Assessment of the broilers performance, gut healthiness and carcass characteristics in response to dietary inclusion of dried coriander, turmeric and thyme

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Abstract*—The objectives of the current study were to evaluate the performance responses, guts healthiness, and carcass characteristics of broiler chickens fed on formulated diets included dried coriander, turmeric and thyme. Unsexed commercially available chicks were enrolled into five experimental treatments each of eighty birds with four replicates per treatment. The birds were housed in deep litter clean pens. The experimental groups were as follow: Control; coriander; thyme; turmeric, and mixed. Two formulated diets (starter & finisher) to which all the dietary additives were added in a dried powdered form and at the level of 0.75% expect for the mixed group as each additive was used at level 0.25%. Performance parameters including weekly body development, body weights gain, feed intake, and feed conversion ratio were recorded during the 35-d experimental period. Also, representative samples from each replicate were gathered for the detection of carcass traits, consumer acceptability, and the gut morphometric changes. The data revealed that coriander, and turmeric significantly ($p<0.05$) increased the villus heights and crypt depths as compared to control which is concomitant with the improvement of performance results when incorporated solely in broilers diet at 0.75% level , but consumer acceptability was lowered specifically for the turmeric –fed group*.

Keywords*— *Broiler performance, Coriander, Gut, Thyme, Turmeric.

I. INTRODUCTION

The everlasting improvement on poultry genes seeking for great performance and more economical profit has resulted in dramatic changes in the bird's gut during growth (Tottori et al. 1997) rendering young birds to be highly vulnerable to enteric infection. It is logic that sustaining a healthy gut is a precondition golden role for efficient broilers performance. The use of antibiotic growth promoter (AGP) in poultry industry had been banned since 2006 in Europe as there is increased community awareness for their public health hazard for human being incriminated for the acquired resistance in zoonotic bacterial pathogens (Williams and Losa, 2001;Bostoglou et al. 2004). On view of that, a great burden has been facing nutritionist to surge for applicable alternatives maintaining birds gut health, performance as well as poultry enterprises profits. The properties of phytogenic feed additives (PFA) which are originally a plant derivative products have candidate them as safe and cost-efficient alternatives for AGP in livestock production (Windisch et al., 2008; Jacela et al. 2010). The mode of action of these feed additives to improve performance parameter is not completely clear but it includes enhancing feed intake, enzymatic digestion, feed conversion as well as body weight gain (Lovkova et al. 2001, Williams and Losa 2001, Ertas et al. 2005). Moreover, some of the PFA has biological activities including antimicrobial, antiviral, and antioxidant (Osawa et al.1995; Ertas et al. 2005; Cross etal.2007).

Coriander (*Coriander sativum*) is one plant of parsley family, natively cultivated in Mediterranean but found in many other parts of the world (Ertas et al., 2005).The dietary inclusion of coriander essential oil at the levels of 100, 200 and 300mg/kg induced growth performance improvement of broilers attributed to intestinal health enhancement (Ghazanfari et al.,2015). On the contrary, using coriander seeds oil at a level of 20 mg / kg diet had no effect on daily gain or feed conversion of broiler (Vogt and Rauch ,1991). Ali et al. (1992) observed significantly improved in body weight development of broiler chickens at the different weeks of the study and increased total weight gain due to the use of Bio- Tonic (dried extracts of several herbs included *Coriandrum Sativum*).Moreover, Saeid and AL-Nasry (2010) found that the broilers fed 0.3% coriander seed supplemented diet exhibited significant improvement in performance parameters as compared to the groups fed 0.2 and 0.1%. In quails' diets, coriander seeds exhibited a growth enhancement impact when included at a rate of 2% (Güler et al. 2005).

Turmeric (*Curcuma longa*) contains numerous active ingredients such as curcumin, demethoxycurcumin, bisdemethoxycurcumin, (Wuthi- Udomler et al. 2000) and tetrahydrocurcuminoids (Osawa et al. 1995). Dietary Inclusion of 5 g/kg turmeric meal in broilers diet induced significant improvement in productive performance (Al-Sultan 2003 & Durrani et al. 2006), similar results had been reported with the same level of a blend of turmeric and cumin (Al-Kassie et al. 2011). Even the dietary use of turmeric meal at the lower rate (1g/kg) enhanced the overall performance of broiler chickens (Kumari et al. 2007).

