PRODUCTIVE PERFORMANCE OF BROILER CHICKS AS AFFECTED BY DIETARY LEVELS OF L-CARNITINE OR HERBAL MIXTURE.

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SUMMARY

A study was conducted to determine the growth performance, digestibility, serum components, carcass traits, immunity, gastrointestinal tract (gut) characteristics of broilers fed diets supplemented with dietary levels of L-carnitine (LC) or herbal mixture (HM), which are among alternative growth promoters. In the study, 546 one-week-old broilers (Ross-308) were used. There were 7 dietary treatments; each consisted of 3 replicates (13 males and 13 females in each replicate). The control group was fed basal diet, L-carnitine was supplemented at 10, 20 and 30 *mg/kg* in three experimental diets (LC_1, LC_2 and LC_3) ,while, herbal mixture was supplemented at 5,10, 15 g/kg in other three experimental diets (HM_4, $HM_5$and HM_6), respectively. From 7 days to 42 days of age, live body weight was significantly greater ($P < 0.05$) in broilers fed L-carnitine or herbal mixture -supplemented diets compared to the control group. The HM_6 group significantly ($p<0.05$) recorded the best value of digestible crude fiber compared to the other tested groups. Groups supplemented with dietary 5 and 15 g HM/kg significantly ($p<0.05$) digested higher percentage of crude fat than LC_1 group. Dietary levels of L-carnitine or herbal mixture significantly ($p<0.05$) reduced total feed intake and improved total live body weight gain more than the control group .Best values of feed conversion ratios were obtained with LC_1 and LC_2 groups, while, the highest values of performance index were achieved with LC_1 ,HM_5 and HM_6 groups. Groups supplemented with dietary 5, 10 and 15 g HM /kg significantly ($p<0.05$) showed lower abdominal fat %, cholesterol, triglycerides, GOT, GPT, cecum weight % and cecum pH than the LC and control groups. No significant differences were detected with respect to haemagglutination inhibition test (HI) in the control, LC groups and HM_5, HM_6 groups. While, the HM_4 group significantly ($p<0.05$) recorded the lowest value of (HI) compared to other groups. Chicks supplemented with dietary 10 g HM /kg (MH_5) showed the best values of total bacterial counts (*cfu*), *Salmonella, E. coli.* , meat color, meat taste and meat aroma ($p<0.05$). In conclusion, dietary herbal mixture - as a natural growth promoter-supplementation appeared to be beneficial in enhancing the growth performance, digestibility, serum components, carcass and meat quality, immunity, gastrointestinal tract (gut) characteristics of broilers more than L-carnitine.

Keywords: *L-carnitine, herbal mixture, performance, broilers, feed conversion, ratio, performance index.*

INTRODUCTION

Recently, most of the antibiotics that used as growth promoters have been banned because feeding antibiotics is risky (Neu, 1992) due to not only cross-resistance but also to multiple resistances. Ban on the use of antibiotics as growth promoters in the European Union (Regulation 1831/2003/EC) and the potential for a ban in the United States have prompted the search for alternative feed supplements in animal production.

Prebiotics, probiotics and organic acids are three of several approaches that have the potential to reduce enteric diseases and improve performance in poultry and to decrease subsequent contamination of poultry products (Patterson and Burkholder, 2003 and Ricke, 2003).

Supplementation of healthy animals with dietary carnitine may also produce positive outcomes, such as improved growth and feed efficiency, and reduced body lipid content (Owen *et al.*, 1996 and Rabie and Szilagyi, 1998), which is probably associated with the role of carnitine in oxidation of lipids and its amino-acid-sparing properties (Owen *et al.*, 1996). Additionally, carnitine may modulate immune function as evidenced by enhanced antibody responses in L-carnitine-supplemented broiler chickens (Mast *et al.*, 2000) and pigeons (Janssens *et al.*, 2000); however, the relationship between dietary carnitine and the immune system has not been well defined yet in avian and other species.

Lien and Horng (2001) indicated that supplementary carnitine did not significantly influence the performance, carcass characteristics, serum cholesterol, phospholipids concentrations and lipoprotein profiles of the broilers. Also, they demonstrated that supplementary carnitine facilitated fatty acid transportation and did not influence the performance or carcass characteristics of broilers. On the other hand, Xu z *et al.*,(2003) indicated that L-carnitine could reduce the deposit of subcutaneous fat by decreasing total activities of enzymes in the fat and enhance intramuscular fat by decreasing the activity of carnitine palmitoyltransferase-I in breast muscles.

The integrated antioxidant systems in chicken tissues are responsible for the protection of polyunsaturated fatty acids , protein and DNA from damaging effect of free radicals and toxic products of their metabolism (Surai *et al* ., 2003). Active ingredient such as *thymol* and *carvacrol* in oregano oil, *eugenol* in clove have antioxidant effects (Lee and Shibamoto, 2002 and Gülçin *et al.*, 2004).Also, *thymol* , *carvacrol,* and *eugenol* have digestive stimulating effects (Çabuk *et al.*, 2003). Besides, *thymol*, *carvacrol* ,and *eugenol* affect pathogen microorganism in the digestive system.

There are a large numbers of feed additives available for inclusion in animal and poultry diets to improve their performance. However, the use of chemical products especially (hormones and antibiotics), may cause unfavorable side effects. Moreover, there is evidence indicating that these products could be considered as pollutants for human and threaten the health on the long–run. Attempts to use the natural materials such as medicinal plants could be widely accepted as feed additives to improve the efficiency of feed utilization and productive performance (Aboul-fotouh *et al.*, 1999).

Herbs and herbal extracts contain different photochemical compounds with biological activity that may provide therapeutic effects. Several herbs, help to reduce high blood

cholesterol concentration, provide some protection against cancer, and/or stimulate the immune system. Furthermore, it was found that a diet in which culinary herbs are used generously to flavor food provides a variety of active photochemical which promote health and protect against chronic diseases (Craig, 1999 and Abdo *et al.*, 2003).

Various dietary herbs, plant extracts, especially essential oils, have been studied for their antimicrobial and growth promoter abilities (Cross *et al.*, 2007; Demir *et al.*, 2003; Acamovic and Broker, 2005; Bampidis *et al.*, 2005).

