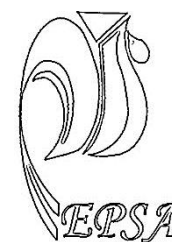


Egyptian Poultry Science Journal

<http://www.epsaegypt.com>

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



**PRODUCTIVE PERFORMANCE AND IMMUNE RESPONSE OF
BROILER CHICKS AS AFFECTED BY DIETARY MARJORAM
LEAVES POWDER**

A. H. H. Ali,

Anim. and poult. Prod. Dep., Fac. of Agric., South Valley Univ., Qena, Egypt

Received: 16/01/2014

Accepted: 02/02/2014

ABSTRACT: Ninety six unsexed one-day old, Ross 308 broiler chicks, were randomly divided into 4 treatment groups. Each treatment had 3 replicates with 8 chicks each. The chicks of each replicate were allocated in a cage. The basal experimental diets had 24 and 22% crude protein and 3009 and 3135 Kcal ME/kg diet for the starter and the grower diet, respectively. The experiment was included four treatments, treatment 1; chicks were fed on basal diet without any addition (control). Whereas, in treatments 2, 3 and 4 chicks were received 0.5%, 1.0% and 1.5% marjoram leaves powder (*Origanum marjorana*), respectively.

Supplementing the broiler diet with marjoram leaves powder increased significantly ($P<0.05$) Live body weight (BW) at 21 and 42 days of age, daily body weight gain (BWG) at all periods and globulin than the control group. Moreover, addition of marjoram improved ($P<0.05$) feed conversion ratio (FCR) at all periods and decreased significantly ($P<0.05$) daily feed intake (FI) at 4-6 and 0-6 weeks of age, albumin and albumin/ globulin ratio in the treated groups as compared with control group. Conversely, supplementing the broiler diets with marjoram leaves powder had no significant effect on feed intake (FI) at 0-3 weeks of age, hematocrit HCT, hemoglobin, glucose, total protein, cholesterol, LDL cholesterol, HDL cholesterol, heterophils (H), lymphocytes (L), monocytes, H/L ratio, averages of serum haemagglutinin antibody (Ab.) titers against SRBC's at 6 weeks of age and spleen and bursa percentages. Overall, these data indicate that, supplementing marjoram into the broiler diets improved productive performance but it did not affect the immune response.

Key Words: Marjoram leaves, immune response, productive performance.

Corresponding author: attai73@yahoo.com

INTRODUCTION

Antibiotic feed additives have long been used as growth promoters in poultry nutrition. However, concern has been expressed about the potential development of antibiotic resistant bacteria (Sarica et al., 2005). Consequently, the animal feed industry, exposed to increasing consumer pressure to reduce the use of antibiotic growth promoters (AGPs) in poultry diets, has to find alternative feed additives (Humphrey et al., 2002; Botsoglou et al., 2004). Herbs could be used as alternatives to AGPs in poultry nutrition due to their antimicrobial properties. Many herbs and their bio-active constituents possess a broad antimicrobial activity (Dorman and Deans, 2000; Kamel, 2001; Tucker, 2002; Cross et al., 2003; Lewis et al., 2003). Scientific evidence exist that herbs and plant extracts stimulate the growth of beneficial bacteria and minimize pathogenic bacterial activity in the gastrointestinal tract of poultry (Gill, 1999; Lanhout, 2000; Wenk, 2000).