Thyme (*Thymus vulgaris L.*) is a worldwide medicinal plant mostly used as a spice and its major components are the essential oil thymol and its isomer carvacrol (Mikaili et al., 2010). In a study of Toghyani et al. (2010) to compare between dietary supplementation of antibiotic vs. 5 g/kg thyme , a significant improvement in body weight gain was observed in broilers but FCR was the best in antibiotic treatment. Different inclusion rates of thyme essential oil in broilers diets had been reported to be of significant performance benefits , 100 and 200 mg/kg, and 200 or 300 mg/kg of carvacrol, thymol or their mixture, (Bölükbasi et al., 2006 & Abdel-Wareth, 2011), respectively. However, Cross et al. (2007) reported that dietary thyme had different effects on bird's weight gain and carcass traits when included in the bird's diets either as a dried herb or as an essential oil. Ocak et al. (2008) found no growth promoting effect of the dietary supplementation of 0.2% dried thyme as compared to control.

Keeping in view the significant importance of the aforementioned three phytogenic herbs (coriander, turmeric and thyme), the present study was conducted to evaluate the performance responses, guts healthiness, and carcass characteristics of broiler chickens fed on formulated diets included dried coriander, turmeric, and thyme at the level of 0.75% either solely or as mixture (0.25% each).

II. MATERIAL AND METHOD

2.1 Herbal preparation, experimental birds and diets

The herbal feed additives (coriander, thyme, and turmeric) were purchased from a local market in Egypt. The plants were dried, ground as fine powdered to be ready for incorporation in the formulated diets. Two experimental corn- soy basal (BD) starter and finisher diets were formulated to meet ROSS® 308 broiler's requirement . Five dietary treatments each contained 80 of the commercially available unsexed (ROSS®308) broiler chicks, with four replicates (20bird/replicate) were reared in clean pens fitted with deep litter under a standard hygienic condition for 35 days. All birds have free access to feed and water and were routinely vaccinated against Newcastle disease, infectious bronchitis, and infectious bursal disease. The Five dietary treatments were as follows: Control (BD); coriander (Cr); turmeric (T); thyme (Z), and mixed (mix). All the dietary additives were added on top of the diets in a dried powdered form and at the level of 0.75% expect for the mixed group as each additive was used at level 0.25%. The ingredients composition % and calculated analysis of the formulated diets are presented in Table 1.

2.2 Performance parameters

Performance parameters including, the weekly body weight development, feed consumption, feed conversion ratio (FCR) as well as overall performance were determined.

2.3 Carcass traits and morphometric measurements

At the end of the study, 5 birds with the nearest average live body weight were randomly selected from each replicate and were deprived of feed for 16 h prior to slaughtering. The birds were weighed, feet were removed and carcasses were manually eviscerated and the abdominal fat, giblets (liver, gizzard, and heart) were removed and were weighed to calculate dressing, edible organs weights and abdominal fat percentages (Ademola et al., 2009). Samples of the jejunum (3 cm length) from all the respective groups were collected then fixed and after histological procedure stained with H&E. Villus height and crypt depth were determined using the light microscope and software for image analysis. Apparent villus surface area was estimated by trigonometry as described by Ijt et al. (2001).

2.4 Organoleptic test

The organoleptic test was done using 10 birds per treatment at the end of the experiment. The birds were coded and blindly distributed for assessment by using designed questionnaire for data collection (Bratte, 2011).

2.5 Statistical analysis

All the collected data were statistically evaluated using analysis of variance (ANOVA) in a completely randomized design of SAS® (2000). The significant differences among means were identified using LSD (Snedecor and Cochran, 1967).