Rosemary has long been recognized as having antioxidant molecules that have been identified as carnosic acid, carnasol, carsolic acid ,found in ethanol-soluble fraction (Svoboda and Deans 1992). Extracts of rosemary and sage have played an important role but other herbs of the labiates family, such as thyme ,have also exhibited substantial antioxidant activity (Schwartz *et al.*,1996).

Similarly, clove (*Syzygium arimaticum L.*) has been used as an antiseptic (Çabuk *et al.*, 2003) antimicrobial (Dorman and Deans, 2000; and Valero and Salmeron, 2003), analgesic and local anesthetic (Feng and Lipton, 1987). In addition, it has an appetizing and stimulating effect of digestion (Çabuk *et al.*, 2003), antifungal (Velluti *et al.*, 2003), antipyretic (Feng and Lipton, 1987), antiparasitic (Kim *et al.*, 2004) and antioxidant (Gülçin *et al.*, 2004).

Ali *et al* (2007) reported that addition of thyme to local strains of laying hen,s diet increases antioxidant capacity in plasma ,while decreased LDL, HDL total cholesterol , triglyceride and total lipids in blood plasma .Meanwhile, Ocak *et al.* (*2008*) reported that supplementation with dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves, are among the alternative growth promoters . The peppermint or thyme leaves increased ($P < 0.05$) the abdominal fat at 42 days of age. Thus, the dry peppermint leaves had a higher growth promoting efficacy than the dry thyme leaves at an early stage of broilers life.

Abdel-Rahman *et al.*(2008) used corn-soya bean meal basal diet as a control diet supplemented with levels of L-carnitine (LC) (10,20 and 30 mg /kg) and supplemented levels of Herbal mixture (HM) 5,10 and 15 g/kg. They concluded that supplementation of 15g/kg of herbal mixture (HM) as a natural antioxidant to broiler breeder laying hen diets during 40-52 weeks of age improved their productive and reproductive performance than artificial antioxidants.

Therefore, the present study was conducted to evaluate the effect of dietary L-carnitine (LC) (as an artificial feed additive) and Herbal mixture (HM) (as a natural feed additive) supplementation on productive performance as well as physiological parameters and economical efficiency of broiler chickens.

MATERIALS AND METHODS

The present study was carried out at Poultry Research Station belonging to Environmental Studies and Research Institute, Minufiya University, Sadat City, Minufiya Governorate, Egypt.

The aim of this investigation was to state the productive performance of broilers as affected by L-carnitine (LC) (as an artificial antioxidant) and Herbal mixture (HM) (as a nature antioxidant) supplementation during starter, grower and finisher periods.

Management and allocation of birds:

A total of 546 unsexed day- old broiler chicks (ROSS-308) obtained from a local hatchery (El-Wadi Hatcheries) was used in this study. Chicks were give a starter control diet (Table 1) for the first week of age and then chicks were wing banded individually, weighed and randomly distributed into7dietary treatments, each consisted of 3 replicates; 13 male and 13 female for each replicate. Floor brooders with ground wheat hay litter were used. Continuous lighting was provided throughout the experiment. The ambient temperature was gradually decreased from 30°C on day 7 to 25°C on day 21 and was then kept constant. All broilers were kept under the same managerial hygienic and environmental conditions throughout the entire experimental period that lasted for 6 weeks. Feed and water were supplied *ad libitum* .

The experimental diets and preparation of feed additives:

The ingredients and composition of the basal diet (starter from 7 to 21 days of age, grower from 21 to 35 days of age and finisher from 36 to 42 days of age) are presented in Table (1). All birds used in the experiment were fed according to applicable recommendations of requirements of Ross broilers and the National Research Council (NRC, 1994). L-carnitine (LC) used in the experiment, (carnikingr) 3- carboxy -2-hydroxypropal irimethyl ammonium-hydroxide .inner salt) manufactured by Lohman animal health GMMH & Co. KG-Germany ,was obtained from International Free Trade Company (IFT) . While, Herbal Mixture (HM) was composed of 6 different medicinal and aromatic plants purchased commercially in dried form. The HM consisted mainly of thyme *(Foenicilum vulgar ,Mill)* ;oregano *(Origanum Vulgare L.)* ;clove *(Syzygium Arimaticum L.)*;marjoram(*Origanum MarjoranumL.)*; rosemary *(Rosmarnus Officinalis)* and peppermint (*Mentha Piperita*). Were mixed in different percentages (25;25;15;15;10 and 10% ,respectively) and ground then kept in clean, dry and closed plastic bags. The mixture was supplemented during the preparation of the experimental diets.

Four birds (2 females and 2 males) from each replace with body weights within one standard deviation of the mean of treatment weight (16 birds per treatment) were slaughtered to determine carcass weight, dressing percentage, and weights of entire gut, empty gizzard, pancreas, edible inner organs and abdominal fat pad, and the length of the entire gut. The gut, from the esophagus to the cloaca, and the organs were carefully excised. Any digesta remaining in the entire gut was emptied by gentle pressure. Weights of gizzard, heart and liver were recorded as the weight of edible inner organs. Weights of gut and edible inner organs (g/100 g body weight), length of gut (cm/100 g body weight) were expressed as a part of body weight.

Table (1): Composition and calculated analysis of basal diets.

