J. Sus. Agric .Sci. **Vol. 44,** No.3, pp. 123 - 133 (2018)

Effect of Dietary Probiotic and Citric Acid Addition on Growth Performance, Carcass Traits and Blood Parameters in Broiler Chicks

T. H. Tag El-Din[1] ; A. L. Awad [2] and O.A.M Eid[1]
[1]*Poultry Production Dept., Fac. of Agric., Damietta Univ*
[2]*Animal Production Research Institute, Agric. Res. Centre, Dokki, Giza, Egypt.*

A TOTAL of 360IR broiler chickens used at hatch, weighed and divided into equal six experimental groups each of three replicates to investigate the effect of dietary probiotics (Bioplus®,PB), citric acid salt (CA) and their mixture addition on growth performance and physiological parameters atfattening period.Chicks in the first group were fed experimental diets without any supplement and as the control, the second group was fed diets supplemented with 0.05% PB,the third and fourth groups were fed diets supplemented with 0.25 and 0.50% CA, respectively, while the fifth and sixth groups were fed diets supplemented with mixture of PB and 0.25 or 0.50% CA, respectively during the experimental period (from hatch up to m 42 days of age). The results indicated that growth performance traits were not significantly influenced by PB and CA addition except for feed intake which significantly ($P \leq 0.05$) improved by 0.25% CA than the control**.**All nutrients digestibility were significantly improved with supplementing CA alone to the diets except for crude fiber. Chicks fed PB or CA and their combination had higher insignificant hemoglobin, red blood cells, white blood cells and lymphocytes (%) than the control ($P > 0.05$), however, heterophils(%) and H/L ratio were significantly decreased. Serum cholesterol and triglycerides were insignificantly decreased by dietary treatments. Economic efficiency was improved for alltreated groups than the control. Therefore,it might be concluded that supplementing 0.25% CA by alone or in the combination with 0.05% PB to broiler diets might be used to improve growth performance and physiological status as well as economic efficiency during the fattening period**.**

Keywords: Probiotic, Citric acid, growth, Nutrient digestibility, Blood chemistry, Broilers, Carcass traits**.**

Introduction

During long time, antibiotic feed additives were used in poultry diets (as growth promoters) to improve the intestinal microflora, productive and reproductive performance and prevent some intestinal pathology (Hosamani et al., 2010). Removing antibiotics from poultry production may contribute to induce performance problems such as, depress body weight gain, feed efficiency and rise the incidence poultry diseases (Owen et al., 2008). As a result of good human healthy, researchers have intensified their efforts to find other feed additives, which are promising as alternatives of antibiotics in poultry production (Abdel-Raheem et al., 2012).

Nowadays, alternative feed additives are useful for improving poultry productive and preventing bacterial infection (Ng et al., 2009). Probiotics (PB) are live microorganisms cultures such as yeast, fungi and bacteria that are used in poultry diet to induce the balance in microbial communities in the gastrointestinal tract, it consist of single or mixtures strains of microorganisms (Colin et al., 2014). Adding probiotics tobroier diets improves growth performance (body weight gain and feed efficiency), immune status, intestinal function, and nutrients utilization of birds (Chichlowski et al., 2007 and Ohh, 2011). Agawane and Lonkar (2004) reported that improvement in serum albumin concentration and decreased triglycerides and cholesterol by probiotics supplementation to broilers diet.

Organic acids are organic compounds with acidic properties. The most common examples are carboxylic acids like lactic, propionic, acetic, formic, ascorbic, citric, oxalic, uric and butyric acid. Organic acids have not gained as much attention in broiler chick's production (Langhout, 2000). Organic acids can be used as alternatives to antibiotics, because they can prove powerful in maintaining gut healthyfor poultry,

DOI: 10.21608/jsas.2018.5292.1101

thus improving their livability, feed conversion ratio, weight gain, and immune responses (Fascina et al., 2012). Some studies explained that the addition of citric acid to broiler diets improved weight gain (Nezhad et al., 2007), increased feed consumption (Moghadam et al., 2006), and improved feed efficiency (Abdel-Fattah et al., 2008). Its addition, its use increased retention of phosphorus (Liem et al., 2008), tibia ash (Martinez-Amezcua et al., 2006), and toe ash (Atapattu and Nelligaswatta, 2005) in broiler chicks.

Therefore, this study is planned to evaluate dietary addition of PB, citric acid salt (CA) and their mixture effect on growth performance, carcass traits, nutrients utilization and blood constituents as well as economic efficiency of broiler at fattening period under Egyptian condition.

Materials and Methods

This study carried out in a private farm near Kafr Saad City, Damietta Governorate, Egypt. During the period between the 25th of April and 6th of June 2018. Three hundred and sixty unsexed commercial broiler chicks (IR), at hatch weighed anddividedinto equal six experimental treatments, each contained three replicates. Experimental groups were arranged as: the first group was fed theexperimental diet without any supplementand servedas thecontrol, the second group was fed diet supplemented with 0.05% PB (*BioPlus*®), the third and fourth groups were fed diets supplemented with CA by 0.25 and 0.50 %, respectively, while fifth and sixth groups were fed diets supplemented with mixture of0.05 % PBplus 0.25 or 0.50% CA, respectively. Experimental groups were fed the starter diet from one to 14 days, thenthe grower diet from 14 to 28 days and the finisher diet from 28 to42 days of age. Experimental diets formulated iso- energetic and iso- nitrogenous in order to meet the broiler requirements according to NRC (1994). Experimental diets composition and calculated analysis are present in Table 1.