The genus *Origanum majorana* L. is an aromatic, perennial, herbaceous plant belonging to the family Lamiaceae. The plant has been used as a flavoring and herbal spice from time immemorial. Steam distillation of leaves and flower heads yields a volatile oil, known in the trade as oil of Sweet marjoram, widely used in flavoring food and also in perfumery. Medicinally it is used in both Ayurveda and Yunani system to cure various human ailments Leeja and Thoppil, (2007). Marjoram (*Origanum marjorana*) is a very popular and a common medicinal plant Ezz El-Arab (2008). It contains about 0.5-3% oil. The main chemical composition of marjoram oil is Borneol, Terpinene, Pinene, Sabinene and Terpineol (Banchio et al., 2008). The plant is pungent, bitter, hot, stomachic, anthelmintic, useful in diseases of the heart and blood, fevers and inflammation (Kirtikar and Basu, 1985). An infusion of the plant is used as a

stimulant, sudorific and also useful in asthma, hysteria and paralysis (Farooqi and Sreeramu, 2004). The plant is reported to possess antibacterial activity (Ben et al., 2001; Farooqi and Sreeramu, 2004).

The present study was carried out to investigate the effect of adding different levels of marjoram leaves powder into broiler diets on the productive performance and immune response of broiler chicks.

MATERIALS AND METHODS

This study was carried out at the Poultry Farm, Department of Animal and Poultry Production, Faculty of Agriculture, South Valley University, Qena. It was designed to evaluate the effects of adding different levels of marjoram leaves powder (*Origanum Marjorana*) into broiler diets on the productive performance (body weight, daily gain, feed intake and feed conversion) and immune responses of broiler chicks.

1. Chicks and Housing:

Ninety six unsexed one-day old; Ross 308 broiler chicks were obtained from a commercial local source and used in this study. Chicks were randomly divided into 4 treatment groups. Each treatment had 3 replicates with 8 chicks each (4 treatments X 3 replicates X 8 chicks = 96 chicks). Chicks in each replicate within each treatment had nearly similar initial live body weight (50 ± 2 gm). Chicks were reared in two-tier wire floor battery in a windowless house including ventilation systems and heater that functions as needed, most often with micro-processor controls. The chicks of each replicate were allocated in a cage with slatted floor of iron.

2. Diets and management:

The experimental period was divided into two feeding phases, starter (from 0-3 weeks of age) and grower (from 4-6 weeks of age). The basal experimental diets had 24 and 22% crude protein and

Marjoram leaves, immune response, productive performance

3009 and 3135 Kcal ME/kg diet for the starter and the grower diet, respectively (Table 1). Experimental diets were formulated to meet the nutrients requirements of the broiler chicks (National Research Council, NRC, 1998).

Chicks have full access to feed and water during the experimental period. Artificial light was applied to maintain 23 hrs. light per day during the experimental period. The environmental temperature was about 32° C during the first week old and it was gradually reduced by about 2° C

weekly until about 24° C at the fourth week up to the end of experiment (at 6 weeks of age).

The experiment was included four treatments, treatment 1; chicks were fed on basal diet without any addition (control). Whereas, in treatments 2, 3 and 4 chicks were received 0.5%, 1.0% and 1.5% marjoram (*Origanum Marjorana*) leaves powder, respectively. Chemical composition of marjoram leaves is presented in Table (2).

Table (1): Composition of the starter and grower basal diets.

Ingredients	Starter	Grower
Yellow corn	52.59	56.04
Soybean meal (44% CP)	32	30
Corn gluten (60% CP)	9	6
Vegetable oil	2	4
Premix*	0.3	0.3
Dicalcium phosphate	2	1.8
Limestone	1	1
Lysine	0.3	0.2
Methionine	0.25	0.125
Choline chloride	0.2	0.175
Salt	0.36	0.36
Total	100	100
Calculated values		
Crude protein %	24	22
ME (Kcal/kg)	3009	3135
Calcium %	0.91	0.86
Av. Phosphorus %	0.48	0.43
Methionine	0.74	0.55
Lysine %	1.45	1.27

*Vitamins and minerals premix provided per kilogram of the diet: Vit A, 1000 IU; D3 2000 ICU; Vit E, 10 mg; Vit K, 1mg; B1, 10 mg; B2, 5 mg; B6, 1500 mg; B12, 10mg Pantothenic acid, 10 mg; Nicotinic acid, 30 mg; Folic acid, 1mg; Biotin, 50 mcg; Chloride, 500 mg; copper, 10 mg; iron, 50 mg; Manganese, 60 mg; Zinc, 50mg, and selenium, 0.1 mg.