Ingredients	Starter	Grower	Finisher
Yellow corn	52.93	60.57	63.94
Soy bean Meal (44%)	34.30	28.2	22.9
Full fat Soybean (38%)	8.80	10.0	10.0
Vegetable Oil	----	1.32	2.02
Ca CO_3	1.68	0.17	0.16
Mono Calcium Phosphate(23%P)	1.36	0.12	0.11
Premix*	0. 30	0. 30	0. 30
L-Lysine Hcl	0. 12	0.04	0.06
DL-Methionine	0.10	0.10	0.10
Choline Chloride ,60%	0.03	0.03	0.03
Coccidiostat , %	0.01	0.01	0.01
NaCl	0. 37	0. 37	0. 37
Total	100.00	100.00	100.00
Calculated chemical analysis**			
Dry Matter,%	87.68	87.79	87.89
Crude Protein,%	23.02	21.05	19.04
Metabolizable Energy ,Kcal/kg	2871.55	3030.20	3059.85
TMEn, Kcal/kg	2988.86	3173.56	3226.27
Crude Fiber,%	3.92	3.64	3.34
Ether Extract,%	4.54	6.87	8.86
Arginine ,%	1.64	1.50	1.35
Lysine,%	1.34	1.22	1.09
Methionine ,%	0.67	0.54	0.47
Methionine + Cystine,%	1.06	0.91	0.80
Tryptophan,%	0.30	0.27	0.24
Calcium ,%	1.00	0.90	0.85
Available Phosphorus,%	0.50	0.45	0.42
Total Phosphorus ,%	0.84	0.77	0.73
Cl , %	0.26	0.26	0.26
Na, %	0.16	0.16	0.16

**Premix contains per 3kg Vit A 12 000 000, vit D3 2 500 000 IU, Vit E 10000 mg, Vit K3, 1000mg, Vit B1, 2000mg, Vit B2, 5000mg, Vit B6, 2000mg, Vit B12, 10mg, Pantothenic acid 10000mg, Niacin, 30000mg; Biotin, 50mg, Folic acid 1000,mg; Choline, 250gm, Selenium, 100mg, Copper, 4000mg; Iron ,30000mg; Manganese, 60000mg; Zinc ,55000mg; Iodine, 300mg; Cobalt, 100mg and CaCO3 to 3000g.*

***According to Feed Composition Tables for Animal and Poultry Feedstuffs used in Egypt (2001).*

Individual blood samples were taken from birds within each treatment and collected into dry clean heparinzed centrifuge tubes and centrifuged for 20 minutes (3000 rpm). The antioxidant capacity in plasma was determined using a commercial kits (Biodiagnostic

Company). The biochemical characteristics of blood serum were determined calorimetrically, using commercial kits as described by (Emam, 2007).

Chemical analysis:

Total cholesterol, urea, triglycerides, total protein, albumin, Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) were determined using suitable commercial kits. Globulin concentration of each assayed sample was calculated by subtracting the albumin value from its total protein concentration. Proximate analysis of feed and the finely ground excreta was analyzed for Gross Energy (GE) and N content were determined according to the official methods (A.O.A.C, 1990).

Digestibility Trials:

The digestibility coefficients of nutrients of the tested diets were determined at the end of experiment using 3 birds from each treatment. Fecal nitrogen was determined by separating method of Tri-chloro acetic acid according to Jakobsen *et al.* (1960). Urinary Organic Matter was evaluated according to Abou-Raya and Galal (1971). The microbial content was studied, *E.coli* and Salmonella was enumerated according to the methods described by (A.O.A.C, 1990). Nitrogen retention (NR %) was calculated from the following formula: NR (%) = N content of dry feed - N content of dried excreta / N content of dry feed ×100. Apparent Metabolizable Energy (AME) was calculated by

subtracting GE of dried excreta from GE of dried feed.

Determinations of Haemagglutination activity:

Titration of Haemagglutination activity of the NDV antigen in the allantoic fluid using the HA test was carried out according to Anon (1971) and Maestrini *et al.*,(1981).While , Haemagglutination inhibition test (HI) for detection of antibodies against NDV in Serum of vaccinated chickens was carried out according to the standard procedure described by Mcjiyabe and Hitchner (1977) and Antony et al.,(1999).

Statistical Analysis:

The effects of diet on bird performance, carcass characteristics, blood parameters, The antioxidant capacity ,digestion coefficients, fecal N, NR, microbiological studies and immune response and oreganoleptic properties of broilers meat were analyzed by one-way ANOVA using the General Liner Model procedure of SAS (version 6. 12) (SAS Institute, 1999). Significant differences among treatment means were separated using Duncan (1955) Multiple Range Test. The statistical model used for analyzing data obtained was:

$$Yij = M + Ti + Eij$$

where:

Yij = The individual observation,

M = The overall mean,

Ti = The effect of supplementation,

Eij = The experimental error

RESULTS AND DISCUSSION

Broilers Performance:

Data obtained during the experimental periods regarding the broilers performance as affected by different dietary levels of LC or HM are presented in Table (2). Results indicate that the group fed diet supplemented with 15g Herbal mixture (HM)/kg recorded significantly ($P < 0.05$) the best final live body weight value compared with the control group.(1751.2g *vs.* 1626.5). While, the group supplemented with 10g HM/kg (T_5) significantly ($P < 0.05$) recorded the highest value of body weight gain (1578.7g) compared with the group fed diet supplemented with 15g Herbal mixture (HM)/kg(T6) (1453.7g) . Meanwhile, insignificant differences were observed between control group and other experimental diets.

Concerning feed intake, results indicate that the control group and the 30 mgLC group (T3) significantly consumed ($P < 0.05$) the highest amounts (2867.9 and 2881.1 g) compared with the other experimental groups. Furthermore, feed intake was significantly ($P < 0.05$) affected by the dietary HM treatments, hence the groups fed 10 and 15gHM/kg (T_5 ,T_6) consumed significantly ($P < 0.05$) the lowest amounts (2601.8 and 2563.3) compared with the control and other experimental groups. and hence feed conversion ratio seemed to be improved in the groups fed dietary 5 or 10g HM/kg compared with the control group (1.96 and 1.88 *vs.* 2.05) (Table 2) .

Concerning the Performance Index (PI) of the experimental groups, data indicated that supplementation of 10g dietary HM/kg(T_5) significantly($P < 0.05$) resulted in maximum level for best performance compared to the other experimental groups . Meanwhile , the group fed 15gHM/kg (T6) significantly($P < 0.05$) recorded the worst performance index . Similarly, Ather (2000) reported that broiler performance was improved when using a poly herbal premix which contained five herbs.

These results were in agreement with those obtained by Buyse et al., (2001) who concluded no beneficial effect of L-carnitine supplementation on broiler performance. However, Rabie *et al.* (1997*a*, *b*) and Rabie and Szilágyi (1998) noticed improved growth rate, better feed efficiency, greater breast and thigh meat yield, and lower abdominal fat content in broilers supplemented with L-carnitine.

