Egyptian Poultry Science Journal

http://www.epsaegypt.com

ISSN: 1110-5623 (Print) – 2090-0570 (On line)

EFFICACY OF ANTIBIOTIC GROWTH PROMOTER (AGP) ALTERNATIVES SUPPLEMENTATION IN THE DIET ON BROILER PERFORMANCE, INTESTINAL MORPHOLOGY AND CECAL MICROBIOTA

T. M. Younis[1]; A. A. Amer[1]; Gehan M. El-Mogazy[2]; and A. M. Kewan[1]

[1] Dep. of Anim. Prod., Fac. of Agric., Al-Azhar Univ., Cairo, A.R.E.

[2] Cen.l Lab. For Food and Feed, Agric.e Res. Center, Cairo, A.R.E

Corresponding author:Dr. Tarek Younis; E-mail:tyouniss@hotmail.com

Received: 14/04/2016 Accepted: 30/04/2016

ABSTRACT: The aim of this work was to study the efficacy of AGP alternatives supplementation in the diet on broiler performance, intestinal morphology, cecal microbiota and carcass traits. Three hundred seven-day old broiler chicks (cobb500), un-sexed of 160gm average body weight, were randomly divided into five experimental treatments and three replicates per treatment group. Antibiotic and Coccidiostate-free commercial diets cover the broiler recommendation during each growth phase were used. Each group was fed on one of the following experimental diets: TC- basal diet (control), COA-basal diet + Coated Organic Acids Mixture 750gm/Ton, OA- basal diet + Organic Acids Mixture 750gm/Ton, (EO)-basal diet + Encapsulated blend of Essential oils 100gm/Ton, PRO-basal diet + Probiotic 500gm/Ton.

At 42 days results revealed that, supplementation of broiler diets with COA and EO led up to insignificant numerical increase in BWG by 3 and 1.9 % , respectively compared with the control group. There were insignificant numerical improvement in CFCR by 6.4, 2.46, 5.4 and 4.43% for COA, OA, EO and PROgroups, respectively. Supplementation of broiler diets with COA vs.OA improved BWG and FCR by 5 and 4%, respectively. Treatments had no effects on dressing percentage and meat yield At 42 days of age, all AGP alternatives supplementation tended to increase the number of Enterrococci and lactic acid bacteria group and to decrease the numbers of E. coli group in compared with the control group. However, the Cecal digesta pH tended to be similar in treated birds in compare with control group. At 42 days of age, birds fed OA diets had the longer and wide jejunum villi (the height and the area of the villi increased by 17 % and 23.3%, respectively) deeper crypts (increased by 26.6%) and lower jejunum mucosal layer thickness (39.1 % lower) in compared with control group.Broilers fed diets supplemented with COA, EO and PRO tend to improve PCR by 6.5, 5.6 and 4.79, respectively and EPEF by 12.0, 9.5 and 1.74% in compared with those fed the control diet.

Key Words: AGP Alternatives- Performance- Histomorphology- Microflora- Broiler.

INTRODUCTION

The gut is a defensive wall between the birds and the environment, and its function is to digest feed and selectively absorb the nutrients required for health, at the same time ensuring harmful substances stay out. Consequently, maintenance of gut development and health is very important to support development and health of the entire organism (Dizaji et al., 2013). Apajalahti et al. (2004) indicated that the best performance will be achieved when the birds are in a healthy state and supported by high quality diet. An optimal quality of diets will significantly improve gut development and the growth of the gut and digestive organs are influenced by the growth and establishment of the populated microflora. The condition of the gastro intestinal tract (GIT) beneficial bacteria also influences the host's gastrointestinal development, biochemistry, immunology, physiology, and nonspecific resistance to infection. Microflora that colonizes the gut during the early post-hatch period forms a synergistic relationship with their host (Torok et al., 2009). Some studies assumed that pathogenic microflora in the gut decrease nutrient absorption by increasing intestinal thickness, digesta passage time, and nutrient requirements of the bird by accelerating turnover of the intestinal mucosa and also by competing for some of the feed protein and energy with the bird (Ravindran et al., 1984; Dibner and Buttin, 2002; Apajalahti et al., 2004). These enteric problems related with the existence of pathogenic microflora can be inhibited and/or cured with antibiotics addition. The growth-promoting effects of antibiotic are closely related to their inhibitory effect on pathogenic bacteria in the GIT tract. Reduction of the population of intestinal harmful microflora have beneficial effects, including a decrease in the occurrence of sub-clinical diseases (thus results in reducing nutritional costs of the immune mechanisms), reduction in the quantity of growth depressing metabolites produced by intestinal microbes, a reduction in the competition between microbes and hosts for available nutrients, and improve nutrient uptake by absorptive cells of the intestinal tract (Niewold, 2007).

Moreover, mechanism of antibiotics to promote better growth rate has also been attributed to the stimulation in absorptive cells growth and improvement in nutrient absorption in the gut (Anderson et al., 1999). In other studies, it has been described that the absorptive cells in the intestine can be stimulated for proliferation upon treating the diets with antibiotics. Greater villus height and crypt depth in the intestine observed following antibiotics medication (Iji et al., 2001; Xia, et al., 2004). Miles et al. (2006) stated that improvement in intestinal morphology stimulates better nutrient absorption, leading to sparing energy for tissue maintenance that can be used instead for growth, or enhancing the absorption of various nutrients.

Strong evidence that the antibiotics use in animals and humans leads to the selection of resistant organismsthat may cause treatment failure and the human costs, including death and prolonged illness, associated with such failures. Thisconcern has led to the banning of certain antibiotic growth promoters (AGPs) in European Union countries by April 1997. Consumer pressure in other countries, such as USA, is pushing the poultry business to rear animals without using AGPs (Dibner and Richards, 2005; Castanon, 2007).

The removal of AGP's authorization resulted in substantial increase in infection inpoultry (Knarreborg et al., 2002; Casewell, 2003). Poultry business has needed to find alternatives to AGP in order to stem the spike in infection rates. These alternatives are required to be environmental friendly and safe for both animal and humans who consume animal products (Cabuk et al., 2006).

Various types of alternatives have been evaluated under experimental trials and in commercial farms with the objective to achieve improvements on productive performance and the best economic income (Bozkurt et al., 2009). Some of the alternatives that have been studied include probiotics or direct fed microbials, several plant extracts and essential oils (An et al., 2008), prebiotics (Dahiya et al., 2006), synbiotics (Ghasemi et al., 2010), organic acids, and dietary enzymes (Cowieson et al., 2006; Dahiya et al., 2006).

Therefore, the aim of this work was to investigate the economic benefits of some AGP's alternatives under free-antibiotic feeding conditions and also, to compare coated (protected) and non-coated (non-protected) organic acids efficiency as growth promoters under commercial conditions in Egypt.

MATERIALS AND METHODS

This study was conducted at the Experimental Poultry Station, Faculty of Agriculture, Al-Azhar University, Nasr city, Cairo, Egypt during September and October 2014 to investigate the efficacy of dietary supplementation of three different AGP alternatives (coated organic acids mix., non-coated organic acids mix., Essential oils and probiotics) on broiler performance, intestinal morphology and cecal microflora.

Experimental Design & Treatments

Three hundred day old broiler chicks (cobb500), non-sexed obtained from commercial hatchery received and allocated in floor pens. All birds received a commercial diet exceeded the cobb500 requirements (Table1). Water and feed were provided *ad libitum* until 7days of age, thereafter birds were divided into five equal groups (60 chicks per each treatment with 20 birds per replicate). Floor space was 0.2 m^2/bird. The average live body weight for chicks at 7 days of age was about 160gm. Starter diets were fed from one-day old and switched to grower diets from 12 to 22 days of age, then fed finisher diets during 23-42 days of age.