III. RESULTS AND DISCUSSION

Data on performance parameters are summarized in Fig. 1 and Table 2. The results showed a significant ($p<0.05$) positive effect of the coriander and turmeric phytogenic feed additives on body weight development established by the end of the starting period (21d) up to the finishing period as compared to control except for the mix- group which sustained the lowest body weight throughout the experimental period. The coriander as well as the turmeric dried powders significantly ($P<0.05$) improved all performance parameters as compared to the BD, Z, and the mix groups. The overall FCR of the group fed coriander (1.73) surpassed that obtained by the turmeric (1.77) as well as the BD- fed(1.79) groups. The improving results of coriander on final body weight and weight gain was previously recorded by Ali et al. (1992) and Abaza (2001) in broilers and by Güler et al.(2005) in quails using different levels. On the contrary, Vogt and Rauch (1991), failed to observe any improving effect on daily gain or feed conversion of broilers using coriander oil at a level of 20 mg / kg diet. Although, turmeric (T) – fed group showed a significant improvement in all performance parameters as did the Cr group, yet coriander surpassed all groups achieving the best FCR value. The feed consumption of the Cr- fed group (Table2) was higher than the feed consumption recorded by the other treated groups and the BD- fed group, and this is probably due to that coriander contains linalool essential oil which has appetizing properties and stimulating effects on the digestive process (Cabuk et al. 2003). Moreover, coriander seeds is rich in many nutrients, as Abaza (2001) found that it contains 14.83 CP and 23.63 EE% which suggested added nutritive values for the respective group.

The results of the effect of coriander, turmeric, thyme and their mixture on the carcass traits of broiler chickens are presented in Table 3. There was a no significant difference in the dressing % and in the abdominal fat % between treatments, except for the coriander - fed group which achieved the best dressing %. Regarding the results of the giblet weights, the liver and heart% showed a similar pattern as there was a significant ($p<0.05$)difference between the CR- fed group and the basal diet-fed group. All phytogenic treatments showed no effect on the gizzard and the abdominal fat %.
The results of the current study could be explained under few hypothesis of phytogenic feed additives mechanisms including; the significant influence on the development of some digestive organs(Ademola et al. 2009) and the thinning of the gut mucosa which improves nutrient absorption (Windich et al. 2008). Additionally, the role of phytogenic feed additives in inhibiting pathogens and lowering the total bacterial count in the gut will eventually allow more energy and nutrients to be delivered to the body (Yang et al. 2015).

The organoleptic tests (Table4) for the raw and cooked meat of the different experimental treatments showed no significant differences between treatments except for the turmeric – fed group which was significantly($P<0.05$) affected in color and appeared unaccepted to the consumers. In agreement with our results, Abaza (2001) found a highly significant difference ($P<0.01$) for meat color among treatments using different essential oil of medicinal plants which included thyme.

The results of gut soundness represented by the morphometric changes of the jejunum of the experimental chickens detected by the end of the study (Table 5 and Fig.2) showed significant differences ($p<0.05$) between the phytogenic groups and the control group. The results demonstrated the beneficial effect of all phytogenic feed additives on the jejunum morphology by the end of the experimental period. Coriander, turmeric and thyme significantly ($p<0.05$) increased the villus heights and crypt depths as compared to control which is concomitant with the improvement of performance results (Table2). This result can be speculated as the gut mucosa is the first tissue that comes in contact with the dietary constituents and the increased integrity of the gut is associated with a higher surface area of the villi, resulted in positive performance results. Many studies confirmed that the intestine can adapt and react morphologically by growing in length, and/ or by elongation or decrease the villus height in response to external factors related to dietary changes (Žikic et al.2008& Peric et al.2010.) The failure of the mix -group to achieve an equal improvement as the other phytogenic feed additives achieved when each was fed solely might not directly be correlated to the results of gut morphology, but suggesting no synergistic effect between the active substance of each additives and probable interference between other mechanisms of action.

IV. CONCLUSION

The inclusion of the dried powder of certain phytogenic feed additives namely the coriander or turmeric at the level of 0.75% of the broiler's diet has positive effects on various indices of performance, carcass traits and jejunal morphometric criteria of broiler chickens which empowers them for practical application at a commercial level.

TABLE 1
THE INGREDIENTS AND CALCULATED ANALYSIS OF FORMULATED BASAL BROILER STARTER AND FINISHER DIETS

Feedstuff inclusion %	Starter Control	Finisher Control
Yellow corn	56.7	68.3
SB Meal (48%)	35.2	23.9
Vegetable oil	3.5	2.8
Corn gluten meal(62%)	-	1.8
Ca phosphate dibasic	2.1	1.1
Lime stone	1.20	0.8
Methionine	0.22	0.22
Lysine	0.40	0.4
Nacl	0.38	0.38
Anti oxidant	0.08	0.08
Vitamins & minerals premix*	0.22	0.22
Calculated analysis		
CP%	22	18.48
ME(Kcal/Kg)	3004.0	3121.4
EE	6.7	7.13
CF	3.8	4.14
Methionine	0.55	0.46
lysine	1.64	1.1
Ca%	1.0	0.91
Av.p%	0.45	0.32