Although it was expected that supplementing dietary herbs or plant extracts would stimulate the growth performance of broilers, research on herbs, plant extracts, essential oil and/or the main components of the essential oil yielded contradictory results (Alcicek *et al.*, 2003, 2004; Bampidis *et al.*, 2005; Griggs and Jacob, 2005).

Mortality reduced significantly($P < 0.05$) with groups fed HM levels (T_4,T_5,T_6) compared to L-carnitine and control groups(T_1,T_2,T_3 and T_0, respectively).That is may be due to essential oils substances in HM that have antimicrobial activity in broilers digestive tracts environments . Besides, *thymol, carvacrol, eugenol and anothole* affected pathogen microorganism in the digestive system (Çabuk *et al.*, 2003). These Results are in agreement with those of Alcicek *et al.*, 2003 and Abdel-Rahman *et al.*,2008) .

Table (2): Performance of broilers as affected by dietary levels of L-carnitine (LC) and Herbal mixture (HM).

Item	Age (Day)	Control (T_0)	L-Carnitine levels, mg/kg			Herbal mixture levels, g/kg			±SE	Sign.
			10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
body weight at one day age, g	1	51.0	50.00	51.50	50.45	50.00	51.23	50.65		NS
Initial body weight ,g	7	172.92	172.92	172.92	172.92	172.92	172.92	172.92	1.39	NS
Live body weight, g	21	819.93^{bcd}	849.38^{a}	838.47^{abc}	811.32^{d}	844.44^{ab}	815.69^{cd}	848.68^{a}		*
	35	1576^{b}±18.6	1656^{a}±17.2	1680.7^{a}±18.7	1639.3^{a}±17.98	1648.3^{a}±17.4	1649.8^{a}±18.2	1677.1^{a}±18.2		*
	42	1626^{b}±18.6	1698^{a}±17.2	1720.7^{a}±18.7	1694.2^{a}±18.0	1705.4^{a}±17.4	1721.6^{a}±18.2	1751.2^{a}±18.2		*
Body weight gain ,g	7-21	676.46^{a}	665.56^{ab}	638.40^{c}	671.53^{a}	642.78^{bc}	675.76^{a}	647.01^{bc}	8.21	*
	7-35	1050.42^{a}	1023.61^{ab}	1005.56^{bc}	1037.57^{ab}	1020.56^{ab}	1029.72^{ab}	981.11^{c}	11.94	*
	7-42	1525^{a} ±16.8	1548^{a}±18.3	1520.8^{a} ± 17.58	1532.27^{a} ±17.01	1548.35^{a} ±17.74	1578.7^{a}±17.8	1453.7^{b}±18.2		*
Feed intake ,g	7-21	672.84^{a}	656.70^{b}	657.74^{b}	657.67^{b}	658.37^{b}	593.09^{d}	623.23^{c}	2.18	*
	7-35	1932.12^{ab}	1860.76^{abc}	1887.44^{abc}	1972.37^{a}	1845.19^{bc}	1776.68^{c}	1777.16^{c}	38.04	*
	7-42	2867.92^{a}	2665.90^{ab}	2725.48^{ab}	2881.14^{a}	2665.35^{ab}	2601.77^{b}	2563.27^{b}	81.60	*
Feed conversion ratio, g feed/g gain	7-21	1.01^{b}	1.00^{b}	1.05^{ab}	0.99^{b}	1.10^{a}	0.89^{c}	0.98^{b}	0.03	*
	7-35	1.87^{ab}	1.85^{ab}	1.91^{a}	1.93^{a}	1.88^{ab}	1.75b78^{b}	1.84^{ab}	0.05	*
	7-42	2.01^{b}	2.02^{ab}	2.02^{ab}	2.03^{ab}	1.96^{b}	1.88^{c}	2.09^{a}	0.03	*
Performance Index , PI	7-21	171.5^{b}± 3.6	175.6^{b}± 3.96	166.98^{b}± 3.81	175.22^{b}± 3.68	169.95^{b}± 3.84	197.93^{a}± 3.85	171.3^{b}± 3.9		*
	7-35	89.5^{ab} ±1.87	87.2^{b} ±2.04	84.09^{b} ±1.96	86.47^{b} ±1.90	88.90^{ab} ±1.98	93.57^{a} ±1.98	83.5^{b}±2.03		*
	7- 42	86.78^{bc} ±2.5	87.4^{bc} ±2.31	85.74^{bc} ±2.51	85.90^{bc} ±2.41	90.18^{ab} ±2.34	94.91^{a} ±2.44	81.1^{c} ±2.44		*
Mortality %	%	22.22^{a}	9.72^{b}	15.28^{ab}	23.61^{a}	6.94^{b}	9.72^{b}	6.94^{b}	3.19	*

a, b….. means with different superscripts in the same row are significantly different at (p<0.05). *NS = not significant-*

In this concern , Ertas *et al.*,(2005) used essential oil mix (EOM) contained three different essential oils derived from oregano (*Origanum vulgare L.*), clove (*Syzgium aromaticum*) and anise (*Pimpinella anisum L.*) in broiler nutrition as a natural growth promoting substance instead of antibiotic (Avilamycin) and observed that The feed intake was similar between the groups ($p>0.05$) and daily live weight gain increased in the 200 ppm EOM group by approximately 16 % over the control group and approximately 8 % over the antibiotic group. Also, they found that feed conversion ratio improved in the 200 ppm EOM group by approximately 12 % over the control group and approximately 6 % over the antibiotic group and concluded that, EOM could be considered as a potential natural growth promoter for poultry.

Ocak *et al.* (2008) reported that the dry peppermint leaves had a higher growth promoting efficacy than the dry thyme leaves at an early stage of broilers' life.

Digestibility Coefficients:

The results of digestion coefficients indicate that no significant differences ($P<0.05$) were detected among treatments in CP,OM , NFE , ash retention, nitrogen retention (NR), and AME (Table 3). However, the addition of 15g HM/kg diet significantly ($P <0.05$) improved CF digestibility compared with control and other experimental groups Also, EE digestibility significantly ($P <0.05$) improved in T_3,T_4,T_5 and T_6 compared with the control and other experimental groups. Ertas et al.,(2005) found that essential oil mix could be considered as a growth promoter for poultry due to digestive stimulating effect, antimicrobial effect and positive effect on performance . These differences among the groups may be due to active ingredient such as *thymol* and *carvacrol* in oregano oil, *eugenol* in clove and *anothole* in anise. Because, *thymol. carvacrol, eugenol* and *anothole* have digestive stimulating effects (Çabuk *et al.*, 2003).