At 7 days of age, diets were supplemented with additives according to manufacturer's recommendation to provide 5 treatment groups:

1 – Control group: Basal diet

2- Coated Organic Acids Mixture (COA):

A mix of selected organic and inorganic acids coated with a specific fat matrix was administered at a concentration of 750 gm/ton (calcium format 98% (17.55%), fumaric acid 98% (20%), ascorbic acid 98% (5%), citric acid 99.5% (4.25), fat coating material (53.2%).

3- Non-coated Organic Acids Mixture (OA):

Lab manufactured formula composed of the same mix of selected organic acids used in treatment 1, but without coating and mixed with wheat bran as a carrier material. The Formula was administered at a concentration of 750gm /ton.

4- Encapsulated Blend of Essential oils (EO):

The two active ingredients in the EO Mixture were thymol 15 g/ton and cinnamaldehyde 5 g/ton. It was administered at 100gm/ton.

5-Probiotic (PRO):

A Probiotic based on three *B. subtilis* strains (BS8, 15AP4 and 2084) at a rate of 500gm/ton.

Measurements and Sample Collection

Productive performance traits:

Weekly records on live body weights (LBW) of chicks and feed intake (FI) were maintained per replicate group during the period from 7 to 42 days of age. Thus, body weight gain (BWG) and feed conversion ratio (FCR) were calculated weekly based on excluded mortality. Mortality was monitored and recorded daily.

Slaughter and carcass traits:

At the end of the trail (42 days of age), 6 birds were randomly selected per each treatment for carcass characteristics

measurements. Birds were slaughtered after weighed individually. Their feathers were removed mechanically and they were eviscerated by hand. Each individual carcass, neck, front half, hind half, gizzard, liver, and heart, breast meat without bone, thigh, thigh meat, drumstick, and drumstick meat were separated from each carcass and weighed individually. All tested carcass organs were calculated as a percentage of dressing weight. Carcass defined as the weight of fresh dressed carcass without the neck, abdominal and giblets fat.

Cecal microbial populations:

Cecal microbial samples were collected from 3 birds per each treatment at 21 and 42 days of age. The ceca were removed and cut to separate left and right cecum. After that, each cecum was placed in a sterile sample bag and put in an ice bath. Then samples was kept at (-20˚C) for 2 weeks. After that ceca were thawed in a cool water bath, and lactic acid bacteria (LAB), Enterococci, Bacillus Subtilis and E.Coli bacteria were counted. Cecal content samples were then diluted serially from$10^{-1}$to 10^{-7}. One-tenth milliliter of each diluted sample was immersed on the appropriate agar media, in duplicate for enumeration of the selected microbial populations. Bacterial counts were performed using the appropriate dilution and plate culture techniques under aerobic or anaerobic conditions.

Intestinal Histomorphology

Intestinal samples were collected at 21 and 42 days of age from 3 birds per each treatment. Villus height, crypt depth, villus surface area, and muscularis mucosa thickness from the jejunum (from the end of duodenum to Meckel's diverticulum) were measured. A 2-cm segment of the midpoint of the jejunum was dissected and fixed in 10% buffered formalin. Each segment was embedded in paraffin. A 5 µm section of each sample was placed onto a glass slide and stained with hematoxylin and eosin (Sakamoto et al., 2000; Fausto, 2008). Slides were viewed with on an upright microscope equipped with a microscope digital camera. Villus length, width and surface, crypt depth, and muscularis mucosa thickness were acquired and measured using image analysis software (ImageJ 1.48v, Wayne Rasband, National Institute of Health, USA). The villus height was measured from the top of the villus to the top of the lamina propria. Crypt depth was measured from the base upward to the region of transition between the crypt and villus (Aptekmann et al., 2001). The muscularis mucosa thickness was measured in the space between the end of the lamina propria and the top of the serosa. Villi area was calculated using the following formula: $(2\pi) \times (VW/2) \times (VL)$ in which, VW= villus width and VL= villus length (Sakamoto et al., 2000).

European Production Efficiency Factor (EPEF):

Calculation of EPEF for the experimental period (7-42 days of age):

EPEF = livability (%) × live weight (kg) × age (d)/FCR × 100

Economic Efficiency (7-42 days of age)

- **Feed Cost (L.E) per kg of live body weight**

= (S price x S consume+ G price x G consume+ F price x F consume) /Total live body weight

Where: S: starter diet; G: grower diet; F: finisher diet.

- Total saving (L.E) per Kg (vs. Control)

= Cost of Kg for each treatment – Control Cost.

Protein Conversion Ratios:

Protein conversion ratio (PCR) was calculated for each growing phase and for whole period according to the following formula:

PCR (g protein/g gain) = protein intake (g)/ body weight gain (g)

Statistical analysis:

Experimental data were statistically analyzed with one-way analysis of variance

(ANOVA) using the statistical package of SPSS version 23 for Windows (SPSS, Inc., Chicago, IL, USA).

RESULTS AND DISSCUSION

Productive results:

Effect of Antibiotic Growth Promoter (AGP) alternatives supplementation in broiler diets on body weight, body weight gain, feed intake and feed conversion ratio:

The effects of AGP alternatives [coated organic acids (COA), organic acids(OA), essential oils (EO), and probiotics (PRO)] supplementation in broiler diets on body weight, body weight gain, weekly cumulative feed intake and feed conversion ratio during the experimental period are presented in Tables (2 and 3). In general, no significant effect was observed in body weight and body weight gain among the experimental groups. However, inclusion of broiler diets with coated organic acids and essential oils led up to clear numerical increase in the weight gain by 3.0 and 1.9%, respectively in compared with the control group. Results in tables (4 and 5) revealed numerical improvement in cumulative feed conversion ratios by 6.4, 2.46, 5.4 and 4.43% for groups COA, OA, EO and PRO, respectively. The improvement noticed in this study for the feed conversion of broiler groups treated to the different types of AGP alternatives may refer to some reasons, a) improvement of BWG and the decrease in cumulative feed intake in case of COA and EO supplemented groups compared with the control group, or b) the decrease in cumulative feed intake of OA and PRO supplemented groups compared with the control group.

Results of the current study are in agreement with those obtained by Alcicek et al. (2003) who indicated that essential oils combination increased the body weight and improved FCR for broilers. Denli et al. (2004) recorded that thyme essential oil improved feed efficiency and BWG in Japanese quails. Many authors have been suggested that dietary EO's Enhance bird performance because these alternatives stimulate the secretion of digestive enzymes which then increase nutrient digestion, gut passage rate or feed consumption (Salam et al., 2002; Lee et al., 2003a; Lee et al., 2004a; Jamroz et al., 2005; Jang et al., 2007). Also Brzoska et al. (2013) reported that feeding the acidifier to chicken at 3,6 and 9 g/kg significantly increased body weight of chickens by 6.2, 8.2 and 8.2% at 21 days of age and by 2.7, 3.6 and 3.7% at 42 days of age in compared with the control group, respectively ($P<0.01$).

Kim et al. (2009) indicated that the overall body weight and weight gain were significantly higher in broilers fed 0.5% organic acid than those fed antibiotic free diet ($P<0.05$). The FCR in all supplemented groups were significantly better as compared with that of control group ($P<0.05$).

In the current study, the inclusion of AGP alternatives decreased cumulative feed intake compared with control group. Pirgozliev et al. (2008) reported that birds fed diets containing organic acid had lower feed intake than those of control group. Also, Lee et al. (2003a) showed that supplementing broiler diets with Thymol or Cinnamaldehyde slightly decrease feed intake at 40 days of age. In addition, Lee et al. (2003b) reported that carvacrol supplementation decrease feed intake and weight gain but enhance feed conversion in broilers.