All experimental chicks were reared under similar conditions. Diets and fresh water were available *ad-libitum* through the experimental period. Chicks were kept under 23 hours light and 1hours dark throughout the experimental period. Chicks were vaccinated against Newcastle (ND) disease and (IB) infectious broncheitis at the first week of age, Gumboro disease vaccine was administrated at the second week of age in drinking water. The antibiotic and vitamins were not used during the experimental period for all groups.

Measurements and estimated parameters

1. *Growth performance:* Live body weight and feed intake were weekly recorded per replicate of broiler. Also, number of dead chicks was recorded daily during the whole experimental period. Weight gainandfeed efficiency were calculated at certainperiods per replicate, while mortality and viability percentage of chicken's were calculated during the overall experimental period as well as production index (LBW, kg/ FCRx100).

2. *Digestion trial:* At 42 days of age, three chicks per treatment (about 2.0 kg) were taken to determine nutrients digestibility coefficients. Chicks were fed their experimental diets for three days. Feed intakewas recorded perreplicate, and excreta was voided, pooled and thoroughly mixed per replicate for each treatment. Feedsamplesand representative excreta samples were dried immediately for chemical analysis. Digestion coefficients of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free extract (NFE) were determined according to Jakobsen et al. (1960) ; Abou-Rayaand Galal (1971), while total digestible of nutrients (TDN) and metabolizable energy (ME) were calculated**.**

3. *Blood samples and analysis:*
   - A- *Blood hematological parameters:* Blood samples collected from five chicks per treatment at slaughtering in vial tubes containing EDTA as anticoagulant to evaluate blood content like hemoglobin, red and white blood cell counts, heterophils (H) and lymphocytes (L) percentage (Ritchie et al. , 1994), then H: L ratio was calculated.
   - B- *Serum constituents:* Blood samples collected from five chicks per treatment at slaughtering in non-heparinized tubes to obtained serum. Then serum biochemical parameters were determined calorimetrically by using commercial kits.

4. *Carcass traits:* At 42 days of age, five chicks per each treatment randomly taken, fasted for 12 hours before slaughtering and individually weighed pre-slaughtering and post complete bleeding. Then, scalding, feather picking and evisceration were performed and different body parts, organs and abdominal fat were dissected and weighed. Relative weights of carcass traits were expressed as a percentage of live body weight.

5. *Economic efficiency:* Feeding cost was calculated using existing market prices of one kg of starter, grower and finisher diet consumed per each treatment, while the other costs such as chicken price at hatch, farm, labor, vaccination and mortality were calculated according to experiment area. Sales

revenue was determined by using the price of the poultry stock exchange for the kilo of current living weight at the experiment time.

6. *Statistical analysis:* Data were statistically analyzed according to SPSS (2004) computer program using the following fixed model: $Y_i=\mu + T_i + e_i$ Where: Y_i = The observation; μ = Overall mean; T_i = Effect of treatments (i = 1, 2, …. and 6); e_i= Random error component assumed to be normally distributed. The differences among means were tested using Duncan's New Multiple Range Test (Duncan, 1955). All data are presented as least square means.

TABLE 1 . Experimental diets composition and calculated analysis

%	Experimental diets		
	Starter 1-14 day	**Grower 14-28 day**	**Finisher 28-42 day**
Yellow corn	54.0	58.05	62.07
Soya bean meal (48%)	31.0	25.85	22.20
Corn gluten (60%)	5.55	5.80	4.33
Soya oil	1.30	2.00	3.0
Limestone	1.60	1.75	1.78
Monocalcium phosphate	1.60	1.60	1.57
Vit.& Min. premix[1]	0.30	0.30	0.30
Salt	0.35	0.35	0.35
Methionine	0.10	0.10	0.10
Lysine	0.20	0.20	0.30
Molasses (dry matter basis)	4.00	4.00	4.00
Total	**100.0**	**100**	**100**
Calculated analysis[2]			
Crude protein,%	23.21	21.24	19.01
ME (kcal/kg)	2976.0	3057.0	3140.0
Crude fiber, %	3.36	3.09	2.92
Calcium, %	0.96	1.01	1.00
Av. Phosphorus, %	0.46	0.46	0.44
Methionine, %	0.47	0.45	0.41
Lysine,%	1.03	0.91	0.80
Sodium,%	0.15	0.15	0.15
Price, (LE/kg)[3]	6.773	6.589	6.386

1. Vit and Min.(3 kg) contains: Vit A 10 MIU, Vit. D 2 MIU, Vit E 10 g, Vit. K 2 g, Thi. 1 g, Ribo. 5 g, Pyrid. 1.5 g, Niac. 30 g, Vit. B12 10 mg, Panto. 10 g, Fol. 1.5 g, Biot.50 mg, Cho.Chl. 250 g, Man. 60 g, Zin. 50 g, Iro. 30 g, Cop. 10 g, Iod. 1g, Sel.0. 10 g, Cob. 0.10 g. and carrier CaCO3 to 3000 g.
2. NRC (1994)
3. Ingredientsprice (LE) / kg : yellow corn , 3.90 ; Soy bean meal, 9.20; corn gluten , 13.20 ; Mono-calcium Phosphate,16.50 ; limestone, 0.25 ; Vit&Min.premx,60.0 ; Nacl,0.80, Lysine, 35.0 ; Methio.,80.0 ; soya oil (one liter) , 14.00 and Molasses, 3.0 LE ; as well as manufacture process, 200.0 LE/ton during experiment time

Results and Discussion

Growth performance parameters

All studied growth performance parameters were not significantly influenced bydietary PB or CA and their mixture addition except of feed intake (Table 2). Dietary supplementation of 0.25% CA with or without PB recorded the highest insignificant live body weight and weight gain than other treatments and the control group at the whole experimental period. These results are in the line with Ahmad et al. (2018) who reported that weight gain was improved due to dietary CA supplementation with 0.3 or 0.5% than the control group. Also, Ndelekwute and Enyenihi (2017) found that organic acids addition to basal broiler diet improved growth parameters as compared with those fed un-supplemented diets.Improvement of weight gain may be attributed to the effect of organic acids onthe integrity of microbial cell membrane, cell macromolecules or meddle with the nutrient transport and energy metabolism causing the bactericidal effect in gut (Rout et al., 2016), or they induced an inhibition of intestinal bacteria which resulting in reduction bacterial competition with the host for available nutrients and reduction toxic bacterial metabolites, resulting in improvement of protein and energy digestibility, thereby improving the weight gain of broiler chicks (Fascina et al., 2012).