The active principles of essential oils act as a digestibility enhancer, balancing the gut microbial ecosystem and stimulating the secretion of endogenous digestive enzymes and thus improving growth performance in poultry (Williams and Losa, 2001 and Cross *et al.*, 2007).

Therefore, the main compound of peppermint may probably improve the digestibility of diet as a digestion stimulant, and hence increase the nutrient entry rate at an early stage of bird's life without affecting feed conversion. Besides, *thymol, Carvacrol, eugenol and anothole* affected pathogen microorganism in the digestive system and increased live weight gain and feed (Çabuk *et al.*, 2003).

Ali *et al.* (2007) reported that Addition of thyme or anise to laying hens diets succeeded in improving the performance of birds because their effect of fiber matrix (phenolic compound and other fiber components) and consequently improve the digestion coefficient and nutrients retention. Ocak *et al.*,(2008) demonstrated that the active principles of herbs act as a digestibility enhancer, stimulating the secretion of endogenous digestive enzymes.

Carcass Characteristics:

Data of carcass characteristics as affected by different levels of L-carnitine and Herbal mixture for experimental broilers are summarized in (Table 4). Results showed that no significant ($P<0.05$) differences between LC (T_2,T_3) and HM (T_4,T_5) groups among carcass

Table (3): Digestibility coefficients and feeding values as affected by L-carnitine (LC) and Herbal mixture (HM) as dietary feed additives for broilers.

Item	Control	L-Carnitine levels, mg/kg			Herbal mixture levels, g/kg			± SE	Sig.
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
DCP	96.52±0.63	96.52±0.16	96.64±0.31	96.45±0.21	96.17±0.18	95.93±0.54	96.61±0.3		NS
DCF	22.20^{b}	22.08^{b}	24.77^{b}	25.28^{b}	24.70^{b}	22.04^{b}	31.17^{a}	1.03	*
DEE	96.88^{b}	93.68^{b}	95.00^{b}	97.69^{a}	97.22^{a}	96.71^{ab}	97.31^{a}	1.01	*
DNFE	77.12±4.18	84.06±1.31	83.13±1.44	83.92±1.31	80.27±0.2	79.04±2.76	80.45±0.39		NS
DOM	81.95±2.62	85.26±0.33	85.52±1.15	86.42±0.99	83.70±0.18	82.59±1.85	84.14±0.42		NS
Ash R	76.12±5.15	80.20±2.29	82.45±1.16	82.96±1.73	79.63±1.09	76.01±1.72	81.94±0.48		NS
NR	82.59±2.94	82.46±0.47	83.54±1.78	83.34±1.37	81.15±0.44	79.26±3.22	82.70±0.96		NS
AME	3428.4±94.5	3494.28±37.17	3545.7±48.86	3591.99±37.38	3492.64±8.17	3450.47±66.3	3508.77±16.61		NS

DCP= Digestible Crude Protein; DCF= Digestible Crude Fiber ; DEE= Digestible Ether Extract ;DNFE= Digestible Nitrogen Free Extract ; DOM= Digestible Organic matter

Ash R= Ash Retention ; NR = Nitrogen Retention .; AME = Apparent Metabolizable Energy .

a, b..... means with different superscripts in the same row are significantly different at ($p<0.05$). NS = not significant.

Table (4): Carcass Characteristics as affected by different dietary levels of L-carnitine(LC) and Herbal mixture(HM).

Item	Control	L-Carnitine levels, mg/kg			Herbal mixture levels, g/kg			±SE	Sig.
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
Live body weight ,Kg	2.11	2.17	2.14	2.16	2.18	2.20	2.11	0.03	NS
Carcass ,Kg	1.47^{ab}	1.51^{ab}	1.66^{a}	1.63^{ab}	1.59^{ab}	1.60^{ab}	1.40^{b}	0.07	*
Dressing, %	69.66^{ab}	69.21^{ab}	77.39^{a}	75.10^{a}	72.95^{ab}	75.45^{ab}	66.27^{b}	2.59	*
Blood,%	1.71	2.30	1.75	2.64	2.40	2.47	1.78	0.33	NS
Total giblets,%,	13.23	10.99	13.21	12.91	12.17	13.24	10.99	0.96	NS
Edible giblets,%	4.96^{ab}	4.14^{bc}	4.61^{abc}	4.29^{abc}	4.43^{abc}	5.17^{a}	3.91^{c}	0.27	*
Abdominal fat,%	1.48^{a}	1.04^{ab}	1.34^{ab}	0.93^{ab}	0.70^{b}	0.80^{b}	1.07^{ab}	0.20	*
Head ,%	2.21	2.18	2.09	2.66	2.13	2.16	2.44	0.27	NS
Legs,%	3.75	3.73	3.66	3.60	3.85	3.75	3.39	0.17	NS
Small ints. Length,cm	186.0^{a}	179^{ab}	130^{b}	179^{ab}	179^{ab}	150^{ab}	160^{ab}	14.9	*
Cecum wt., %	0.76^{a}	0.52^{b}	0.80^{a}	0.52^{b}	0.46^{b}	0.57^{b}	0.65^{ab}	0.06	*
Cecum length ,cm	15.50^{ab}	15.25^{ab}	15.75^{a}	15.25^{ab}	15.0^{ab}	13.75^{b}	15.0^{ab}	0.55	*
Ileum pH	5.75^{c}	6.98^{a}	5.83^{bc}	6.78^{ab}	6.18^{abc}	5.68^{c}	6.23^{abc}	0.31	*
Cecum pH	5.23	5.73	5.78	5.75	5.38	5.23	5.53	0.43	NS

a, b..... means with different superscripts in the same row are significantly different at (p<0.05). *NS = not significant.*

weight (kg) ,(1.66,1.63,1.59 and 1.60 , *respectively*) however, these values were higher than that of the control group (1.47kg).