Results in table (3), indicated that probiotic supplementation reduced feed intake and improved FCR with no influence on weight gain throughout the trail indicated that probiotic indeed exerted some positive effect on broilers. Previous studies examining the effect of probiotics showed inconsistent effect on broiler performance (Amerah and Gracia, 2011; Amerah et al., 2012). Zhou et al. (2010) found that the inclusion of Bacillus

coagulans at two levels improved body weight and FCR in chickens. Similarly, Cavazzoni et al. (1998) reported that dietary B. coagulans strain as probiotic to broiler chickens improved FCR and body weight, an effect comparable to virginiamycin. However, other researchers have found no or minimal effect of probiotic supplementation on broiler performance (Watkins and Miller, 1983; Willis et al., 2007), which may be related to differences in the type of probiotic used, dose, method of preparation, type of diet and sanitary status.

Results in tables (2 and 3), indicated also that supplementation of broiler diets with coated organic acids vs. uncoated ones improved BWG and FCR by 5 and 4%, respectively. These results are in agreement with the finding that, non-protected short chain fatty acids (SCFA) added into poultry feed are readily digested (Bolton and Dewar, 1965; Hume et al., 1993), while different systems of encapsulation prevent dissociation of short chain fatty acids in the upper gut and help to deliver their bioactivity towards distal parts of the intestine and effectively modulate the GIT microflora and mucosal morphology in weaning pigs and in chickens (Mroz et al., 2006; Hu and Guo, 2007).

The mean percentage of carcass parts in different treatments is documented in Tables (4 and 5). Treatments had no significant effects on dressing percentage, breast muscle yield and leg quarter yield but relative liver weight was reduced by dietary treatments in compared with the control group ($P<0.05$). Awad et al. (2009) showed that the relative weight of liver was greater for birds fed probiotic (2.11%) compared with the control ones (2.04%). Also, Kirkpinar et al. (2014) reported that dietary organo or garlic oil did not affect carcass yield, the relative weight of carcass parts, breast and thigh meat. Zhang et al. (2005) observed that birds given essential oils showed no significant changes in dressing. Kim et al. (2009) stated that the carcass rate and relative organs weights were not significantly affected among the treatment groups.

Cecal bacterial count in broilers at 21 and 42 d of age are presented in Table (6). Data indicated that at 42 days age all AGP alternatives used in the current study tend to increase the number of Enterrococci and lactic acid bacteria groups. On the other hand, the number of E.coli was decreased in compared with the control group. Birds fed coated organic acids recorded the lowest E.Coli count followed by the groups supplemented with organic acids, probiotics, essential oils and control, respectively. Jordan et al. (1999); Chaveerach et al., (2002) and Heres et al. (2003) reported that organic acids were used to eliminate pathogenic bacteria including E.coli, Campylobacter and Salmonella spp. from the digestive tract. Also, as described by Amit-Romach et al. (2004) over growth of enteropathogens drives the intestine to secrete mucus barrier to protect absorptive surface of the intestine from luminal irritant and lumen bacteria. Therefore, minimization of the growth and population of pathogenic species will lead to the reduction of toxic bacterial metabolites which in turn maximize digestive efficiency by facilitating greater proliferation of the absorptive cells (Iji and Tivey, 1998).

Digesta pH

Table (7), shows the data for Cecal content pH at 21 and 42 days of age. At 21 days of age, the birds in the Pro group had insignificant lower Cecal content pH than the birds in TC, OA, COA and EO groups in ascending manner, respectively. At 42 days of age, the Cecaldigesta pH was insignificant lower for birds in the OA group followed in an increasing order by PRO group whereas COA,EO and TC groups Cecaldigesta pH tended to be similarly higher (7.34,7.37 and 7.38 respectively . In this connection **Cerisuelo *et al.* (2014)** reported that, The Cecal content pH was not different among

treatments. The dietary treatments consisted on a basal diet (control) and its supplementation with different doses of a blend of cinnamaldehyde and thymol [50 mg/kg (EO50) and 100 mg/kg (EO100)] and their combination with 1 g/kg of Na-butyrate (B), respectively [E50 + B (EOB50) and E100 + B (EOB100)].

Smulikowska et al. (2009) reported that supplementation of control diet with 1g/kg organic acid mixture consisted of fumaric acid, calcium formate, calcium propionate and potassium sorbite, coated with plant triglycerides (Galliacid, Vetagro) decreased the PH of Cecaldigesta ($P<0.05$).

Intestinal Histomorphology

Results presented in table (8) indicated that dietary AGP alternatives caused some changes in the intestinal mucosa morphometric. Birds fed COA, OA, EO and PRO had longer Jejunal villi at 42 day of age as compared with the control ones. Birds fed OA diet had longer and wider villi (by 17.0% and 23.3%, respectively). It is assumed that an increased in villus height is paralleled by an increase in digestive and absorptive function of the intestine due to increase of surface area, expressive of brush border enzymes and nutritional transport system (Pluske et al., 1996). Larger villus height is an indicator of intestinal villi activity (Langhout et al., 1999; Shamoto and Yamauchi, 2000). Long villi are usually associated with excellent gut health, increased absorptive efficiency and more healthy GIT. (Alfaro et al., 2007). According to Cera et al. (1988), well-developed enterocytes and longer villus height with large capacity of luminal area are provide a maximum absorption and digestion.

Senkoylu et al. (2007) reported that OA maximized the growth of absorptive cells in the intestinal wall of broiler chickens. Therefore, improvements in the growth performance in current study were likely accredited to the improvement in villi long in the intestine and the reduction in the growth and population of the pathogenic microflora. The longer villi might provide greater absorptive surface and deeper crypt indicate more enhanced capacity for replenishing the enterocytes (Geyra et al., 2001; Mathlouthi et al., 2002) Supplementation of OA resulted in the deeper crypts. The depth of the crypts increased by 26.6% in broilers receiving OA diet and the thickness of the mucosal layer in the jejunum was 39.1% lower than in the birds fed control diet.

Results in table (9) showed that supplementation of broiler diets with COA,OA, EO and PRO tended to improve protein conversion ratio by 6.5, 2.4,5.6 and 4.79%, respectively compared with the control group and the improvement was more pronounced in case of COA supplemented diet.

The effects of AGP alternative supplementation on the EPEF of broilers are presented in table (10). The results indicated that COA, EO and PRO supplementation to chicks feed improved EPEF by 12.0, 9.5 and 1.74% in compared with those fed the control diet which might indicated that COA supplementation improved technical parameters of the production cycle compared to the other additives and followed in a decrease order by EO and pro supplementation.

In general, results of the current study illustrated that AGP alternative supplementation might exerted some positive effect on broilers. The beneficial effects may attribute to one or more mode of action. Probiotics may have nutritional effect by regulation of metabolic reactions that produces toxic substances; stimulation of endogenous enzymes and by production of vitamins or antimicrobial substances (Line et al., 1998), or could act as bio regulator of the intestinal microflora and reinforcing the host natural defenses, through the sanitary effect by increasing the colonization resistance and stimulation of the immune response. Also, this effect can be credited to the trophic effect of this

alternative on the intestinal mucosa, because it increases villus height, particularly during the first 7 days of the chickens life (Santin et al., 2001; Shareef and Al-Dabbagh, 2009). Also, probiotics have ability to enhance the microbial balance of the intestine, decrease passage rate of the digesta and improve digestion of amino acids (Biggs et al., 2007).