Table (2): Chemical composition of marjoram leaves powder based on dry matter

Ingredient Chemical composition %	Marjoram
Moisture	7.25
Protein	12.05
Fat	2.98
Ash	9.88
Fiber	16.44
NFE (nitrogen free extract)	51.40
Total	100

3. Hygiene:

Chicks were vaccinated against Newcastle disease three times, firstly with Hitchner B1 on the 7th day of age and twice with Lasota strain in drinking water at 12 and 24 days of age. At 14 and 28 days of age, chicks were vaccinated against infectious bursal disease (Gumboro).

4. Productive performance:

Live body weight and feed intake were recorded at 3 and 6 weeks of age (two periods) for each replicate. Daily body weight gain and feed conversion ratio (gm feed: gm gain) were calculated for each replicate within each period.

There was not any died chick at whole experimental period from any treated group or control group.

5. Physiological measurements:

Fresh blood samples, each of 2 ml, were collected from six chicks (chosen randomly) within each treatment at 5 and 6 weeks of age in heparinized tubes. However, blood samples were betided every time between 8:00 to 8:30 am. The blood samples were collected to determine hematological parameter, hemoglobin (Hb) concentration using hemometer as the method described by Tietz (1982), hematocrit (HCT) according to Winderobe (1967). Two drops of blood from each

sample were smeared on two glass slides. The smears were stained within 2 to 3 hrs. of preparation using May-Gunwale, Giemsa Stains. One hundred leukocytes, including heterophils (H), lymphocytes (L), basophils, eosinophils and monocytes were counted on each slide and H/L ratio was calculated by dividing the number of heterophils by that of lymphocytes as described by Sturkie (1986). Both slides were counted and the mean H/L ratio was calculated for each chick.

At 5 weeks of age, six chicks from each treatment were injected intravenously in the brachial vein with 0.2 ml of 10% suspension of packed sheep red blood cells (SRBC's). Sera were collected on the seventh day post immunization (at 6 weeks of age) and antibody titer against SRBC's was determined using the micro titer procedure described by Van der Zijpp and Leenstra (1980). Titers were expressed as the log₂ of the reciprocal of highest dilution giving complete agglutination. Serum total protein and albumin were determined according to Doumas, (1971); Witt and Trendelenburg (1982). Globulin concentration was calculated as the difference between total protein and albumin, then the ratio of albumin/ globulin was also calculated. Total cholesterol was determined according to (Watson, 1960) and HDL Warnick (1983), LDL Assmann

et al. (1984). Additionally, Plasma Glucose was determined according to the procedure of Coles, (1986).

At 6 weeks of age six chicks (within average weight of treatment) from each treatment groups were slaughtered for estimation weights and percentages of spleen and bursa from live body weight.

6. Statistical Analysis:

Data collected were statistically analyzed by the analysis of variance with the General Linear Model (GLM) procedure of the SAS Institute (SAS, 1996). All statements of significance are based on the 0.05 level of probability. Significant differences among treatments were performed using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Body weight and daily gain:

Data of body weight at 21 and 42 days of age are listed in Table (3). Data showed that all treated groups were significantly ($P < 0.05$) heavier in body weight at 21 days of age than the control group. Moreover, supplementing the broiler diet with marjoram leaves powder had significant ($P < 0.05$) effect on body weight at 42 days of age being the heaviest in the supplemented groups with 1 and 1.5% marjoram and lowest one was the control group even from supplemented group with 0.5% marjoram. The results are in agreement with Ezz El-Arab, (2008) and Mona Osman et al. (2010) who noted that, at 28 and 42 days of age chicks fed either rosemary, marjoram or sweet basil containing basal diets at the upper level (1g/kg) had a higher body weight means

than those received the same studied feed additives at the lower level of 0.5g/kg. Also, treatment of Marjoram (1g/kg) supplementation during growth periods of 42 days old gave the best score when compared with the corresponding treatments by an increment of 14.88, 5.23 and 2.42% over those of the control, Rosemary and Sweet Basil, respectively.