Feed consumption was significantly ($P \leq 0.05$) higher for chicks reared on diet supplemented with 0.25% CA than those reared on control diet and the mixture of PB plus 0.50% CA, while it was insignificantly higher than other treatments through the whole experimental period. Sheikh et al. (2011) reported that feed intake significantly increased by acidifier addition to broilers diet.

Feed conversion was ratio (FCR) insignificantly better for treated groups than the control except of those fed 0.25% CA (Table 2). This change might be because of the expansion in the absorbability of supplements because of good gut conditions including diminished pH of digesta in various section, enhanced gut measure and morphometry, which represents expanded ingestion surface. These results are in concurrence with those detailed by Ndelekwute and Enyenihi (2017) who found that FCR was not significantly influenced for chicks by dietary PB supplementation during growth period.

Production index was improved by 4.00, 4.41, 9.59, 11.06 and 9.19% for the groups fed diet supplemented with PB, 0.25% CA, 0.50% CA, combination of PB plus 0.25 or0.5% CA, respectively than the control group through the whole experimental period. These findings are in a similar line with Yousefi and Karkoodi (2007) who found that production index was not affected by dietary probiotic and yeast supplementation to broilers diet. However, Dimcho et al. (2005) found that supplementing probiotic to broilers diets resulted in a significant increase in production index than the control.

Noteworthy, chicks reared on diet supplemented with PB and 0.25 or 0.50 % CA and the mixture of PB plus 0.25% CA recorded the best viability percentage comparing with those reared on the control diet, while, the lowest percentage occurred by supplementing PB with 0.5% CA.These results may be attributed to the effect of dietary organic acids in reducing the pathogenic and non-pathogenic bacteria as a result of the reduction in intestinal colonization and infectious (Fascina et al. 2012), while the negative effect for combination of PB and CA on viability may be due to their antagonism as a result of decreasing pH by adding CA, which probably reduced the beneficial microorganisms activity in the probiotic.

TABLE 2.Growth performance parameters as affected by dietary supplementation of probiotic (PB), citric acid (CA) salt and their combination for broilers during fattening period(1-42 day of age)

Treatments	Live body weight , g		Body weight gain, g	Feed intake, g/chick	FCR	Production index %	Viability, %
	1- d	42- d					
Control	45.5	2070.4	2024.9	3576.0^{bc}	1.77	117.47	86.67
PB (0.05%)	46.4	2132.4	2086.0	3643.5^{abc}	1.75	122.17	93.33
CA_1 (0.25 %)	46.2	2220.2	2174.1	3935.7^{a}	1.81	122.65	93.33
CA_2 (0.50%)	46.3	2195.9	2149.6	3665.0^{abc}	1.71	128.73	90.00
PB +CA_1	46.2	2265.9	2219.7	3852.6^{ab}	1.74	130.46	91.67
PB+CA_2	45.8	2149.3	2103.6	3526.5^{c}	1.68	128.27	85.00
SEM	0.12	28.7	20.7	48.0	0.16	2.27	1.07
P-value	0.260	0.476	0.480	0.052	0.161	0.603	0.078

FCR: feed conversion ratio; PI: production index
Means in the same column bearing different superscripts aresignificantly different ($P \leq 0.05$); SEM: standard error mean;

Nutrients digestibility coefficients

Nutrients digestibility coefficients and feeding value were significantly (P≤0.05 or 0.01) influenced by supplementing different levels of CA with or without PB to the diets except of crude fiber of broiler chicks (Table 3). Ash retention was significantly higher for the chicks fed diet supplemented with 0.25 or 0.50 % CA and the mixture of BP plus 0.25% CA than those fed the control diet. Crude protein was digestibility significantly (P≤0.01) elevated by 11.18 and 7.33 % for chicks fed diet supplemented with 0.25 or0.50% CA, respectively than those fed the control diet, while it insignificantly higher for the groups fed diet supplemented with PB and the mixture of PB plus 0.25 or 0.50 % CA.

Crude fiber digestibility coefficient was insignificantly higher for all chicks fed diet supplemented with PB or CA and their mixture than the control. Ether extract digestibility was significantly improved for chicks fed diets supplemented with 0.25 and 0.50% CA and the mixture of PB plus 0.25% CA, while it was decreased (P>0.05) by supplementing PB alone compared with those fed the control diet, while nitrogen free extract (NFE) digestibility was significantly (P≤0.01) improved by supplementing both CA levels alone, while it was significantly lower with supplementing PB alone or the mixture of BP plus 0.50% CA than the control group. The NFE improvement was recorded 2.76 and 1.87 %, respectively for chicks fed diet supplemented with 0.25 or 0.50% CA than those fed the control diet.