The mode of action of acidifier in poultry will be mainly as a result of its antimicrobial action and not like in pig farming on the reduction of the stomach-pH. It is therefore of high importance to balance the organic acids combination according to this theory. Ricke (2003) described a mechanism in which organic acids penetrate the lipid membrane of the bacterial cell and once incorporated into the neutral pH of the cell cytoplasm dissociate into anions and protons (Eklund, 1983; Salmond et al., 1984; Cherrington et al., 1990; Cherrington et al., 1991). Export of excess protons requires intake of cellular adenosine triphosphate. This may result in a depletion of cellular energy, and thus in cell death. It has also been speculated that organic acids interfere with cytoplasmic membrane structure and intercellular transport as a result of changes in electrical gradients across cell membrane, which may also be lethal to pathogenic bacterial cells.

Essential oils have long been recognized for their anti-microbial activity (Lee et al., 2004a), and they have obtained much attention for their Importance as alternatives to antibiotics. Although the precise anti-microbial mode of action of essential oils is not completely understood, it may be related with their lipophilicity and chemical structure (Lee et al., 2004b). Helander et al. (1998) studied how carvacrol and thymol, and the phenylpropanoid, cinnamaldehyde, exert their anti-microbial effects on escherichia coli and salmonilla Typhimurium. Both thymol and carvacrol disintegrated the bacteria membrane of, resulting to the release of membrane-associated materials from the cells to the outer medium.

Conversely, cinnamaldehyde showed its antimicrobial activity due to ability of terpenoids and phenylpropanoids to dissolve in lipids, which can breach the membrane and spread in the inner part of the cell and impair bacterial enzyme systems. Therefore, these plant extracted phenolic compounds have antibacterial ability similar to antibiotic substances produced by fungi.

Table (1): Basal diet fed to broilers during the experimental periods

Ingredient	Starter (1-11 days)	Grower (12-22 days)	Finisher (23-42 days)
Yellow Corn	47.8	54.86	60.02
Soybean Meal 46%	24.83	-	-
Soybean Meal 48%	-	21.5	12.2
Full Fat Soybean	19.36	-	-
Corn Gluten Meal	2.2	6.5	10
DDG	2.0	9.5	10.2
Di Calcium Phosphate	-	1.7	1.7
Sunflower Oil	-	3.5	-
Soybean Oil	-	-	3.2
Mono Calcium Phosphate	1.5	-	-
Limestone	1.37	1.37	1.28
Salt	0.35	0.28	0.30
Premix *	0.30	0.30	0.30
DL-Methionine	0.19	0.06	0.1
Choline Chloride	0.06	0.06	0.06
HCL- Lysine	0.04	0.37	0.60
Total	100	100	100
Calculated Analysis			
Protein%	23.94	21	19
Fat%	5.86	6.70	6.60
Fiber%	3.86	3.00	2.90
Metabolizable Energy(kcal/kg)	3050	3100	3175

*Premix supplied per Kg of diet: Vit. A, 12000 I.U; Vit. D_3, 3100 I.U; Vit. E, 30 mg; Vit. K_3, 1.65 mg; Vit. B_1, 4.4mg; Vit. B_2, 5.5mg; Vit. B_6, 3.3mg; Vit. B_{12}, 15 µg; Niacin, 53 mg; Pantothenic acid, 11 mg; Folic acid, 1 mg; Biotin, 200 µg; Choline, 715 mg; Copper, 9 mg; Iodine, 1.1 mg; Iron, 88 mg; Manganese, 66 mg; Zinc, 40 mg, Cobalt, 0.2 mg and Selenium, 0.3 mg

Table (2): Live body weight (LBW) and body weight gain (BWG) of broiler chicken fed experimental diets at different ages

Treatments		Live Body Weight (gm)					Weight Gain (gm)					
		14D	21D	28D	35D	42D	14D	21D	28D	35D	42D	Total Gain
TC	Control	395±3.97	750^{ab}±12.65	1088^{ab}±11.63	1455^{ab}±8.59	1828±33.36	229±3.71	355^{ab}±12.85	338±9.01	367^{a}±20.03	373±25.16	1662±33.70
COA	Coated Organic Acids	405±1.74	787^{a}±9.42	1150^{a}±7.02	1500^{a}±8.77	1881±61.40	236±0.87	382^{a}±10.59	363±10.49	350^{a}±4.06	382±53.31	1712±60.28
OA	Organic Acids	401±3.31	775^{a}±9.34	1091^{ab}±25.27	1373^{b}±17.28	1796±24.61	231±3.56	374^{a}±9.49	316±22.26	282^{b}±18.60	423±9.22	1626±24.31
EO	Essential Oils	395±3.95	712^{b}±23.60	1046^{b}±37.90	1408^{ab}±47.80	1860±65.55	229±3.60	317^{b}±19.80	334±23.97	362^{a}±14.49	453±18.81	1694±65.09
PRO	Probiotics	397±5.42	707^{b}±20.66	1055^{b}±28.67	1380^{b}±44.82	1784±59.71	230±3.77	311^{b}±26.08	348±11.64	325^{ab}±27.91	404±26.53	1617±60.87

Table (3): Cumulative feed intake (CFI) and cumulative feed conversion ratio (CFCR) of broiler chicken fed experimental diets at different ages

Treatments		Cumulative Feed Intake (gm)					Cumulative Feed Conversion Ratio (FCR)				
		14D	21D	28D	35D	42D	14D	21D	28D	35D	42D
TC	Control	$326^{b}\pm3.88$	$946^{a}\pm7.42$	$1626^{a}\pm18.14$	$2475^{a}\pm55.95$	3377±36.20	$1.42^{ab}\pm0.02$	1.62±0.04	$1.77^{a}\pm0.04$	$1.92^{a}\pm0.04$	2.03±0.03
COA	Coated Organic Acids	$328^{b}\pm1.07$	$918^{ab}\pm11.21$	$1566^{ab}\pm29.18$	$2327^{b}\pm36.06$	3247±77.95	$1.39^{b}\pm0.01$	1.49±0.00	$1.60^{b}\pm0.02$	$1.75^{b}\pm0.02$	1.9±0.04
OA	Organic Acids	$324^{b}\pm0.26$	$904^{ab}\pm7.72$	$1589^{ab}\pm12.42$	$2306^{b}\pm39.37$	3218±125.29	$1.40^{ab}\pm0.02$	1.49±0.01	$1.73^{ab}\pm0.05$	$1.92^{a}\pm0.04$	1.98±0.06
EO	Essential Oils	$336^{a}\pm0.43$	$877^{bc}\pm22.02$	$1528^{bc}\pm37.35$	$2264^{b}\pm60.55$	3251±102.91	$1.47^{a}\pm0.02$	1.61±0.04	$1.74^{ab}\pm0.03$	$1.83^{ab}\pm0.04$	1.92±0.06
PRO	Probiotics	$337^{a}\pm0.73$	$839^{c}\pm20.19$	$1463^{c}\pm9.42$	$2208^{b}\pm14.19$	3132±39.27	$1.47^{a}\pm0.02$	1.56±0.08	$1.65^{ab}\pm0.07$	$1.82^{ab}\pm0.06$	1.94±0.05

Table (4): Effect of dietary treatments on carcass parts as percentage of dressing weight of broiler chickens at 42 days

Treatments		Live Weight (gm)	Dressing Weight (gm)	Dressing (%)	Front Parts (%)	Hind Parts (%)	Neck (%)	Gizzerd (%)	Heart (%)	Liver (%)
TC	Control	1850^{ab}±9.31	1383±13.08	74.78±0.63	39.9±0.63	29.4±0.40	5.33±0.16	1.33±0.09	0.46±0.09	2.69^{a}±0.02
COA	Coated Organic Acids	1866^{a}±11.72	1400±26.33	75.01±1.12	40.52±1.11	29.32±0.56	5.09±0.30	1.22±0.09	0.4±0.09	2.12^{b}±0.02
OA	Organic Acids	1765c±9.83	1323±18.43	74.92±0.74	39.99±0.54	29.75±0.38	5.15±0.13	1.2±0.09	0.42±0.09	2.40^{ab}±0.02
EO	Essential Oils	1819^{b}±16.25	1322±11.60	72.67±0.64	39.05±1.06	28.48±0.61	5.05±0.16	1.36±0.08	0.44±0.08	2.15^{b}±0.03
PRO	Probiotics	1747c±13.82	1312±17.73	75.1±0.82	40.64±0.55	29.02±0.35	5.16±0.27	1.2±0.06	0.4±0.06	2.24^{ab}±0.03

*all parts calculated as a percentage of dressing weight.