Obtained data of daily body weight gain at 0-3, 4-6 and 0-6 weeks of age in Table (3) indicated that treatment with marjoram increased ($P < 0.05$) daily body weight gain during all periods than the control group. Also, supplemented groups with 1.0 and 1.5% marjoram achieved the greatest body weight gain during 4-6 and 0-6 weeks of age. The results are in agreement with Ezz El-Arab, (2008) and Mona Osman et al. (2010). This may be due to the ability of marjoram to increase the efficiency of digestion by increasing digestive enzymes and saliva, calming the stomach and digestive system, improving appetite, curing or preventing basic intestinal infections and relieving diarrhea and constipation. This is in agreement with those mentioned by Hallnet, (2014). Ezz El-Arab, (2008) mentioned that, ability of natural feed additives to enhance broiler's appetite, is due to the fact that it is rich in a wide variety of secondary metabolites, such as, terpenoids, which have been found to have antimicrobial properties (Cowan, 1999), and antioxidant activity (Triantaphyhou et al., 2001), which in turn improves the lower gut health, bacterial population, improves nutrients absorption, utilization and eventually improves bird's health and increases body weight and weight gain.

Table (3): Averages \pm (SE) of body weight (gm) and daily body weight gain (gm) as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Body weight (gm)		Daily body weight gain (gm)		
	21 days	42 days	0 – 3 weeks	4 – 6 weeks	0 – 6 weeks
0	810.4 \pm 5.51 ^b	2320.4 \pm 5.61 ^c	36.2 \pm 0.26 ^b	71.9 \pm 0.51 ^c	54.1 \pm 0.13 ^c
0.5	839.6 \pm 5.51 ^a	2460.4 \pm 9.08 ^b	37.6 \pm 0.26 ^a	77.2 \pm 0.19 ^b	57.4 \pm 0.22 ^b
1.0	849.2 \pm 4.35 ^a	2516.7 \pm 11.02 ^a	38.1 \pm 0.21 ^a	79.4 \pm 0.33 ^a	58.7 \pm 0.26 ^a
1.5	852.1 \pm 2.08 ^a	2511.7 \pm 12.94 ^a	38.2 \pm 0.10 ^a	79.0 \pm 0.52 ^a	58.6 \pm 0.31 ^a

Means within each column bearing different letter(s) are significantly different ($P < 0.05$)

2. Feed intake and feed conversion ratio:

Data of feed intake at 0-3, 4-6 and 0-6 weeks of age are listed in Table (4). Data explained that supplementing the broiler diet with marjoram leaves powder had no significant effect on feed intake during the period from 0-3 weeks of age. On the other hand, at 4-6 and 0-6 weeks of age treated groups achieved the lowest ($P < 0.05$) feed intake as compared with control group. The results are in agreement with Ezz El-Arab, (2008) and Mona Osman et al. (2010) who revealed that chicks received basal diets with either levels of Rosemary, 0.5g/kg of Marjoram or Sweet Basil supplementation consumed the lowest ($P < 0.05$) amounts comparing with that of the control.

Also, supplementing the broiler diet with marjoram leaves powder improved ($P < 0.05$) feed conversion ratio during the all periods as compared with the control group. Also, supplemented groups with 1.0 and 1.5% marjoram achieved the best value of feed conversion ratio during 4-6 and 0-6 weeks of age. The results are in agreement

with Ezz El-Arab, (2008) and Mona Osman et al. (2010) who stated that, broilers fed the control (un-supplemented) diet had the worst feed conversion ratio of 1.89 compared with chicks received diets of the upper level of Marjoram 1.58 being the best. However, no significant differences was observed in this regard between chicks fed diets supplemented with either Marjoram (0.5 g / kg) of 1.60, Sweet Basil (0.5g/kg) of 1.61 or Rosemary (0.5 or 1 g / kg) of 1.62 and 1,63, respectively.