Concerning percentage of abdominal fat, groups fed 10,15 g HM/kg diet significantly ($P<0.05$) recorded the lowest percentage compared with the control and other experimental groups .This may be due to HM included oregano which decreased malondialdehyde in meat (Botsoglou et al.,2002) .Also, *thymol. carvacrol, eugenol* and *anothole* and other active ingredients in this formula of herbal mixture (HM) may increased muscle alpha-tocopherol which is an important factor influencing lipid oxidation (Papageorgiou,2003). Meanwhile, insignificant ($P<0.05$) differences were detected between the group fed 15 g HM/kg diet (T_6) control and L-carnitine groups (T_1,T_2,T_3).

Regarding ileum pH (Table 4),the results showed significantly ($P<0.05$) improvements in ileum pH of the HM groups more than the control and L-carnitine groups due to some active ingredients in herbal mixture that improve the environment of digestive tract. These results are in agreement with obtained by (Ather, 2000 ; Williams and Losa, 2001and Alçiçek *et al.*, 2003) who reported that essential oils derived from different aromatic plants improved feed intake, feed conversion ratio and carcass yield .

The values of cecum pH showed that no significance differences were noticed among the control and experimental groups.

Blood parameters:

Data of blood parameters as affected by dietary different levels of L-carnitine and herbal mixture for experimental broilers are shown in Table (5) . There was a significant effect of LC or HM level on serum antioxidant capacity ,urea, albumin, globulin ,total protein, globulin, AST, and ALT. Results of antioxidant capacity indicated that group fed 15 g HM/kg diet (T_6) significantly ($P<0.05$) was the best value of Antioxidant Capacity (0.986 mmol/L) compared with control and other experimental groups. That is may be due to high level contents of HM ingredients from Antioxidant substances.(Miura *et al.*,2002; Ali *et al* .,2007 and Abdel-Rahman *et al.*, 2008) .This improvement may be due to the appetizing effect of active ingredient (such as *carvacrol, thymol,eugenol* and *anethole*) (Çabuk *et al.*, 2003).

The essential oils of oregano plants, is well known for its antioxidative activity (Economou *et al.*, 1991). Carvacrol and thymol, the two main phenols that constitute about 78-82% of the essential oil of oregano, are principally responsible for this activity (Adam *et al.*, 1998).

Results indicated that diets supplemented with Herbal mixture (HM) significantly improved blood values of albumin, total cholesterol and triglycerides compared to control and L-carnitine groups. These results confirmed that broiler diets supplemented Herbal mixture (HM) is the best natural resources to produce a good quality of meat and improve stored chicken meat. Several recent reports have shown that extracts of rosemary and sage (Lopez-Bote *et al.*, 1998), oregano essential oil (Botsoglou *et al.*, 2002; 2003a), and a blend of several essential oils (Botsoglou *et al.*, 2004) improved the oxidative stability of stored chicken meat when added in diets. However, in turkeys, only the essential oil of oregano has been yet investigated as an antioxidant feed supplement (Botsoglou *et al.*, 2003b).

Table (5): Blood parameters as affected by different dietary levels of L-carnitine(LC) and Herbal mixture(HM).

Item	Control	L-Carnitine levels, mg/kg			Herbal mixture levels, g/kg			±SE	Sig.
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
Antioxidant Capacity, mmol/l,	0.396^{d}	0.453^{d}	0.558^{c}	0.648^{c}	0.583^{c}	0.826^{b}	0.986^{a}	0.035	*
Urea ,mg/dl	4.97^{a}	4.97^{a}	3.22^{abc}	4.79^{a}	1.73^{c}	3.93^{ab}	2.14^{bc}	0.61	*
Albumin ,g/dl	2.04^{ab}	2.02^{a}	2.13^{a}	2.10^{a}	1.71^{c}	1.55^{c}	1.80^{bc}	0.09	*
Total Protein ,g/100ml	3.74^{ab}	3.95^{ab}	4.28^{a}	3.36^{bc}	2.34^{d}	3.93^{ab}	2.74^{cd}	0.25	*
Globulin ,g/dl	1.71^{abc}	1.93^{ab}	2.16^{a}	1.26^{bcd}	0.63^{d}	2.38^{a}	0.94^{cd}	0.25	*
Albumin/Globulin ratio	1.36^{bc}	1.07^{bc}	1.00^{bc}	2.22^{ab}	2.78^{a}	0.66^{c}	1.99^{abc}	0.41	*
Total Cholesterol ,mg/dl	148.78^{ab}	122.52^{c}	158.51^{a}	135.9^{abc}	82.78^{d}	128.12^{bc}	118.32^{c}	7.24	*
Triglycerides ,mg/dl	137.35^{b}	139.75^{b}	147.58^{a}	149.43^{a}	133.41^{b}	135.62^{b}	137.69^{d}	2.28	*
Alanine amino transferase AST (u/L)	8.00	6.00	6.67	6.00	5.00	6.67	5.00	1.37	NS
Aspartate amino transferase ALT (u/L)	19.33^{b}	80.67^{a}	78.67^{a}	76.33^{a}	72.33^{a}	22.76^{b}	25.00^{b}	4.39	*

a, b..... means with different superscripts in the same row are significantly different at ($p<0.05$). NS = not significant

Table (6): Immunity and Total bacterial Counts (*cfu*) of broilers as affected by dietary levels of L-carnitine (LC) and Herbal mixture (HM).