Feeding value (Total nutrients digestibility% and metabolizable energy kcal/kg) was significantly (P≤0.01) elevated with supplementing both CA levels alone, while it was significantly decreased by supplementing PB alone and the mixture of PB plus 0.50% CA than the control group. The improvement of TDN was recorded 4.71 and 3.38 % , while ME recorded 4.74 and 3.42 % by dietary 0.25 and 0.50% CA addition, respectively in comparison with the control group (Fig. 1 and 2). These results are corrsistent with Ndelekwute and Enyenihi. (2017) who concluded that digestibility coefficients of nutrients was significantly (P≤0.01) improved by supplementing organic acids mixture to broiler diet as compared to the un-supplemented diet. These results might be related to the lessening in pH of digesta, enhanced gut size and morphological, which represents expanded absorption surface as well as enhanced absorbability which may increment due to zymogen activation and protease secretion as a result of elevation gut lumen acidity following enhanced gastrin and cholecystokinin hormones release which regulate the digestion and absorption of proteins (Deepa et al., 2011). However, the mixture of PB and CA resulted in diminishing nutrients digestibility probably because their antagonism which expanded acidic condition by adding CA which might be decreased the movement of the advantageous microorganisms present in the probiotic, thus, the effect of these supplements became neutralized and diminished the enzymatic activity and performance.

TABLE 3. Nutrients digestibility coefficients as affected by dietary supplementation of probiotic (PB), citric acid (CA) salt and their combination at 42 day of age

Treatments	Ash-ret.	Nutrients digestibility coefficients, %			
		Crude protein	Crude fiber	Ether extract	Nitrogen Free Extract
Control	33.84^{b}	73.62^{c}	28.14	94.01^{b}	87.25^{b}
PB (0.05%)	32.67^{b}	74.02^{bc}	35.53	91.74^{b}	84.57^{c}
CA_1 (0.25 %)	52.68^{a}	81.85^{a}	40.24	97.73^{a}	89.66^{a}
CA_2 (0.50%)	48.34^{a}	79.02^{ab}	39.52	97.65^{a}	88.88^{a}
PB +CA_1	46.17^{a}	77.83^{abc}	35.53	97.50^{a}	87.31^{b}
PB+CA_2	29.62^{b}	75.66^{bc}	37.65	94.98^{ab}	82.96^{d}
SEM	1.96	0.89	1.70	0.68	0.56
P-value	0.053	0.023	0.398	0.016	0.001

means in the same column bearing different superscripts are significantly different (P ≤ 0.05);SEM : standard error mean; ME: metabolizable energy; SEM : standard error mean

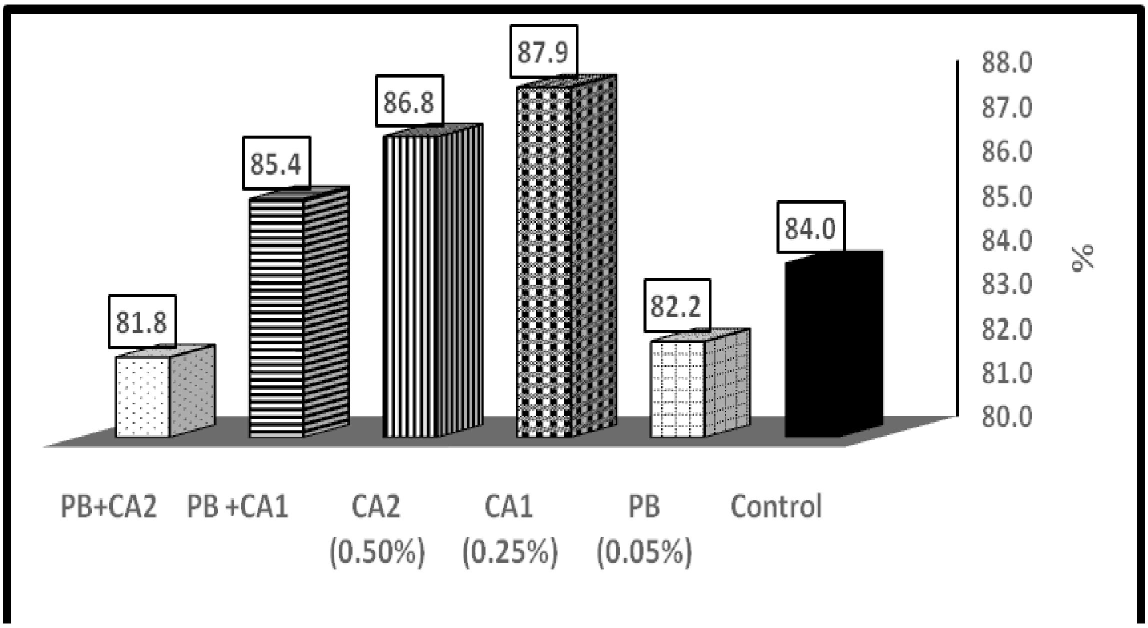

Fig. 1. TDN (%) for broilers fed diets supplemented with probiotic (PB), citric acid (CA) and their combination at 42 days of age