As mentioned before, this may be due to the ability of marjoram to increase the efficiency of digestion by increasing digestive enzymes and saliva, calming the stomach and digestive system, improving appetite, curing or preventing basic intestinal infections and relieving diarrhea and constipation which resulting in maximizes the benefit of feed without increase in feed intake. Abaza (2001) showed that mixture of medicinal plants containing diets improved the digestibility of nutrients.

Table (4): Averages \pm (SE) of daily feed intake (gm) and feed conversion ratio as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Daily feed intake (gm)			Feed conversion ratio		
	0 – 3 weeks	4 – 6 weeks	0 – 6 weeks	0 – 3 weeks	4 – 6 weeks	0 – 6 weeks
0	57.8 \pm 0.48	150.7 \pm 0.71 ^a	104.3 \pm 0.31 ^a	1.60 \pm 0.007 ^a	2.10 \pm 0.005 ^a	1.93 \pm 0.003 ^a
0.5	57.2 \pm 0.66	142.3 \pm 0.66 ^b	99.7 \pm 0.42 ^b	1.52 \pm 0.022 ^b	1.84 \pm 0.006 ^b	1.74 \pm 0.004 ^b
1.0	56.9 \pm 0.20	141.6 \pm 0.68 ^b	99.3 \pm 0.43 ^b	1.50 \pm 0.013 ^b	1.78 \pm 0.015 ^c	1.69 \pm 0.015 ^c
1.5	56.9 \pm 0.23	141.1 \pm 0.30 ^b	98.9 \pm 0.18 ^b	1.49 \pm 0.008 ^b	1.79 \pm 0.008 ^c	1.69 \pm 0.007 ^c

Means within each column bearing different letter(s) are significantly different (P<0.05)

3. Physiological parameters:

3.1. Hematocrit, hemoglobin and glucose:

Obtained data of hemoglobin content, hematocrit percentage and glucose level in Table (5) indicated that, marjoram supplementation in broiler diets did not have any effect on hemoglobin content,

hematocrit percentage and glucose level at 35 and 42 days of age. The results are in agreement with Ezz El-Arab, (2008) and Mona Osman et al. (2010) stated that fed basal diets with Marjoram supplementation did not adversely affect the hemoglobin concentration, hematocrit percent and glucose concentration.

Table (5): Averages \pm (SE) of hematocrit, hemoglobin and glucose as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Hematocrit %		Hemoglobin %		Glucose (mg/ dl)	
	35 days	42 days	35 days	42 days	35 days	42 days
0	29.0 \pm 0.58*	29.7 \pm 0.33	8.6 \pm 0.69	9.0 \pm 0.66	205.1 \pm 2.32	206.7 \pm 2.15
0.5	30.7 \pm 0.67	30.0 \pm 0.58	9.7 \pm 0.35	9.8 \pm 0.60	207.8 \pm 3.81	205.7 \pm 2.86
1.0	30.0 \pm 0.58	30.3 \pm 0.33	9.9 \pm 0.45	10.2 \pm 0.55	209.5 \pm 3.74	210.6 \pm 2.83
1.5	31.3 \pm 0.67	31.0 \pm 0.58	10.6 \pm 0.38	10.8 \pm 0.66	213.9 \pm 1.65	217.7 \pm 3.85

* P>0.05

3.2. Total protein, albumin, globulin and albumin/globulin ratio:

Data of serum total protein, albumin, globulin and albumin/globulin ratio at 5 and 6 weeks of age are listed in Table (6). Data showed that supplementing the broiler diet with marjoram leaves powder had significant effect (P<0.05) on albumin, globulin and albumin/globulin ratio at 5 and 6 weeks of age being lower in treated groups than the control group in

albumin and albumin/globulin. The opposite is true, marjoram supplementation in broiler diets increased significantly (P<0.05) globulin level in the treated groups than in the control group.