***per Kg premix: 1200000 IU vit A, 350000 IU vit.D3, 4000 mg vit. E, 250 mg vit.B1, 800 mg vit. B2, 600 mg vit. B6, 3.2 mg vit. B12, 450 mg vit. K3, 4.5 g nicotinic acid, 1.5 g Ca pantothenate, 120 mg folic acid, 5 mg biotin, 55 g choline chloride, 3 g Fe, 2 g Cu, 10 g Mn, 8g Zn, 120 mg I, 40mg Co**

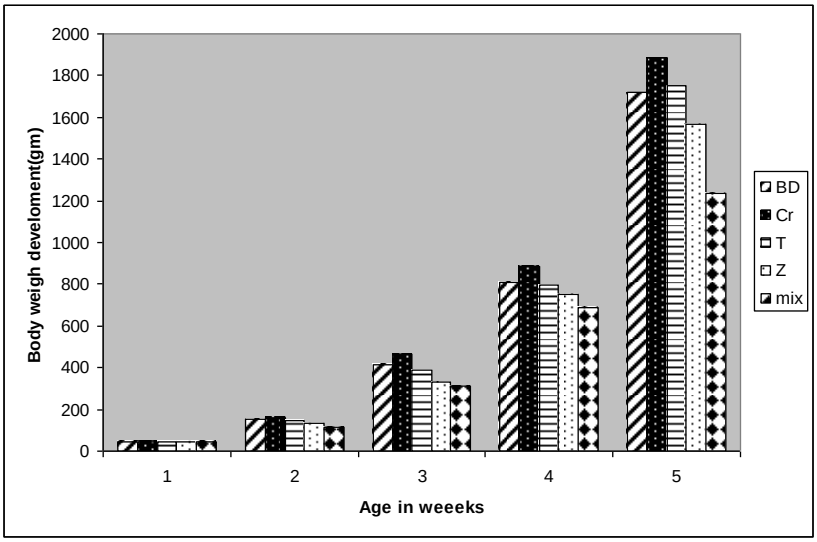

FIG.1 EFFECT OF DIFFERENT DIETARY FEED ADDITIVES ON BODY WEIGHT DEVELOPMENT OF BROILER CHICKENS

TABLE 2
ALLOVER AVERAGE TOTAL BODY WEIGHT GAIN, FEED INTAKE (G/BIRD) AND FEED CONVERSION RATE (FCR) OF BROILER CHICKENS IN RESPONSE TO DIETARY PHYTOGENIC FEED ADDITIVES

Parameter	BD	Cr	T	Z	mix
Bodyweight gain(g/bird)	1671.76 ±21.34	1839.14 ±22.72^{a}	1787.44 ±24.52^{a}	1598.36 ±26.49^{b}	1190.42 ±20.83^{c}
Feed intake (g/bird)	3005.3±62.1^{b}	3190.6±55.6^{a}	3157.9±71.3^{b}	2987.5±68.4^{b}	2656.8± 72.0^{b}
FCR	1.79	1.73	1.77	1.87	2.23

Values are means ± SE

TABLE 3
EFFECT OF DIFFERENT PHYTOGENIC FEED ADDITIVES ON CARCASS TRAITS OF BROILER CHICKENS AT 35 DAYS OF AGE

Parameters	Control (BD)	Coriander (Cr)	Turmeric (T)	Thyme (Z)	Mixture (mix)
Dressing%	72.45±1.65^{ab}	74.66±1.83^{a}	72.77±1.24^{ab}	73.08±1.60^{ab}	70.7±1.21^{b}
Liver%	2.43± 0.03^{c}	2.69± 0.04^{a}	2.78± 0.06^{a}	2.64±0.07^{ab}	2.58±0.04^{b}
Gizzard %	2.67± 0.13^{a}	2.98± 0.25^{a}	2.55± 0.41^{a}	2.47± 0.32^{a}	2.46±0.19^{a}
Heart%	0.47± 0.08^{c}	0.76± 0.06^{a}	0.59± 0.04^{b}	0.62±0.05^{b}	0.53±0.06^{bc}
Abdominal fat%	2.56± 0.19^{a}	2.43± 0.11^{a}	2.39± 0.08^{a}	2.51± 0.16^{a}	2.49±0.18^{a}

Values are means ± SE
Values in the same raw with different superscripts are significantly different at P < 0.05

TABLE 4
ORGANOLEPTIC TESTS FOR BROILERS CARCASS (N=10) SUBJECTED TO DIFFERENT DIETARY TREATMENTS.