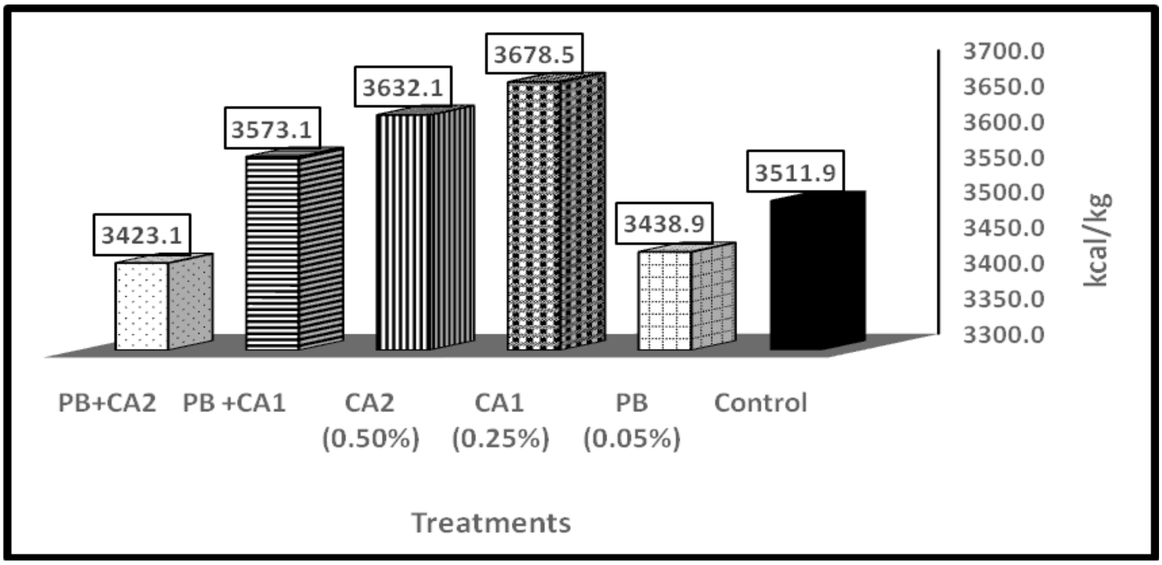

Fig. 2. Metabolizable energy (kcal/kg) for broilers fed diets supplemented with probiotic (PB), citric acid (CA) and their combination at 42 days of age

Blood parameters

Hematological parameters

All studied hematological parameters for broiler chicks were not significantly affected by dietary supplementation of PB, CA levels and their mixture except for heterophils(%) and heterophils to lymphocytes ratio (Table 4). Chicks fed PB or CA and their mixture had insignificantly higher blood hemoglobin, red and white blood cells count and lymphocytes (%) than those fed the control diet, however, both heterophils% and H/L ratio were significantly ($P \leq 0.01$) diminished by dietary supplementation. These results agree with those obtained by Ezendam and van Loveren (2006) who found that an increase of WBCs count by dietary OB supplementation compared to the control. Dimcho et al. (2005) found that RBCs count and hematocrit of broilers werenot significantly influenced by dietary probiotic supplementation, while heterophils % and H/L ratio were significantly diminished compared with the control, in contrary, they reported that WBC count and lymphocytes % were significantly higher than the control group,

TABLE 4. Blood hematological parameters as affected by dietary supplementation of probiotic (PB), citric acid (CA) salt and their combination at 42 day of age

Treatments	Hemoglobin mg/dl	Red blood cells (10^6/mm)	White blood cells (10^3/mm)	Lymphocyte %	Heterphils %	H/L
Control	14.72	2.42	76.43	54.33	29.86^a	0.56^a
PB (0.05%)	15.62	2.64	78.81	58.01	20.73^b	0.36^b
CA_1 (0.25 %)	15.68	2.69	76.42	59.71	18.57^b	0.31^b
CA_2 (0.50%)	16.68	2.82	79.74	56.87	14.28^b	0.26^b
PB +CA_1	15.48	2.78	76.66	59.31	16.92^b	0.29^b
PB+CA_2	16.78	2.87	78.76	60.30	15.19^b	0.25^b
SEM	0.39	0.08	1.49	0.95	1.26	0.03
P-value	0.681	0.605	0.982	0.498	0.001	0.002

SEM : standard error mean
means in the same column bearing different superscripts are significantly different ($P \leq 0.05$),

Serum constituents

Different serum biochemical parameters were not significantly influenced by dietary supplementation of PB, CA and their mixture except for ALT enzyme in broilers (Table 5). Chicks fed PB or CA and their mixture in the diets had similar values of serum total protein and AST enzyme. However, ALT enzyme was significantly ($P \leq 0.05$) lowered in chicks fed diet supplemented with PB in comparison with control diet. Moreover,serum total cholesterol, triglycerides and calcium were insignificantly decreased, while serum phosphorus was slightly higher for chicks fed PB and CA comparing with the control group($P > 0.05$).

TABLE 5. Blood serum constituents as affected by dietary supplementation of probiotic (PB), citric acid (CA) salt and their mixture at 42 day of age

Treatments	Total protein mg/dl	Total choles. mg/dl	Triglyc. mg/dl	AST IU/dl	ALT IU/dl	Total calcium IU/dl	Total phosph. IU/dl
Control	3.92	131.40	44.00	34.12	22.20^a	12.04	5.42
PB (0.05%)	4.34	104.20	37.60	33.16	11.80^b	11.98	6.14
CA_1 (0.25 %)	3.82	108.60	37.60	41.42	22.80^a	12.04	5.42
CA_2 (0.50%)	3.68	104.60	38.80	33.14	19.20^{ab}	11.38	6.10
PB +CA_1	3.98	100.00	28.00	30.74	15.00^{ab}	11.74	6.20
PB+CA_2	4.00	107.20	37.60	39.00	24.20^a	11.56	5.70
SEM	0.08	4.03	1.77	1.91	1.36	0.09	0.12
P-value	0.261	0.270	0.207	0.619	0.039	0.105	0.134

Meansin the same column bearing different superscripts are significantly different ($P \leq 0.05$);SEM : standard error mean

These findings are similar with Ng et al. (2009) who reported that serum total protein, total cholesterol and triglycerides were not significantly influenced with supplementing probiotic to broilers diets during fattening period. Al-Sultan et al. (2016) reported that a reduction in cholesterol and triglycerides for broilers fed diets supplemented with probiotics. Cholesterol reduction could be attributed to the diminished liver cholesterol fixation, which led to less cholesterol in the serum. The hypo- cholsterolaemicimpact may be due to the ability of lactic acid bacteriato producebile salt hydrolase's enzymes, which is in charge of bile salt de-conjugation (Klaver and Van der Meer, 1993). Also, the results of the present study are in harmonywith Abd El- Azeem (2002) who found that broiler chicks fed probiotics recorded significant decrease in ALT enzymes activity than the control. Al-Sultan et al. (2016) reported thatserum AST, ALT were reduced for broilers fed diets supplemented with probiotics.