On the other hand, marjoram supplementation in broiler diets did not have any effect on total protein levels at 5 and 6 weeks of age. These results are in agreement with Ezz El-Arab, (2008) and Mona Osman et al. (2010). The significant increase in plasma globulin and significant

decrease in both albumin and albumin/globulin may be due to the active components of the marjoram that may increase globulin level in the blood and

decrease albumin and albumin/globulin. These results are in agreement with those reported by (Stroev, 1989 and Abdo Zeinab et al., 2003).

Table (6): Averages \pm (SE) of serum total protein, albumin, globulin and albumin/globulin ratio as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Total protein (g/ dl)		Albumin (g/ dl)		Globulin (g/ dl)		Alb./Glob.	
	35 days	42 days	35 days	42 days	35 days	42 days	35 days	42 days
0	3.5 \pm 0.15	3.0 \pm 0.12	2.3 \pm 0.09 ^a	2.1 \pm 0.15 ^a	1.2 \pm 0.09 ^b	0.9 \pm 0.03 ^b	1.9 \pm 0.11 ^a	2.3 \pm 0.24 ^a
0.5	2.9 \pm 0.07	2.9 \pm 0.09	1.7 \pm 0.09 ^b	1.5 \pm 0.09 ^b	1.3 \pm 0.06 ^b	1.5 \pm 0.09 ^a	1.3 \pm 0.11 ^b	1.0 \pm 0.11 ^b
1.0	3.1 \pm 0.14	3.1 \pm 0.14	1.5 \pm 0.03 ^b	1.6 \pm 0.03 ^b	1.6 \pm 0.17 ^{ab}	1.5 \pm 0.15 ^a	0.9 \pm 0.13 ^{bc}	1.1 \pm 0.13 ^b
1.5	3.3 \pm 0.06	3.2 \pm 0.18	1.5 \pm 0.09 ^b	1.4 \pm 0.07 ^b	1.8 \pm 0.12 ^a	1.8 \pm 0.23 ^a	0.8 \pm 0.10 ^c	0.8 \pm 0.14 ^b

Means within each column bearing different letter(s) are significantly different (P<0.05)

3.3. Cholesterol, LDL-cholesterol and HDL-cholesterol:

Data of serum cholesterol, LDL-cholesterol and HDL- cholesterol at 5 and 6 weeks of age are listed in Table (7). Data showed that no significant influence of experimental diets on cholesterol, LDL-cholesterol and HDL- cholesterol. Ezz El-Arab, (2008) obtained that adding the grounds of Rosemary, Marjoram and Sweet Basil did not significantly affect any of blood cholesterol (mg/dl), triglycerides (mg/dl), glutamic oxaloacetic transaminase (GOT) (U/L), glutamic pyruvic transaminase (GPT) (U/L), creatinine (mg/dl) and total protein (g/dl), respectively.

The insignificant effect in the present study may be due to small levels of marjoram, although most of natural feed additives such as powdered green tea flower, have inhibition effect on lipid metabolism by interfering with micelles solubilization of cholesterol in digestive tract which in turns decreased cholesterol absorption and increased the excretion of fecal bile acid cholesterol (Yang and Koo, 2000). Also, green tea like most of natural feed additives reduced pancreatic lipase activity and gastric lipase which resulted in a drastic decrease in gastric lipase that causes inhibition of digestive lipids and so likely to reduce fat digestion (Deng et al., 1998).

