	6.43 [ab]	6.29 [ab]	6.42 [ab]	6.50 [ab]	6.70 [a]	6.02 [b]	±0.18
Rectum	6.08 [b]	6.22 [b]	6.22 [b]	6.09 [b]	6.41 [ab]	6.11 [b]	6.78 [a]	±0.16

a,b …f Means in the same row with different superscripts are significantly different (P<0.01). T1 (control), T2 (0.5%FA+0.25%AC), T3 (0.5%FA+2%CA), T4 (0.5%FA+0.2%BA, T5 (0.25%AC+2%CA), T6 (0.25% AC+0.2%BA) and T7 (2%CA+0.2%BA).

Table (8). Effect of organic acid mixture on ceca microbial content of broiler.

Items	Lactobacillus	Coliforms	Anaerobes	E. Coli
T1(control)	8.41 [e]	2.50 [d]	5.66 [a]	6.33 [a]
T2	8.59 [d]	3.27 [a]	4.22 [e]	5.73 [e]
T3	8.34 [f]	2.40 [f]	4.93 [c]	5.73 [e]
T4	8.33 [f]	2.43 [e]	5.49 [b]	5.87 [d]
T5	8.74 [a]	2.90 [b]	3.96 [g]	6.20 [b]
T6	8.72 [b]	2.73 [c]	4.05 [f]	6.21 [b]
T7	8.64 [c]	2.50 [d]	4.34 [d]	6.13 [c]
MSE	±0.005	±0.006	±0.005	±0.006

a, b…g Means in the same row with different superscripts are significantly different (P<0.01) T1(control),T2(0.5%FA+0.25%AC),T3(0.5%FA+2%CA),T4(0.5%FA+0.2%BA,T5(0.25%AC+2%CA), T6(0.25%AC+0.2%BA)andT7(2%CA+0.2%BA)

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تأثير اضافة مخاليط بعض الأحماض العضوية على الأداء الانتاجى لكتاكيت التسمين.

عبدالله على غزالة [1], قوت القلوب مصطفى السيد مصطفى[2],عبد الرحمن عطا[1] و ريرى فوزى شطا[2]

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أجريت هذة الدراسة لدراسة تأثيرالتغذية على مخاليط بعض الأحماض العضوية على نمو كتاكيت اللحم. تم استخدام أربعة احماض عضوية وهى 0.5%الفورميك ، 0.25%الخليك ، 0.2% البيوتريك و 2% الستريك . أستخدم عدد 210كتكوت ذكر عمر يوم من سلالة الأربور إيكرز حيث قسمت عشوائيا الى7 معاملات كل منها فى 3 مكررات. غذيت المجموعة 1 على العليقة الأساسية بدون أى إضافات لتمثل مجموعة المقارنة (الكنترول) بينما غذيت المجموعات التجريبية الاخرى على العليقة الأساسية مضافا اليها مخاليط الأحماض العضوية المختبرة وهى المعاملة 2(0.5% حمض الفورميك+ 0.25% الخليك) و المعاملة 3(0.5% حمض الفورميك+ 2% الستريك) والمعاملة 4(0.5% حمض الفورميك+ 0.2% البيوتريك) المعاملة5 (2% الستريك +0.2% البيوتريك). المعاملة6(0.25% الخليك + 0.2% البيوتريك) المعاملة7(0.25% الخليك + 0.2% البيوتريك) وقد استمرت التجربة مدة 42 يوم . تم قياس الاداء الانتاجى ودرجة الحموضة على طول القناة الهضمية ومحتوى الأعور من البكتريا ومكونات الدم وخصائص الذبيحة ومعاملات هضم المركبات الغذائية.

أوضحت النتائج المتحصل عليها الاتى:

1- أدى إستخدام معظم مخاليط الأحماض إلى تحسن الأداء الانتاجي للطيور متمثلا فى الكفاءة التحويلية للغذاء وكفاءة الاستفاده من البروتين ودليل الاتحاد الاوروبى مقارنة بالكنترول.

2- أدت مخاليط الأحماض إلى تحسن بعض معاملات هضم المركبات الغذائية مقارنة بالكنترول

3-زاد معنويا محتوى بلازما الدم من الكالسيوم و الفوسفور و البروتين الكلى و الجلوبيولين مقارنة بالكنترول

4- فضلا.عن ذلك فقد زاد الوزن النسبى للأعضاء الليمفاوية (الطحال- برسا) مقارنه بالكنترول

5- انخفضت معنويا درجة الحموضة للحوصله والقانصه للكتاكيت المغذاه غلى مخاليط الاحماض مقارنة بالكنترول.

6- أدى إستخدام معظم مخاليط الأحماض العضوية المختبرة الى زيادة محتوى الأعور من بكتريا اللاكتوباسيلاس وخفض معنوبا المحتوى من البكتريا للاهوائية والإيكولاى فى الاعور.

مما سبق يتضح إمكانية إستخدام 0.5%الفورميك، 0.25% الخليك، 0.2% البيوتريك و 2% الستريك كمخاليط إضافات غذائية فى علائق كتاكيت اللحم لتحسين الأداء الإنتاجى و إنتاج دجاج لحم صحى .