Carcass traits

All studied carcass parameters were not significantly influenced with supplementing PB, CA and their mixture to broiler diets (Table 6). Relative weights of eviscerated carcass, total giblets, total eatable parts and abdominal fat approximately similar of chicks fed diet supplemented with PB, CA and their mixture than those fed the control diet.These findings are in line with Ndelekwute and Enyenihi (2017) who reported that relative eviscerated carcass, liver and heart weight were not significantly influenced in broilers by-acidifier's addition to their diets. Also, Ng et al. (2009) found that relative weights of total giblets and abdominal fat of broilers were not affected by dietary supplementation of probiotics.

Economic efficiency (EEF)

Means of some economic efficiency parameters of broiler as affected by supplementing PB, CA and their mixture to the diet are shown in Table 7. Net revenue for broiler chicks was elevated by dietary treatments compared to control group, which brought about an improvement of economic efficiency for these groups. Chicks EEF was improved by 26.76, 25.88, 25.0, 28.82 and 3.24% for by dietary PB, 0.25, 0.50% CA and the mixture of PB plus 0.25 and 0.50% CA addition, respectively than the control group during 1-42 days of ages.

TABLE 6. Relative weights of some carcass parts (as % of LBW) as affectedby dietary supplementation of probiotic (PB), citric acid (CA) salt and their mixture at 42 day of age

Treatments	SLBW, g	Eviscerated carcass, %	Total giblets, %	Total eatables parts, %	Abd.fat, %
Control	2218.4	74.84	3.99	78.83	0.81
PB (0.05%)	2265.6	74.32	4.03	78.35	0.86
CA_1 (0.25 %)	2229.2	73.93	4.07	78.00	0.91
CA_2 (0.50%)	2215.2	73.93	3.71	77.64	0.82
PB +CA_1	2303.2	74.01	3.90	77.91	0.83
PB+CA_2	2219.2	74.42	3.70	78.12	1.13
SEM	33.8	1.48	0.08	0.25	0.07
P-value	0.976	0.933	0.693	0.836	0.772

SLBW: slaughter live body weight; SEM : standard error mean

TABLE 7.Economic efficiency as affected by dietary supplementation of probiotic (PB), citric acid (CA) salt and their mixtureat the whole experimental period (1- 42 day of age)

Treatments	Total feeding cost[1] (LE)	Variety cost[2] (LE)	Finally total cost[3](LE)	Total revenue[4] (LE)	Net reven. (LE)	EEF[6]	EEF as control, %[7]
Control	23.30	18.43	41.73	55.90	14.17	0.340	100
PB (0.05%)	24.19	16.04	40.23	57.57	17.34	0.431	126.76
CA_1 (0.25%)	25.88	16.10	41.98	59.95	17.97	0.428	125.88
CA_2 (0.50%)	24.35	17.28	41.62	59.29	17.67	0.425	125.0
PB +CA_1	25.50	16.76	42.56	61.18	18.62	0.438	128.82
PB+CA_2	23.86	19.10	42.96	58.03	15.08	0.351	103.24

1- Sum of price feed amount consumed per chick (starter, grower and finisher x price of kg per each) , and dietary supplement cost (probiotic+ citric salt); LE= Egyptian pound

2- Chick price at hatch, farm, labore, vaccination, water, lighting =13.5 LE, and mortality percent of each group x sum total feeding costs

3- Sum of total feeding and variety costs

4- Mean of live body weight at 42 day x kg price (27.0 LE)

5- Total revenue – finally total cost

6- Economic efficiency = Net revenue ÷ finally total cost

7- EEF per each treatment ÷ EEF per control group x 100

Conclusion

It might be concluded that dietary supplementation of 0.25% CA alone or the mixture of 0.05% PB plus 0.25% CA could be used to improve growth performance and physiological status, nutrients digestibility coefficients and economic efficiency of broiler chicks during fattening period.

References

Abd EL-Azeem, F. (2002) Oigeson, neomycin and yeast supplementation in broiler diets under Egyptian summer conditions. *Egypt Poult. Sci.,* **22**, 235-257.

Abdel-Fattah, S. A.; EI-Sanhoury, M. H., EI-Mednay, N. M. and Abdul-Azeem, F. (2008) Thyroid activity of broiler chicks fed supplemental organic acids. *Int. J. Poult. Sci*. **7**, 215–222.

Abdel-Raheem, S.M.; Abd-Allah, S.M. and Hassanein, K.M. (2012) The effects of prebiotic, probiotic and synbiotic supplementation on intestinal microbial ecology and histomorphology of broiler chickens. *Inter. J. of Agro Vet. Med.*, **6**, 277-289.

Abou- Raya, A. K. and Galal, A. Gh. (1971) Evaluation of poultry feeds in digestion trails with reference to some factors involved. U.A.R. (Egypt), *Anim. Prod.* , **11**, 207 – 221.