Table (5): Effect of dietary treatments on meat yield of broiler chickens at 42 days of age

Treatments	TC		COA		OA		EO		PRO	
	Control		Coated Organic Acids		Organic Acids		Essential Oils		Probiotics	
Dressing Weight(gm)	1383	±13.08	1400	±26.33	1323	±18.43	1322	±11.60	1312	±17.73
Front half without wings (%)	42.15	±0.29	43.22	±0.23	43.21	±0.23	43.14	±0.19	43.5	±0.29
Breast(bone-In, Skin-On, %)	20.93	±0.57	21.51	±0.89	21.48	±0.44	21.42	±1.56	21.6	±0.68
Breast Muscle (%)	74.31	±0.29	74.94	±0.68	74.09	±0.22	74.46	±0.57	75.26	±0.21
Hind Quarter (%)	19.63	±1.97	19.55	±1.60	19.81	±1.39	19.53	±1.32	19.41	±1.56
Drumstick (%)	61.06	±0.38	66.27	±0.58	67.57	±0.66	61.55	±0.50	62.3	±0.55
Drumstick meat (%)	72.88	±0.27	75.8	±0.57	74.59	±0.56	74.44	±0.36	74.69	±0.37
Thigh (%)	6.24^{b}	±0.61	6.21^{b}	±1.84	6.91^{a}	±0.99	6.07^{b}	±1.06	6.45^{ab}	±1.20
Thigh meat (%)	81.74	±0.11	82.97	±0.14	79.33	±0.26	77.85	±0.14	80.02	±0.13

*all parts calculated as a percentage of dressing weight.

Table (6): Effect of dietary treatments on cecal bacterial count (log10 cfu/g) in broiler at 21 and 42 days of age

Treatments		Enterococci		Lactic Acid Bacteria (LAB)		E.Coli	
		21	42	21	42	21	42
TC	Control	5.56^{ab}	2.63^{b}	5.7	4.54^{b}	1.4	3.66^{a}
COA	Coated Organic Acids	6.21^{a}	4.97^{a}	6.3	4.69^{ab}	1.8	1.68^{b}
OA	Organic Acids	6.19^{a}	4.74^{a}	6.6	4.94ab	0.7	2.14^{ab}
EO	Essential Oils	5.30^{ab}	5.23^{a}	5.8	5.78^{a}	1	3.56^{a}
PRO	Probiotics	4.70^{b}	5.14^{a}	5.3	5.66^{ab}	3.5	2.97^{ab}

Table (7): Effect of dietary treatment on cecal pH at 21 and 42 days of age

Treatments		Age (Days)	
		21	42
TC	Control	7.12±0.37	7.38±0.09
COA	Coated Organic Acids	7.25±0.13	7.34±0.20
OA	Organic Acids	7.24±0.26	6.76±0.17
EO	Essential Oils	7.37±0.09	7.37±0.29
PRO	Probiotics	6.99±0.33	6.94±0.31

Table (8): Effect of dietary treatment on intestinal histmorphology at 21 and 42 days of age

Treatments		Day 21					Day 42				
		Villus Height (µm)	**Villus Width (µm)**	**Villus Area (µm²)**	**Crypt Depth (µm)**	**Muscularis Externa(µm)**	**Villus Height (µm)**	**Villus Width (µm)**	**Villus Area (µm²)**	**Crypt Depth (µm)**	**Muscularis Externa (µm)**
TC	Control	559^{b}±56.40	121±10.41	214050^{b}±32712	137^{ab}±24.29	97±11.93	1345±7.55	333^{a}±10.58	1408845±52169	330±23.78	337^{ab}±10.03
COA	Coated Organic Acids	698^{ab}±106.90	113±6.69	243432^{ab}±26489	171^{ab}±9.17	133±27.87	1560±95.18	276^{ab}±18.33	1346626±169989	470±59.14	297^{ab}±18.17
OA	Organic Acids	780^{a}±8.02	131±12.39	321650^{a}±28755	207^{a}±44.95	166±49.87	1658±183.29	311^{a}±14.32	1657060±36895	418±31.15	469^{a}±17.68
EO	Essential Oils	516^{b}±25.10	101±14.89	164488^{b}±27697	124^{b}±13.58	101±1.33	1500±141.72	216^{b}±32.75	1028135±337115	397±23.98	211^{b}±116.74
PRO	Probiotics	593^{ab}±39.50	106±2.19	195894^{b}±9477	127^{ab}±6.39	136±16.17	1544±59.41	288^{a}±22.61	1401627±152307	443±68.65	354^{ab}±24.36

Table (9): Effect of dietary treatments on protein conversion ratio (PCR)

Treatment	Total Gain(gm)	Total Protein Intake(gm)	Protein Efficiency Ratio
Control	1662	652	0.3922
Coated Organic Acids	1712	628	0.3668
Organic Acids	1626	622	0.3825
Essential Oils	1694	627	0.3701
Probiotics	1617	604	0.3735

Table (10): Effect of dietary treatments on European production efficiency factor (EPEF) and total saving per kg

Treatments		EPEF	Feed Cost (L.E.) per kg. of live Body Weight	Total Saving (L.E.) per kg of live body weight (against Control)
TC	Control	230	9.23	----
COA	Coated organic acids	258	8.61	0.65
OA	Organic acids	227	8.99	0.05
EO	Essential oils	252	8.71	0.52
PRO	Probiotics	234	8.80	0.27

REFERENCES

Alcicek, A.; Bozkurt, M.; and Cabuk, M., 2003. The effect of an essential oil comb performance. SA J. An. Sci. 33(2).

Alfaro, D. M.; Silva, A. V.; Borges, S. A.; Maiorka, F. A.; Vargas, S.; and Santin, E., 2007. Use of Yucca schidigera extract in broiler diets and its effects on performance results obtained with different coccidiosis control methods. J. Appl. Poult. Res., 16(2): 248–254.

Amerah, A. M.; and Gracia, M. I., 2011. Influence of Three Bacillus subtilis Strains Combination on the Performance, Intestinal Morphology and Blood Parameters of Broilers Fed Wheat-Based Diet. International Poultry Scientific Forum, Atlanta, Georgia.

Amerah A.; Van Rensburg, C. J.; Plumstead, P. W.; Kromm, C.; and Dunham, S., 2012. Effect of feeding diets containing a probiotic or antibiotic on broiler performance, intestinal mucosa-associated avian pathogenic E. coli and litter water-soluble phosphorus. J. Appl. Anim. Nutri. 1: e7.