Item	Treatments							±SE	Sig.
	Control	L-carnitine levels, mg/kg			Herbal mixture levels, g/kg				
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
Haemagglutination Inhibition Test ,HI	7.42 ^{a}±0.20	7.19 ^{a}±0.21	7.71 ^{a}±0.21	7.63 ^{a}±0.22	6.35 ^{b}±0.19	7.16 ^{a}±0.2	7.25 ^{a}±0.19		*
Total bacterial count For:	38.00 ^{c}	48.20 ^{c}	38.80 ^{a}	106.4 ^{a}	71.60	30.0^{c}	48.00^{bc}	8.58	*
Nutrient agar									
Maconkey agar	45.60 ^{ab}	46.0 ^{bc}	22.04 ^{bc}	71.2 ^{a}	2.00^{c}	0.20^{c}	30.00^{bc}	9.74	*
Sabouroud agar	32.80 ^{c}	103.80 ^{b}	2.80 ^{d}	62.00^{b}	16.00^{cd}	7.2^{cd}	23.80^{cd}	9.23	*
Salmonella *Spp.*	1.00 ^{b}	0.20 ^{b}	3.0 ^{a}	0.20^{b}	0.40^{b}	0.20^{b}	0.40^{b}	0.44	*
E. Coil	0.80	0.40	0.40	0.20	0.40	0.20	0.20	0.25	NS

a, b..... means with different superscripts in the same row are significantly different at ($p<0.05$). *NS = not significant*

Insignificant differences were detected between groups supplemented Herbal mixture (HM), LC and control with respect to AST, While, groups supplemented 10 and15g/ kg (HM)(T_5, T_6) significantly ($P<0.05$) achieved better results of ALT than LC groups (22.76 and 25u/L *vs* 80.67 ;78.67 and 76.33 u/L, *respectively*)

On the other hand, Mahmoud and El-Sahn (2005) studied the effect of medicinal plants mixture of fenugreek seeds, anise and pollen grains (FAP) as a natural feed additives on the performance of local Baheij chickens strain and noticed that no significant difference in level of AST, ALT and AST/ALT existed between all groups.

Microbiological Studies and Immune Response:

Results in Table (6), show the effect of dietary different levels of LC and HM for experimental broilers on Haemagglutination Inhibition test (HI) and some measurements of total bacteria counts. No significant ($P<0.05$) differences among HI values for the control, LC groups and groups fed 10,15 g HM/kg diet were observed , Meanwhile, HI value of the group fed 5 g HM/kg recorded significantly ($P<0.05$) the lowest value (6.35) . Similar findings on immune response were reported by Elgayyar *et al.* ,2001;Jamroz and Kamel,2002 and Abdel-Rahman *et al.*, 2008).

Results concerning total bacterial counts showed that broiler group fed diet supplemented with 1.5 kg/ton HM recorded significantly ($P<0.05$)the lowest values(as cfu)of total bacterial counts compared to LC or control groups that is may be due to antimicrobial activity for many of volatile oils including in HM ingredients (Singh *et al* ., 2002 ; Vlero and Salmeron,2003 and Abdel-Rahman *et al.*,2008). Also, Parvu(2008) detected that essential oils from aromatic plants have an antimicrobial activity against many bacterial pathogens.

In this concern, Deans and Ritchie (1987) and Hammer *et al.*, (1999) detected that volatile oil of many plants are known to have antimicrobial activity many researchers interest has focused on various herbs that possess immune simulating properties that may be useful to reduce the risk, and to their antimicrobial activity .

Craig (1999) noticed that various herbs that have hypolipidemic, antiplatelet, antitumor or immune-stimulating properties may be useful for the reducing of the cardiovascular disease and cancer risk.

Lavina *et al.*, (2009) shows that essential oils extracted from plants improve the immune response and also are able to cause changes of the duodenal mucosa with beneficial effects for the animal.

Oreganoleptic properties of broilers meat:

Data of Oreganoleptic properties of broilers meat as affected by dietary levels of LC and HM are presented in Table (7). Results indicated that using dietary levels of herbal mixture as a natural feed additives improved Oreganoleptic properties of broiler meat such as color ,taste, aroma, and texture compared to LC and control groups that's may be due to herbal mixture contents of volatile oils .

Table (7): Oreganoleptic properties of broiler's meat as affected by dietary levels of L-carnitine (LC) and herbal mixture (HM).

Item	Control	L-carnitine levels, mg/kg			Herbal mixture levels, g/kg			±SE	Sig.
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)		
color	5^{d}	6^{cd}	7^{bc}	7^{bc}	8^{b}	10^{a}	7.5^{bc}	0.46	*
Taste	6.75^{b}	6^{b}	7.25^{ab}	7^{ab}	7.5^{ab}	9.5^{a}	7^{ab}	0.87	*
Aroma	6	6	6.5	6.75	8.75	8.75	8.25	1.11	NS
Texture	7.25	7.25	7.00	7.50	7.25	9.25	8.19	1.22	NS
Overall acceptability	6.31^{b}	6.31^{b}	7.94^{b}	7.06^{b}	7.88^{ab}	9.38^{a}	7.73^{ab}	0.67	*

a, b..... means with different superscripts in the same row are significantly different at ($p<0.05$). NS = not significant

Economic Efficiency (EEf):

The Economic Efficiency of dietary treatments is presented in Table (8). The profitability of using L.carnitine or herbal mixture as feed additive in broiler diets depends upon the price of one kg of LC or HM and the growth performance of broiler fed these dietary additives. The total revenue of the groups fed 10 mg/kg LC and the group fed 5g/kg HM appeared to be equal compared with the control group. (14.73, and 14.73 *vs. 14.54, respectively*). While, the groups fed HM with 10g/kg improved total revenue by 3.23% over the control group. The best total and net revenue was obtained from the groups fed 10g/kg HM (T_5). Concerning economic efficiency ratio, groups fed 10 g HM/Kg(T_5) achieved the best results compared with LC and control groups (1.59 *Vs*1.51,1.35, 1.21and 1.36, respectively), Meanwhile, the worst economic efficiency value (1.20) was recorded for the group fed 30 mg LC/Kg.

Moreover, relative economic efficiency showed the same trend of economic efficiency ratio hence, the groups (T_5) fed 10g/kg HM recorded the highest relative economic efficiency (116.91%) compared to the other experimental groups and the control group (Table 8). These results are in agreements with those obtained by Abd El Rahman *et al.* (2008) using the same feed additives (LC and HM) with broiler breeder laying hens.

Similar results were obtained by Abdel-Azeem (2006) who reported that the addition of fennel into broiler diets increased the percent of EEF than those received un-supplemented diet through the whole experimental period. This was due to the improvements in LBW and FC for broilers fed dietary levels of fennel (Abdel-Azeem (2002) . Also, Abdel-Latif *et al.* (2004) reported that, using herbs and medicinal plants in broiler and Japanese quail diets increased EEf.

Simsek et al., (2007) concluded that the advantage of herbal mixture helping to reduce feed costs involved in broiler production.