Agawane, S. B. and Lonkar P. S. (2004) Effect of probiotic containing Saccharomyces boulardii on experimental ochratoxicosis in broilers: hemato-biochemical studies. *J. Vet. Sci.* **5** (4), 359-367.

Ahmad, E.A.M. ; Abdel-Kader, I. A. and Abdel-Wahab, A. A.(2018). Organic acids as potential alternate for antibiotic as growth promoter in Japanese quail. *Egypt.Poult.Sci.* **38**, 359-373

Al-Sultan, S.I.; Abdel-Raheem, S.M.; El-Ghareeb, W.R. and Mohamed, M.H. (2016) Comparative effects of using prebiotic, probiotic, synbiotic and acidifier on growth performance, intestinal microbiology and histomorphology of broiler chicks. *Japanese J. Vet. Res.,* **64**, 187-195

Atapattu, N. S. B. M. and Nelligaswatta, C. J. (2005) Effects of citric acid on the performance and utilization of phosphorous and crude protein in broiler chickens fed rice byproducts based diets. *Int. J. Poult. Sci.* **4**, 990–993.

Chichlowski, M.; Croom, J.; McBride, B. W.; Daniel, L.; Davis, G and Koci, M. D. (2007) Direct-fed microbial PrimaLac and salinomycin modulate whole-body and intestinal oxygen consumption and intestinal mucosal cytokine production in the broiler chick. *Poult. Sci.,* **86**,1100 – 1106.

Colin, H.; Guarner, F. ; Reid, G. ; Gibson, G. R. ; Merenstein, D.J. ; Pot, B.; Morelli, L.; Canani, R. B.; Flint, H. J.; Salminen, S. ; Calder, P. C. and Sanders, M. E. (2014) "Expert consensus document: the international scientific association for probiotics and prebiotics consensus statement on the scope and appropriate use of the term probiotic," *Nature Rev. Gastr. & Hepat.* **11**, : 8.

Deepa, C.; Jeyanthi, G.P. and Chandrasekaran, D. (2011) Effect of phytase and citric acid supplementation on the growth performance, phosphorus, and calcium and nitrogen retention on broiler chicks fed with low level of available phosphorus. *Asian J. of Poult. Sci.,* **5** , 28-34

Dimcho, D.; Svetlana, B.; Tsvetomira, S. and Tatiana, V. (2005) Effect of feeding Lactina probiotic on performance, some blood parameters and cecalmicrofloraofmuleducklings. *Trakia J. Sci.,* **3**, 22-28.

Duncan, D.B. (1955) Multiple range and multiple F tests. *Biometrics,* **11**, 1-42.

Ezendam, J and van Loveren H. (2006) Probiotics: immunomodulation and evaluation of safety and efficacy. *Nutrit. Rev., Vol.* **64**, 1-14

Fascina, V.B.; Sartori, J.R.; Gonzales, E.; Barros De Carvalho, F.; Pereira De Souza, I.M.G.; Polycarpo, G.V.; Stradiotti, A.C. and Pelícia, V,C. (2012) Phytogenic additives and organic acids in broiler chicken diets. *Revista Brasileira de Zootecnia.* **41** (10), 2189–2197.

Hosamani, S.V.;Shivakumar, M.C.; Kulkarni, V.S. and Patil, N.A. (2010) Influence of feed additives on performance of broilers. *Karnataka J. of Agric. Sci.,* **17**, 15-21.

Jakobsen , P.E. ; Kirston, S. G. and Nielsen, H. (1960) Digestibility trails with poultry . 322 bretningfra-foprsgslabratrietudgiveststatens .Husdybugsudval-gkobenhann.

Klaver, F.A.M. and Van der Meer, R. (1993) The assumed assimilation of cholesterol by Lactobacilli and Bifid- bacterium bifidium is due to their bile salt- de- conjugation activity. *Applied and Environ. Microb.,* **59**, 1120-1124.

Langhout, T.P. (2000) New additives for broiler chickens. *World Poult. Elsevier,* **16**, 2–27.

Liem, A.; Pesti, G. M. and Edwards Jr, H. M.(2008). The effect of several organic acids on phytase phosphorus hydrolysis in broiler chicks. *Poult. Sci.* **87**, 689–693

Martinez-Amezcua, C.; Parsons,C. M. and Baker,.D. H. (2006) Effect of microbial phytase and citric acid on phosphorus bioavailability, apparent metabolizable energy, and amino acid digestibility in distillers dried grains with soluble in chicks. *Poult. Sci.* **85**, 470–475

Moghadam, A. N., J. Pourreza, and A. H. Samie. (2006) Effect of different levels of citric acid on calcium and phosphorus efficiencies in broiler chicks. *Pak. J. Biol. Sci.* **9**,1250–1256.

National Research Council (1994) *Nutrient Requirements of Poultry*. 9th rev. ed. National Academy Press, Washington, DC.

Ndelekwute, E.K. and Enyenihi, G.E. (2017). Lime juice as a source of organic acids for growth and apparent nutrient digestibility of broiler chickens. *J. Vet. Medic. and Surgery,* **1**, 1.

Nezhad, Y. E.; Shivazad, M.;Nazeeradl,M. and Babak, M. M. S. (2007) Influence of citric acid and microbial phytase on performance and phytate utilization in broiler chicks fed a corn-soybean meal diet. *J. Fac. Vet. Med. Univ. Tehran.* **61**, 407–413.

Ng, S.; Hart, A.; Kamm, M.; Stagg, A. and Knight, S. (2009) Mechanisms of action of probiotics: recent advances. *Inflammatory Bowel Diseases,* Vol. 15, **2**, 300-310

Ohh, S.J (2011) Meta-Analysis to Draw the Appropriate Regimen of Enzyme and Probiotic Supplementation to Pigs and Chicken Diets. *Asian-Aust J. Anim. Sci.* **24**, 573-586.