Amit-Romach, E.; Sklan, D.; and Uni, Z., 2004. Microflora Ecology of the Chicke. Poult. Sci., 83(7): 1093-1098.

An, B. K.; Cho, B. L.; You, S. J.; Paik, H. D.; Chang, H. I.; Kim, S. W.; Yun, C. W.; and Kang, C. W., 2008. Growth performance and antibody response of broiler chicks fed yeast derived β-glucan and single-strain probiotics. Asian-Aust. J. Anim. Sci., 21(7): 1027–1032.

Anderson, D. B.; McCracken,V. J.; Aminovi, R. I.; Simpson, J. M.; Mackie, R. I.; Verstegen, M. W.; and Gaskins, H. R., 1999. Gut microbiology and growth-promoting antibiotics in swine. Pig News and Information, 20: 115–122.

Apajalahti, J.; Kettunen, A.; and Graham, H., 2004. Characteristics of the gastrointestinal microbial communities, with special reference to the chicken. World's Poult. Sci. J., 60(02): 223–232.

Aptekmann, K. P.; Artoni, S. M.; Stefanini, M. A.; and Orsi, M. A., 2001. Morphometric analysis of the intestine of domestic quails (Coturnix coturnix japonica) treated with different levels of dietary calcium. Anatomia, histologia, embryologia, 30(5): 277–280.

Awad, W. A.; Ghareeb, K.; Abdel-Raheem, S.; and Böhm, J., 2009. Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. Poult. Sci., 88(1): 49–56.

Biggs, P.; Parsons, C. M.; and Fahey, G. C., 2007. The effects of several oligosaccharides on growth performance, nutrient digestibilities, and cecal microbial populations in young chicks. Poult. Sci., 86(11): 2327–2336.

Bolton, W., and Dewar, W. A., 1965. The digestibility of acetic, propionic and butyric acids by the fowl. Br. Poult. Sci., 6(2): 103–105.

Bozkurt, M.; Alçiçek, A.; Çabuk, M.; Küçükyilmaz, K.; and Çatli, A. U., 2009. Effect of an herbal essential oil mixture on growth, laying traits, and egg hatching characteristics of broiler breeders. Poult. Sci., 88(11): 2368–2374.

Brzoska, F.; Śliwiński, B.; and Michalik-Rutkowska, O., 2013. Effect of dietary acidifier on growth, mortality, post-slaughter parameters and meat composition of broiler chickens/Wpływ zakwaszacza diety na masę ciała, śmiertelność, wydajność rzeźną i skład mięsa kurcząt rzeźnych. Annals of Animal Science 13(1): 85–96.

Cabuk, M.; Bozkurt, M.; Alcicek, A.; Akbaþ Y.; and Küçükyýlmaz, K., 2006. Effect of a herbal essential oil mixture on growth and internal organ weight of broilers from young and old breeder flocks. S. Afr. J. Anim. Sci., 36(2): 135–141.

Casewell, M., 2003. The European ban on growth-prmal health. J. Antimicrob. Chemother., 52(2): 159-161.

Castanon, J. I., 2007. History of the use of antibiotic as growth promoters in European poultry feeds. Poult. Sci., 86(11): 2466–2471.

Cavazzoni, V.; Adami, A.; and Castrovilli, C., 1998. Performance of broiler chickens supplemented with Bacillus coagulans as probiotic. Br. Poult. Sci., 39(4): 526–529.

Cera, K. R.; Mahan, D. C.; Cross, R. F.; Reinhart, G. A.; and Whitmoyer, R. E., 1988. Effect of age, weaning and postweaning diet on small intestinal growth and jejunal morphology in young swine. J. Anim. Sci., 66(2): 574–584.

Cerisuelo, A.; Marín, C.; Sánchez-Vizcaíno, F.; Gómez, E. A.; de la Fuente, J. M.; Durán, R.; and Fernández, C., 2014. The impact of a specific blend of essential oil components and sodium butyrate in feed on growth performance and Salmonella counts in experimentally challenged broilers. Poult. Sci., 93(3): 599–606.

Chaveerach, P.; Keuzenkamp, D. A.; Urlings, H. A.; Lipman, L. J.; and Van Knapen, F., 2002. In vitro study on the effect of organic acids on Campylobacter jejuni/coli populations in mixtures of water and feed. Poult. Sci., 81(5): 621–628.

Cherrington, C. A.; Hinton, M.; and Chopra, I., 1990. Effect of short-chain organic acids on macromolecular synthesis in Escherichia coli. Journal of Appl. Bacteriol., 68(1): 69–74.

Cherrington, C. A.; Hinton, M.; Pearson, G. R.; and Chopra, I., 1991. Short-chain organic acids at pH 5.0 kill Escherichia coli and Salmonella spp. without causing membrane perturbation. J. Appl. Bacteriol., 70(2): 161–165.

Cowieson, A. J.; Hruby, M.; and Pierson, E. M. E., 2006. Evolving enzyme technology: impact on commercial poultry nutrition. Nutri. Res. Rev., 19(01): 90–103.

Dahiya, J. P.; Wilkie, D. C., Van Kessel, A. G.; and Drew, M. D., 2006. Potential strategies for controlling necrotic enteritis in broiler chickens in post-antibiotic era. Anim. Feed Sci. Technol., 129(1): 60–88.

Denli, M.; Okan, F.; and Uluocak, A. N., 2004. Effect of dietary supplementation of herb essential oils on the growth performance, carcass and intestinal characteristics of quail (Coturnix coturnix japonica). S. Afr.J. Anim. Sci., 34: 174–179.

Dibner, J. J.; and Buttin, P., 2002. Use of organic acids as a model to study the impact of gut microflora on nutrition and metabolism. J. Appl. Poult. Res., 11(4): 453–463.

Dibner, J. J.; and Richards, J. D., 2005. Antibiotic growth promoters in agriculture: history and mode of action. Poult. Sci., 84(4): 634–643.

Dizaji, B. R.; Zakeri, A.; Golbazfarsad, A.; Faramarzy, S.; and Ranjbari, O., 2013. Influences of different growth promoters on intestinal morphology of broiler chickens. Eur. J. Experi. Biol., 3(2): 32–37.

Eklund, T., 1983. The antimicrobial effect of dissociated and undissociated sorbic acid at different pH levels. J. Appl. Bacteriol., 54(3): 383–389.

Fausto, Solis, de los Santos, 2008. Caprylic acid supplemented in feed reduces Campylobacter jejuni colonization in broiler chickens. Ph.D., University of Arkansas.

Geyra, A.; Uni, Z.; and Sklan, D., 2001. Enterocyte dynamics and mucosal development in the posthatch chick. Poult. Sci., 80(6): 776–782.

Ghasemi, H. A.; Shivazad, M.; Esmaeilnia, K.; Kohram, H.; and Karimi, M. A., 2010. The effects of a synbiotic containing Enterococcus faecium and inulin on growth

performance and resistance to coccidiosis in broiler chickens. J. Poult. Sci., 47(2): 149–155.

Helander, I. M.; Alakomi, H. L.; Latva-Kala, K.; Mattila-Sandholm, T.; Pol, I., Smid, E.; Gorris, J.; Leon, G. M.; and Von Wright, A., 1998. Characterization of the Actiria. J. Agric. Food Chem. 46(9): 3590-3595.

Heres, L.; Engel, B.; Van Knapen, F.; de Jong, M. C.; Wagenaar, J. A.; and Urlings, H. A., 2003. Fermented liquid feed reduces susceptibility of broilers for Salmonella enteritidis. Poult. Sci., 82(4): 603–611.