CONCLUSION

1) Addition of herb mixture (as a natural antioxidant) to broiler diets numerically increased digestibility, live body weight and improved feed conversion more than L-carnitine.

2) Inclusion dietary levels of HM in broiler diets up to 1.5 kg/ton improved significantly final live body weight and live body weight gain .

3) Addition of herb mixture improved antioxidant capacity; ALT and AST while decreased, total cholesterol, triglyceride and total lipids in blood plasma.

4) From economical point of view, the supplementation of 1.5kg/ton Herbal mixture achieved the best results of economic efficiency ratio and relative economic efficiency percent compared with the LC and control groups.

5) More researches are necessary to characterize the medicinal aromatic plants and higher levels of Herbal mixtures with regard to their effects on digestibility, amino acid profile, toxins, colonization and proliferation of microorganisms in the broiler intestine and contents of anti-nutritional factors.

Table (8): Economic efficiency of broilers as affected by dietary different levels of L-carnitine(LC) and Herbal mixture(HM).

Item	Control	L-carnitine levels, mg/kg			Herbal mixture level, g/kg		
	(T_0)	10(T_1)	20(T_2)	30(T_3)	5(T_4)	10(T_5)	15(T_6)
Ave. feed intake, kg/hen/period(a)	2.87	2.67	2.73	2.88	2.67	2.60	2.56
Price /kg feed (PT)*(b)	215	220	225	230	219	223	227
Total feed cost (LE) axb= c	6.17	5.87	6.14	6.62	5.85	5.80	5.81
Live body weight gain ,kg/period (d)	1.53	1.55	1.52	1.53	1.55	1.58	1.45
Broiler meat price/kg (LE)** (e)	9.50	9.50	9.50	9.50	9.50	9.50	9.50
Total revenue /chick/period (d×e=f)	14.54	14.73	14.44	14.55	14.73	15.01	13.78
Net revenue (LE) (f-c=g)	8.37	8.86	8.30	7.93	8.88	9.21	7.97
Economical efficiency*** (g/c)	1.36	1.51	1.35	1.20	1.52	1.59	1.37
Relative economical efficiency %****	100	111.03	99.26	88.34	111.77	116.91	100.74

* *According to the price of different ingredients available in the market at the experimental period.*

** *According to the local market price at the experimental period.*

*** *Net revenue per unit cost.*

**** *Group fed control diet (1) =100%.*

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الأداء الإنتاجى لدجاج اللحم المغذى على علائق تحتوى على مستويات مختلفة من ل- كارنتين أو مخلوط الأعشاب

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اجريت هذه الدراسة لتقدير الأداء الانتاجى ومعدلات الهضم ومكونات سيرم الدم وصفات الذبيحة ومقاييس المناعة وخصائص القناه الهضمية لدجاج اللحم المغذى على علائق تحتوى على مستويات مختلفة من الكارنتين أو مخلوط الأعشاب الطبية كمنشطات نمو طبيعية .

تم استخدام ٥٤٦ كتكوت تسمين عمر أسبوع واحد سلالة (روص ٣٠٨) وزعت عشوائيا إلى سبعة معاملات بكل معاملة ثلاثة مكررات ،بكل مكرر ٢٦طائر . تم تغذية مجموعة المقارنة (T_0) على العليقة الأساسية. تم إضافة الكارنتين إلى علائق المجموعات التجريبية الثلاث الأولى بمستويات ١٠و٢٠و٣٠ جزء في المليون(T_1,T_2 and T_3) بينما تم إضافة مخلوط الأعشاب الطبية إلى علائق الثلاث معاملات الأخرى بمستويات ٥و١٠و١٥ جم /كجم علف (T_4 ,T_5 and T_6) على الترتيب.

أظهرت نتائج وزن الجسم الحي والزيادة الكلية في الوزن ، للكتاكيت في الفترة من عمر ٧ حتى ٤٢ يوم ،تفوقا لكل من المجموعات المغذاة على الكارنتين ومخلوط الأعشاب، بينما انخفض العلف المأكول ،مقارنة بعليقه المقارنة .و أظهرت المجموعة المغذاة على المستوى الثالث(١٥ جم/كجم علف) من مخلوط الأعشاب أحسن القيم لمعامل هضم الألياف مقارنة بباقي المعاملات. كما سجلت المجموعتان ١٠و١٥ جم مخلوط أعشاب ،مستوى أعلى لمعامل هضم الدهون في العليقة من عليقه المستوى الأول كارنتين . و سجلت المجموعتان الأولى والثانية للكارنتين أحسن القيم لمعامل التحويل الغذائي بينما حققت المعاملة الأولى كارنتين والثانية والثالثة مخلوط أعشاب أعلى القيم لدليل الإنتاج . و سجلت معاملات مخلوط الأعشاب معنويا قيم اقل لكل من دهن البطن، والكولسترول، والجلسيريدات الثلاثية ،وإنزيمات الكبدفى بلازما الدم فضلا عن الوزن ودرجة الحموضة للأعور، مقارنة بعلائق الكارنتين، ومجموعة المقارنة .بينما لم تسجل اى اختلافات معنوية بين علائق المقارنة والكارنتين، والمجموعة الثانية والثالثة مخلوط أعشاب بالنسبة لاختبار تكوين الأجسام المضادة في الجسم ضد النيوكاسل ، بينما أظهرت المجموعة المغذاة على المستوى الثاني مخلوط أعشاب معنويا اقل القيم لاختبار تكوين الأجسام المضادة في الجسم ضد النيوكاسل مقارنة بباقي المعاملات. و حققت المجموعة المغذاة على المستوى الثاني مخلوط أعشاب أحسن القيم في كل من عدد البكتريا الكلي ،والسالمونيلا ،وبكتريا القولون وكذلك لون وطعم ورائحة اللحوم الناتجة .

يمكن التوصية من هذه الدراسة ،أن إضافة مخلوط الأعشاب الطبية كمنشطات نمو طبيعية يمكن أن يتفوق في الأداء الانتاجى ومعاملات الهضم وصفات الذبيحة واختبارات المناعة وخصائص القناة الهضمية لدجاج التسمين مقارنة بمنشطات النمو الصناعية مثل الكارنتين .