Table (7): Averages \pm (SE) of serum cholesterol, LDL-cholesterol and HDL- cholesterol as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Cholesterol (mg/ dl)		LDL (mg/ dl)		HDL (mg/ dl)	
	35 days	42 days	35 days	42 days	35 days	42 days
0	127.9 \pm 1.50*	128.3 \pm 0.86	39.9 \pm 0.55	37.9 \pm 0.58	66.6 \pm 0.66	74.3 \pm 1.33
0.5	124.6 \pm 1.76	126.8 \pm 1.35	38.4 \pm 0.87	39.1 \pm 0.65	67.6 \pm 0.56	75.6 \pm 1.22
1.0	125.4 \pm 1.85	124.9 \pm 1.09	38.8 \pm 0.50	37.9 \pm 0.81	69.5 \pm 0.78	77.9 \pm 1.09
1.5	124.6 \pm 2.08	127.5 \pm 1.37	39.6 \pm 0.33	38.5 \pm 0.58	68.8 \pm 0.66	78.8 \pm 1.61

* P>0.05

3.4. Monocytes (M), heterophils (H), lymphocytes (L) and H/L ratios:

Percentages of white blood cells: monocytes (M), heterophils (H), lymphocytes (L) and H/L ratios are presented in Table (8). Data explained that the differences between all treated groups and control were not significant. These results are in agreement with those reported by (El-Sherbiny et al., 1990, Abdel-Azeem,

2001, Soliman, 2003) of which, feeding broiler chickens different feed additives did not significantly affect blood constituents. While Ezz El-Arab, (2008) stated that, H/L ratio was significantly increased due to treatments of Marjoram at level 1g/kg diet compared with those of Sweet Basil levels and Marjoram (0.5g/kg) and that of the control and attributed it to enhance cellular functions due to studied feed additives supplementation.

Table (8): Averages \pm (SE) of percentage white blood cells differentiation: monocytes (M), heterophils (H), lymphocytes (L) and H/L ratio as affected by the addition of marjoram leaves powder into broiler chick diets.

Items Treat.	Lymphocytes		Heterophils		Monocytes		H/L ratio	
	35 days	42 days	35 days	42 days	35 days	42 days	35 days	42 days
0	56.3 \pm 0.67*	60.3 \pm 0.33	28.3 \pm 0.33	28.7 \pm 0.33	5.3 \pm 0.33	4.3 \pm 0.33	0.50 \pm 0.006	0.48 \pm 0.005
0.5	57.3 \pm 0.33	61.0 \pm 0.58	29.3 \pm 0.33	29.3 \pm 0.88	5.7 \pm 0.33	5.0 \pm 0.58	0.51 \pm 0.003	0.48 \pm 0.016
1.0	57.3 \pm 0.33	62.0 \pm 0.58	30.3 \pm 0.67	30.3 \pm 0.67	4.7 \pm 0.33	4.7 \pm 0.33	0.53 \pm 0.010	0.49 \pm 0.015
1.5	58.3 \pm 0.33	62.3 \pm 0.33	29.7 \pm 0.33	31.3 \pm 0.67	6.0 \pm 0.58	5.7 \pm 0.33	0.51 \pm 0.009	0.50 \pm 0.013

* P>0.05

3.5. Haemagglutinin antibody (Ab) titers, spleen and bursa percentages:

Averages of serum haemagglutinin antibody (Ab) titers at 6 weeks of age, spleen and bursa percentages are listed in Table (9). Data elucidated that, treatment with marjoram did not show any significant effect on Ab. titers at 6 weeks of age, spleen percentage and bursa percentage. The results of the present study are in contrast to Ezz El-Arab, (2008) who stated that, feeding experimental diets inclusive either Rosemary, Marjoram or Sweet Basil improved the immune status as reflected by ELISA titer compared with that of the

control and attributed the improvement of antibody level against Newcastle disease virus (NDV) may be due to the higher mineral contents of Marjoram, and this might affect the oxygen transportation that is needed for eventually increasing hemoglobin synthesis in the blood (Jones and Bark, 1979). Toghyani et al. (2011) used thyme powder 5g/kg diets and did not find any significant differences of NDV antibody titers compared to the control. Moreover, Toghyani et al.,(2010) did not find any effect of ginger and thyme on the relative weight of bursa and spleen in the broiler chicks.

Table (9): Averages ± (SE) of spleen percentage, bursa percentage and haemagglutinin antibody (Ab) titers against (SRBC's) as affected by the addition of marjoram leaves powder into broiler chick diets.