Hu, Z.; and Guo, Y., 2007. Effects of dietary sodium butyrate supplementation on the intestinal morphological structure, absorptive function and gut flora in chickens. Anim. Feed Sci. Technol., 132(3): 240–249.

Hume, M. E.; Corrier, D. E.; Ivie, G. W.; and Deloach, J. R., 1993. Metabolism of [14C] propionic acid in broiler chicks. Poult. Sci., 72(5): 786–793.

Iji, P. A.; and Tivey, 1998. Natural and synthetic oligosaccharides in broiler chicken diets. World's Poult. Sci. J., 54(02): 129–143.

Iji, P. A.; Saki, A. A.; and Tivey, D. R., 2001. Intestinal development and body growth o - Animal Feed Science and Technology. Anim. Feed Sci. Technol., 89(3-4): 175-188.

Jamroz, D.; Wiliczkiewicz, A.; Wertelecki, T.; Orda, J.; and Skorupińska, J., 2005. Use of active substances of plant origin in chicken diets based on maize and locally grown cereals. Br. Poult. Sci., 46(4): 485–493.

Jang, I. S.; Ko, Y. H.; Kang, S. Y.; and Lee, C. Y., 2007. Effect of a commercial essential oil on groon in broiler chickens. Anim. Feed Sci. Technol., 134(3-4): 304-315.

Jordan, S. L.; Glover, J.; Malcolm, L.; Thomson-Carter, F. M.; Booth, I. R.; and Park, S. F., 1999. Augmentation of killing of Escherichia coli O157 by combinations of lactate, ethanol, and low-pH conditions. Appl. Environ. Microbiol., 65(3): 1308–1311.

Kim, D.-W.; Kim, J. H.; Kim, S. K.; Kang, G. H.; Kang, H. K.; Lee, S. J.; and Kim, S. H., 2009. A study on the efficacy of dietary supplementation of organic acid mixture in broiler chicks. J. Anim. Sci. Technol., 51(3): 207–216.

Kirkpinar, F.; Ünlü, H. B.; Serdaroğlu, M.; and Turp, G. Y., 2014. Effects of dietary oregano and garlic essential oils on carcass characteristics, meat composition, colour, pH and sensory quality of broiler meat. Br. Poult. Sci., 55(2): 157–166.

Knarreborg, A.; Simon, M. A.; Engberg, R. M.; Jensen, B. B.; and Tannock, G. W., 2002. Effects of dietary fat source and subtherapeutic levels of antibiotic on the bacterial community in the ileum of broiler chickens at various ages. Appl. Environ. Microbiol., 68(12): 5918–5924.

Langhout, D. J.; Schutte, J. B.; Van Leeuwen, P.; Wiebenga, J.; and Tamminga, S., 1999. Effect of dietary high-and low-methylated citrus pectin on the activity of the ileal microflora and morphology of the small intestinal wall of broiler chicks. Br. Poult. Sci., 40(3): 340–347.

Lee, K. W.; Everts, H.; Kappert, H. J.; Frehner, M.; Losa, R.; and Beynen, A. C., 2003a. Effects of dietary essential oil components on growth performance, digestive enzymes and lipid metabolism in female broiler chickens. Br. Poult. Sci., 44(3): 450–457.

Lee, K. W.; Everts, H.; Kappert, H. J.; Yeom, K. H.; and Beynen, A. C., 2003b. Dietary Carvacrol Lowers Body Weight Gain but Improves Feed Conversion in Female Broiler Chickens. J. Appl. Poult. Res., 12(4): 394–399.

Lee, K. W.; Everts, H.; Kappert, H. J.; and Beynen, A. C., 2004a. Growth performance of broiler chickens fed a carboxymethyl cellulose containing diet

with supplemental carvacrol and/or cinnamaldehyde. Int. J. Poult. Sci., 3(9): 619–622.

Lee, K. W.; Everts, H.; Kappert, H. J.; Wouterse, H.; Frehner, M.; and Beynen, A. C., 2004b. Cinnamaldehyde, but not thymol, counteracts the carboxymethyl cellulose-induced growth depression in female broiler chickens. Int. J. Poult. Sci 3(9): 608–612.

Line, J. E.; Bailey, J.; Stan, N. A.; Cox, N.; Stern , J.; and Tompkins, T., 1998. Effect of yeast-supplemented feed on Salmonella and Campylobacter populations in broilers. Poult. Sci., 77(3): 405–410.

Mathlouthi, N.; Lalles, J. P.; Lepercq, P.; Juste, C.; and Larbier, M., 2002. Xylanase and β-glucanase supplementation improve conjugated bile acid fraction in intestinal contents and increase villus size of small intestine wall in broiler chickens fed a rye-based diet. J. Anim. Sci., 80(11): 2773–2779.

Miles, R. D.; Butcher, G. D.; Henry, P. R.; and Littell, R. C., 2006. Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. Poult. Sci., 85(3): 476–485.

Mroz, Z.; Koopmans, S. J.; Bannink, A.; Partanen, K.; Krasucki, W.; Øverland, M.; Radcliffee, S.; Mosenthin, R.; Zentek, J.; and Żebrowska, T., 2006. Carboxylic acids as bioregulators and gut growth promoters in nonruminants. Biology of nutrition in growing animals, 81–133.

Niewold, T. A., 2007. The nonantibiotic anti-inflammatory effect of antimicrobial growth promoters, the real mode of action? A hypothesis. Poult. Sci., 86(4): 605–609.

Pirgozliev, V.; Murphy, T. C.; Owens, B.; George, J.; and McCann, M., 2008. Fumaric and sorbic acid as additives in broiler feed. Res. Vet. Sci., 84(3): 387–394.

Pluske, J. R.; Thompson, M. J.; Atwood, C. S.; Bird, P. H.; Williams, I. H.; and Hartmann, P. E., 1996. Maintenance of villus height and crypt depth, and enhancement of disaccharide digestion and monosaccharide absorption, in piglets fed on cows' whole milk after weaning. Br. J. Nutri., 76(03): 409–422.

Ravindran, V.; Kornegay, E. T.; and Webb, K. E., 1984. Effects of fiber and virginiamycin on nutrient absorption, nutrient retention and rate of passage in growing swine. J. Anim. Sci., 59(2): 400–408.

Ricke, S. C., 2003. Perspectives on the use of organic acids and short chain fatty acids as antimicrobials. Poultry Science 82(4): 632–639.

Sakamoto, K.; Hirose, H.; Onizuka, A.; Hayashi, M.; Futamura, N.; Kawamura, Y., and Ezaki, T., 2000. Quantitative study of changes in intestinal morphology and mucus gel on total parenteral nutrition in rats. J. Surg. Res., 94(2): 99–106.

Salam, O. M.; Nada, S. A.; and Arbid, M. S., 2002. The effect of ginseng on bile-pancreatic secretion in the rat. Increase in proteins and inhibition of total lipids and cholesterol secretion. Pharmacol. Res., 45(4): 349–353.

Salmond, C. V.; Kroll, R. G.; and Booth, I. R., 1984. The effect of food preservatives on pH homeostasis in Escherichia coli. Microbiol., 130(11): 2845–2850.

Santin, E.; Maiorka, A.; Macari, M.; Grecco, M.; Sanchez, J. C.; Okada, T. M.; and Myasaka, A. M., 2001. Performance and intestinal mucosa development of broiler chickens fed diets containing Saccharomyces cerevisiae cell wall. The J. Appl. Poult. Res., 10(3): 236–244.

Senkoylu, N.; Samli, H.; Kanter, M.; and Agma, A., 2007. Influence of a combination of formic and propionic

acids added to wheat-and barley-based diets on the performance and gut histomorphology of broiler chickens. Acta Vet. Hungarica, 55(4): 479–490.