Meat	Evaluation scheme		Experimental groups					
			Groups					
				BD	CR	T	Z	MX
Row	Color1	Breast	L	0	0	0	0	0
			S	10	10	10	10	9
			D	0	0	0	0	1
		Thigh	L	0	0	0	0	0
			S	10	10	8	10	8
			D	0	0	2	0	2
Cooked	Odor2		N	10	10	10	8	9
			U	-	-	-	2	1
	Flavor3		A	10	10	10	1	1
			B	-	-	-	6	6
			C	-	-	-	3	3
	Tenderness3		A	10	9	9	6	6
			B	-	1	1	3	3
			C	-	-	-	1	1

1 Color: L=lighter; S=similar; D=darker compared to normal commercially available broiler meat.
2 Odor: N=normal, U=abnormal. 3 Flavor and tenderness assessment: A=very good, B=good, C=fairly acceptable

TABLE 5
EFFECT OF DIFFERENT PHYTOGENIC FEED ADDITIVES ON THE LENGTH OF VILLI & DEPTH OF CRYPT (µm) OF JEJUNUM AND CRYPT VILLI RATIO (C/V) OF THE EXPERIMENTAL CHICKENS

Parameter	Control (BD)	Coriander (CR)	Turmeric (T)	Thyme (Z)	Blend (MX)
Villus length	767.7±12.7^{c}	1143.4±15.9^{a}	1110.1±14.5^{a}	1039.0±12.7^{a}	969.9±20.6^{b}
Crypt depth	231.7±8.6^{c}	345.8±11.9^{a}	323.1±8.8^{a}	295.0±8.7^{a}	267.1±9.9^{b}
(C/V)	3.31	3.31	3.44	3.52	3.63

Values are means ± SE
Values in the same raw with different superscripts are significantly different

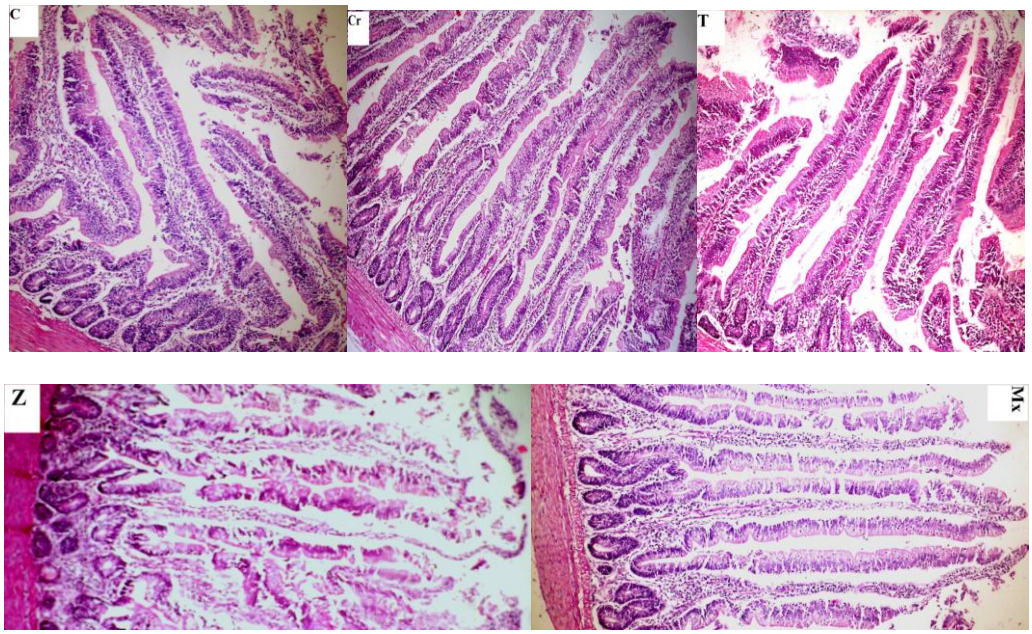

FIG.2: COMPARISON BETWEEN VILLUS HEIGHT IN DIFFERENT TREATMENT GROUPS AND CONTROLS H&E (10X)

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