Owens, B.; Tucker, L.; Collins, M. A and McCracken, K. J. (2008) Effects of different feed additives alone or in combination on broiler performance, gut micro flora and ileal histology. *British Poult. Sci.,* Vol. **49**, 202–212.

Ritchie, B. W.; Harrison, J. G. and Harrison, R. L. (1994) *Avian Medicine.* Winger's publishing Inc, Florida, USA , pp. 176-198

Rout, S.K.; Pradhan, C.R.; Rath, R.; Panda, N.; Panigrahi, B. and Pati, P.K. (2016) Influence of probiotics and acidifier supplementation on growth, carcass characteristics and economics of feeding in broilers. *Indian J. Anim. Nutr.,* **33**, 97-101.

SAS Institute. (2004) SAS User's Guide: Statistics. Edition 9.1 .SAS Institute Inc., Cary, NC.

Sheikh, A.; Tufail, B.; Gulam, A. B.; Mir, S.; Mashuq, R. and Syed, S. (2011) Response of broiler chicken to dietary supplementation of organic acids. *J. Centr. European Agric.,* **12**, 498-508

Yousefi, M. and Karkoodi, K.(2007) Effect of probiotic Thepax"and Saccharomyces cerevisiae supplementation on performance and egg quality of laying hens. *Int. J. Poult. Sci.,* **6**, 52-54.

(*Received:* 26 /9 /2018 ; *accepted:* 22 /11/2018)

تأثير إضافة البروبيوتيك وحمض الستريك للعيقة على أداء كتاكيت اللحم خلال فترة التسمين

تاج الدين حسن تاج الدين[١] ، عوض لطفى عوض[٢] ، عمر على محمد عيد[١]
قسم انتاج الدواجن- كلية الزراعة- جامعة دمياط
معهد بحوث الانتاج الحيوانى-مركز البحوث الزراعية- وزارة الزراعة

أستخدم فى هذه الدراسة عدد ٣٦٠ كتكوت عمريوم واحد وزنت ووزعت عشوائيا الستة مجموعات تجريبية متساوية بكل منها ثلاث مكررات لبحث تأثيراستخداما لبروبيوتيك (البيو بلس) وملح حمض الستريك أو مخلوطهم العلائق كتاكيت اللحم وتأثيرها على الأداء الفسيولوجى والانتاجى ومعامل هضم العناصر الغذائية وصفات الذبيحة فضلا عن الكفاءة الإقتصادية خلال فترة التسمين (١- ٤٢ يوم من العمر).كانت المجموعات التجريبية كالتالى :- الأولى كمجموعة مقارنة وتم تغذيتها على العليقة الأساسية بدون أى إضافات، أما الثانية فتم تغذيتهاعلى العليقة الأساسية مضاف لها البروبيوتيك (بيوبلس) بمعدل ٠,٠٥٪، أما الثالثة والرابعة فقد تم تغذيتهماعلى العليقة الأساسية مضاف لهماحامض الستريك بمعدل ٠,٢٥و ٠,٥٠ ٪ على التوالى، أما الخامسة السادسة فقد تم تغذيتهماعلى العليقة الأساسية مضاف لهما مخلوط البروبيوتيك مع حامض الستريك بمعدل ٠,٢٥ أو ٠,٥٠ ٪ على التوالى.تم تسجيل بيانات وزن الجسم والعليقة المستهلكة وكذلك تم إجراء تجربة هضم لتقدير معاملات هضم العناصر الغذائية وأخذت عينات دم لتقدير بعض محتويات الدم والسيرم وكذلك إختبارذبح فضلا عن الكفاءة الاقتصادية.

وأوضحت النتائج عدم تأثر جميع مقاييس النمو المدروسة معنويا بإضافة البروبيوتيك وحامض الستريك أو مخلوطهما فيما عدا كمية العليقة المستهلكة والتى إرتفعت معنويا للكتاكيت المغذاة على العليقة المضاف لها ٠,٢٥٪ حامض الستريك مقارنة بمجموعة المقارنة. بينما تحسن معامل هضم العناصر الغذائية معنويا بإضافة حامض الستريك فقط (٠,٢٥&٠,٥٠ ٪) فيما عدا الألياف الخام مقارنة بمجموعة المقارنة. لوحظت زيادة غير معنوية فى محتوى الدم من الهيموجلوبين وكرات الدم الحمراء والبيضاء ونسبة الخلايا الليمفاوية بينما وجد انخفاضا معنويا فى نسبة الخلايا المتعادلة والنسبة بين الخلايا المتعادلة إلى الليمفاوية كما وجد انخفاضا غير معنويا فى محتوى السيرم من الكولسترول الكلى والدهون للكتاكيت التي تغذت على العلائق المضاف لها البروبيوتيك أو حمض الستريك أو مخلوطهما مقارنة بمجموعة المقارنة. الأوزان النسبية لصفات الذبيحة كانت متشابهة تقريبا للمعاملات مقارنة بمجموعة المقارنة بينما تحسنت الكفاءة الاقتصادية نتيجة هذه الإضافات.

وتشير النتائج إلى إمكانية إضافة حامض الستريك لعلائق كتاكيت التسمين بمعدل ٠,٢٥٪ بدون أو مع البربيوتيك (٠,٠٥٪) لتحسين الأداء الانتاجى والفسيولوجي وهضم العناصر الغذائية فضلا عن الكفاءة الاقتصادية خلال فترة النمو (١-٤٢ يوم من العمر).