Shamoto, K.; and Yamauchi, K., 2000. Recovery responses of chick intestinal villus morphology to different refeeding procedures. Poult. Sci., 79(5): 718–723.

Shareef A.; and Al-Dabbagh, A. S., 2009. Effect of probiotic (Saccharomyces cerevisiae) on performance of broiler chicks. Iraqi J. Vet. Sci., 23(1): 23–29.

Smulikowska, S.; Mieczkowska, A.; and Jankowiak, J., 2009. The effect of fat-coated organic acid salts and a feed enzyme on growth performance, nutrient utilization, microflora activity, and morphology of the small intestine in broiler chickens. J. Anim. Feed Sci., 18(3): 478–489.

Torok, V. A.; Hughes, R. J.; Ophel-Keller, K.; Ali, M.; and MacAlpine, R., 2009. Influence of different litter materials on cecal microbiota colonization in broiler chickens. Poult. Sci., 88(12): 2474–2481.

Watkins, B. A.; and Miller, B. F., 1983. Competitive gut exclusion of avian pathogens by Lactobacillus acidophilus in gnotobiotic chicks. Poultry Science 62(9): 1772–1779.

Willis, W. L.; Isikhuemhen, O. S.; and Ibrahim, S. A., 2007. Performance assessment of broiler chickens given mushroom extract alone or in combination with probiotics. Poult. Sci., 86(9): 1856–1860.

Xia, M. S.; Hu, C. H.; and Xu, Z. R., 2004. Effects of copper-bearing montmorillonite on growth performance, digestive enzyme activities, and intestinal microflora and morphology of male broilers. Poult. Sci., 83(11): 1868–1875.

Zhang, K. Y.; Yan, F.; Keen, C. A.; and Waldroup, P. W., 2005. Evaluation of microencapsulated essential oils and organic acids in diets for broiler chickens. Int. J. Poult. Sci., 4(9): 612–619.

Zhou, X.; Wang, Y.; Gu, Q.; and Li, W., 2010. Effect of dietary probiotic, Bacillus coagulans, on growth performance, chemical composition, and meat quality of Guangxi Yellow chicken. Poult. Sci., 89(3): 588–593.

الملخص العربي

تأثير إضافة بدائل المضادات الحيوية المنشطة للنمو لعلائق دجاج اللحم على الأداء الإنتاجي ومورفولوجيا الأمعاء وميكروفلورا القناة الهضمية

طارق محمد يونس*، عبد الهادي عامر عامر*، جيهان محمد المغازي**، أحمد محمد كيوان*

****قسم الإنتاج الحيواني – كلية الزراعة – جامعة الأزهر- مدينة نصر- القاهرة-جمهورية مصر العربية.***

*****المركز الإقليمي للأغذية والأعلاف-مركز البحوث الزراعية-جمهورية مصر العربية.***

يهدف هذا البحث لدراسة مدي فاعلية إضافة كل من الأحماض العضوية المغلفة،الأحماض العضوية غير المغلفة،الزيوت الأساسية،البروبيوتك إلى العلائق كبدائل للمضادات الحيوية المنشطة للنمو على الأداء الإنتاجي وموفولوجيا الأمعاء وميكروفلورا القناة الهضمية وصفات الذبيحة لدجاج التسمين.

استخدم في هذه التجربة عدد ٣٠٠ كتكوت لحم غير مجنس من سلالة كوب٥٠٠ عمر ٧ أيام بمتوسط وزن ١٦٠جرام تم تقسيمها الى ٥ معاملات وتحتوي كل معاملة على ثلاث مكررات.

إستخدمت علائق خالية من المضادات الحيوية ومضادات الكوكسيديا وتم تركيبها لتغطي إحتياجات دجاج اللحم خلال مراحل النموحيث غذيت كل مجموعه على واحدة من المعاملات التالية: ١- عليقة أساسية بدون إضافات(الكنترول) ٢- عليقة أساسية+ مخلوط الأحماض العضوية المغلفة ٧٥٠جرام/طن ٣- عليقة أساسية +مخلوط الأحماض العضويةغيرالمغلفة ٧٥٠جرام/طن ٤- عليقة أساسية + الزيوت الأساسية ١٠٠جرام/طن ٥- عليقة أساسية+البروبيوتك٥٠٠جرام/طن.

يمكن تلخيص النتائج المتحصل عليهاعند عمر٤٢ يوم في الأتي:

- أن إضافة الأحماض العضوية المغلفة والزيوت الأساسية الى العلائق أدي الى تحسن واضح غير معنوي في متوسط الوزن بمعدل ٣، ١,٩% على التوالي مقارنة بمجموعة الكنترول كما حدث تحسن غير معنوي في معامل التحويل الغذائي لمجموعة الأحماض المغلفة وغير المغلفة والزيوت الأساسية والبروبيوتك بمعدل ٦,٤،٢,٤٦،٥,٤،٤,٤٣ % على التوالي. استخدام البدائل أدي الى انخفاض استهلاك الغذاء مقارنة بالكنترول وعند مقارنة مجموعة الأحماض العضوية المغلفة بالأحماض العضوية غير المغلفة أظهرت الأولى تحسنا في متوسط الوزن ومعامل التحويل بمعدل ٥،٤% على التوالي.
- لم يحدث تأثير للإضافات على كافة قياسات الذبيحة، وجد تحسن معنوي في نسبة وزن الكبد لمجموعة الكنترول مقارنة بباقي المعاملات.
- في نهاية فترة التجربة وجد أن جميع البدائل المستخدمة أدت الى زيادة في أعداد بكتيريا الإنتيروكوكس وبكتريا حمض اللاكتيك كما أدت الى خفض أعداد بكتيريا الإيشرشيا كولاي مقارنة بمجموعة الكنترول حيث سجلت الأحماض العضوية المغلفة أقل قيمة لأعداد الإي كولاي يتبعها في ترتيب تصاعدي مجموعة الأحماض غير المغلفة والزيوت الأساسية والبروبيوتك على التوالي.
- أدت إضافة الأحماض العضوية غير المغلفة الى العلائق الى إنخفاض رقم الحموضة في محتويات الأعور حيث كانت أقل قيمة يتبعها مجموعة البروبيوتك بينما كانت بقية المعاملات أعلى بشكل متقارب مع الكنترول.
- إضافة جميع البدائل أدي إلى زيادة في طول الخملات في منطقة الصائم في عمر ٤٢ يوم مقارنة بمجموعة الكنترول ، سجلت مجموعة الأحماض العضوية غير المغلفة أعلى قيمة لطول ومساحة الخملات بمعدل ١٧،٢٣,٣% مقارنة بمجموعة الكنترول التي كان سمك الطبقة العضليه لها أقل بمعدل ٣٩,١% من مجموعة الأحماض غير المغلفة.
- إستخدام بدائل المضادات الحيوية المنشطة للنمو أدي الى زيادة معامل تحويل البروتين بمعدل ٦,٥،٢,٤،٥,٦،٤,٧٩ لمجموعات الأحماض العضوية المغلفة وغير المغلفة والزيوت الأساسية والبروبيوتك على التوالي حيث كانت مجموعة الأحماض العضوية المغلفة الأفضل وهذا ما يتفق مع النتائج الخاصة بمتوسط الوزن ومعامل التحويل الغذائي.
- أظهرت النتائج تحسن معامل الكفاءة الأوروبي لمجموعات الأحماض العضوية المغلفة والزيوت الأساسيه والبروبيوتك بمعدل ١٢،٩,٥،١,٧٤% مقارنة بمجموعة الكنترول.