Treat \ Items	Ab.	Spleen%	Bursa%
0	5.1±0.35*	0.21±0.013	0.15±0.009
0.5	6.2±0.18	0.20±0.013	0.15±0.008
1.0	5.8±0.30	0.19±0.006	0.16±0.008
1.5	6.0±0.44	0.20±0.007	0.16±0.005

* P>0.05

CONCLUSION

Considering the results of the current study it could be concluded that supplementation of marjoram powder, particularly the higher levels (1.0 and 1.5%)

in broiler diets has the potential to improve productive performance like a growth promoters but without any detrimental impacts on immune responses and blood parameters of the birds.

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الملخص العربى الاداء الانتاجى والاستجابة المناعية لكتاكت التسمين تحت تاثير استخدام علائق اوراق البردقوش المطحونة

عبدالله حسن حسين على

قسم الانتاج الحيوانى والدواجن - كلية الزراعة - جامعة جنوب الوادى - قنا - مصر

تم تقسيم عدد ٩٦ كتكوت غير مجنس عمر يوم من سلالة روس ٣٠٨ عشوائيا الى ٤ مجموعات معاملة. احتوت كل معاملة على ٣ مكررات واحتوت كل مكررة على ٨ كتاكيت. تم وضع الكتاكيت فى كل مكررة فى قفص. احتوت العليقة الاساسية على ٢٤ و ٢٢% بروتين خام و ٣٠٠٩ و ٣١٣٥ كيلو كالورى طاقة ممثلة/كجم عليقة لعلقتى البادئ والنامى على الترتيب. احتوت التجربة على ٤ معاملات، المعاملة الاولى تم فيها تغذية الكتاكيت على العليقة الاساسية دون اى اضافات (المقارنة). بينما اضيف للعليقة الاساسية للكتاكيت فى المعاملات ٢ و ٣ و ٤ اوراق بردقوش مطحونة (*Origanum marjorana*) بنسب ٠,٥ و ١,٥ و ١,٥% على الترتيب. أدى اضافة اوراق البردقوش المطحونة الى الزيادة المعنوية ($P<0.05$) لكل من وزن الجسم عند عمر ٢١ و ٤٢ يوم ومعدل الزيادة اليومية فى وزن الجسم خلال كل الفترات ومستوى الجلوبيولين عن مجموعة المقارنة. علاوة على ذلك فان اضافة اوراق البردقوش المطحونة الى علائق بدارى التسمين حسنت معنويا ($P<0.05$) معدل التحويل الغذائى خلال كل الفترات. من جهة اخرى اضافة اوراق البردقوش قللت معنويا ($P<0.05$) الغذاء المستهلك اليومى من ٤-٦ و ٦-١٠ اسابيع من العمر و الالبيومين ونسبة الالبيومين على الجلوبيولين فى مجموعات المعاملة مقارنة بمجموعة المقارنة. على العكس فان اضافة اوراق البردقوش المطحونة الى علائق بدارى التسمين لم يكن له اى تاثير معنوى على كل من الغذاء المستهلك اليومى خلال الفترة من ٠-٣ اسابيع من العمر و الهيماتوكريت وتركيز الهيموجلوبين والجلوكوز والبروتين الكلى والكولسترول الكلى والكولسترول منخفض الكثافة والكولسترول عالى الكثافة و الخلايا المتعادلة والليمفية والأحادية و نسبة الخلايا المتعادلة إلى الخلايا الليمفية ومتوسطات الاجسام المناعية ضد كرات الدم الحمراء للاغنام المقدره فى السيرم فى الاسبوع السادس ونسب الطحال وغدة البرسا. توضح هذه البيانات بشكل عام بان اضافة اوراق البردقوش المطحونة الى علائق بدارى التسمين قد حسنت الاداء الانتاجى ولكنها لم تؤثر على الاستجابة المناعية للكتاكيت.