The impact of botanical extract, capsicum (*capsicum frutescence l),* oil supplementation and their interactions on the productive performance of broiler chicks.

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Abstract: A total number of 360 broiler chicks, unsexed Cobb from day-one till marketing age 42 days, were assigned randomly to one of 8 diets; botanical extract (garlic, anise, cinnamon, rosemary and thyme) at 0 or 150ppm; capsicum at 0 or 150ppm, corn oil at 2.5 or 5% or combinations). Additives were supplemented to basal corn-soybean diet (23% CP, 3100 kcal ME/kg and 20% CP , 3100 kcal ME/kg for starter and grower diets, respectively) to evaluate : growth rate, feed conversion, blood parameters, carcass quality, bacterial counts, viability and economical efficiency rate. Results showed improved body weight and overall average daily gain due to interaction effect among dietary treatments (p<.05). Feeding capsicum (150ppm) in presence of 5% oil significantly improved feed conversion ratio during starter period 0-3 wks (p<.05). Protein and calorie conversion ratios were significantly improved (p<.05) due to main effect of oil supplementation only during 0-3 wks of age. Carcass taste panel results indicated that botanical was the most effective feed supplements to elicit improvement in taste, muscle juiciness and overall consumer acceptability mainly in white meat but not the dark meat. Interestingly, both botanical extract and capsicum inclusion reduced body composition of fat and serum levels of lipids and cholesterol at marketing age. The effect of both botanical and capsicum, was due to decreased intestinal absorption of the lipids. Combining both botanical and capsicum at 150ppm significantly (p<.05) achieved the greatest reduction in total microbial counts of the chickens' cecum (log10 CFUg-1 fluid). However, oil negated the effect of botanical and capsicum on reducing the bacterial count. The highest value of economical efficiency rate 98.2% was scored in group received combination of botanical and capsicum at 150mg/ kg diet each. In conclusion, there is possibility of using combination of botanical extract, capsicum and oil in broilers diet to improve performance

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Keywords: botanical extract; capsicum; oil; broiler performance; diet

Introduction

Increased restriction on the use of pharmaceutical antibiotics in feed as growth promoters is an accelerating trend towards the development of using alternative ingredients particularly those from plants which are perceived as "natural" and "safe" ingredients. Rosen (1996) defined the pronutrients as micro-feedingstuff used orally in relatively small amounts to improve the intrinsic value of the nutrient mix in animal diet. They have many possible modes of action; antioxidation and metabolic enhancement (Tucker, 2002), appetizer and guts environment modulation (Jamroz et al., 2004), in addition they can encourage

efficient digestion (Meller, 2000). The mode of action may arise from plant metabolites belong to the classes of isoprene derivatives, flavonoids and glucosinolates and a large number of these compounds have been suggested to act as antibiotics or as antioxidants in vivo as well as in food (Wenk, 2003).

Capsicum or Red pepper (Rosengarten, 1969) was used as a stimulative to produce a strong heat in the body and restore digestive powers. Capsicum is rich in carotenoid pigments, including capsorubrin, capsanthin, carotene, zeaxanthin, lutein, and cucurbitaxanthin A (Leung and Foster, 1996; Hornero-Méndez and Mínguez-Mosquera, 1998). Botanical feed ingredients are substrates derived chemically from simple processes or collected intact from recognized parts of plants that are suitable for practical use in animal diet. A mixed botanical preparation contains garlic, anise, cinnamon, rosemary and thyme extracts standardized on their main active components (Tucker, 2002). Herein, our study has aimed to evaluate the impact of using botanical extract and capsicum as safe feed additives and in combination with corn oil on productive performance of broiler chicks and economical efficiency rate.

Materials and methods

A total number of 360 broiler chicks, unsexed Cobb, were assigned randomly to one of 8 treatment groups (45 chicks/ group, 3 replicates 15 chicks each) as follows ; control group (G1) received basal diet contains 2.5 - 3.1% corn oil during starter and grower periods, respectively; group2 (G2) received control diet plus botanical extract at level 150ppm; group3 (G3) received control diet plus capsicum at 150ppm; group4 (G4) received diet contains 5% corn oil; group5 (G5) received basal diet contains 150ppm botanical extract plus 150ppm capsicum; group6 (G6) received basal diet contains 5% corn oil plus 150ppm botanical extract; group7 (G7) received diet contain 5% corn oil plus 150ppm capsicum and group8 (G8) received all dietary supplementations. Additives were supplemented to basal corn-soybean diet, table 1 (23% CP, 3100 kcal ME/kg and 20% CP , 3100 kcal ME/kg for starter and grower diets, respectively) that met all nutrients requirements according to NRC (1994). Chicks received treatment diets from day-one till marketing age 42- days and raised under managerial standard procedure to evaluate : growth rate, feed conversion, blood parameters, carcass quality, sensory evaluation according to the technique reported by Molander (1960), bacterial counts as described by Postage (1969), and economical efficiency rate according to the (Bayoumi, 1980). All data were analyzed by analysis of variance (ANOVA) using general linear model procedure (GLM) of SAS software (SAS institute, 1996). Significant differences between treatments means were determined using Duncan multiple range test (Duncan, 1955).

Results and discussion

Results presented in (Table, 2) indicated that feeding oil at 5% significantly increased body weight at 3 week-old compared to other treatments, G1, G2 and G3 but not at 6 week-old. As a result, average daily body weight gains of chicks were improved at 3 wks of age as well. According to the interactions that were proved significant, feeding oil with capsicum (G7) or with capsicum and botanical at 150ppm each (G8) significantly increased chicks' body weights and average daily body weight gains at 3 week-old. The best feed conversion value was obtained at 3 week-old when chicks received capsicum (150ppm) in presence of 5% oil (G7),whilst lowest values was recorded in (G2) when botanical was fed at low level of oil. The positive effect of hot pepper may be due to its stimulant, carminative digestion and antimicrobial properties and also the presence of vit. C, E and provitamin A (El-Aidy, 1981, Vogt et al., 1989, Cowan, 1999 and EL-Husseiny et al., 2002). No differences in feed conversion ratios were found during growing period (3 - 6 weeks). In addition, protein and calorie conversion ratios were significantly improved due combination of capsicum and oil (G7) supplementation during period 0-3 wks of age. Addition of fats or oil to iso- caloric, iso nitrogenous balanced diet usually produces a slight increase in growth and further enhances efficiency of feed utilization in both broilers and laying hens (Leeson and Summers 2001).Numerically but not significant the lowest protein conversion ratio (0.46) was obtained due to main

effect of botanical extract (G2) compared to other treatments might explain the lowest body weight and average body daily gain values during the first growing period (0- 3 weeks of age). The negative effect of botanical extract on either protein or energy conversion ratio could be attributed to the fact that plant extracts would be considered as natural growth enhancers in animal feeds for their antimicrobial and antioxidants activities but their effects depends on the hygienic condition during the experimental course (Portsmouth, 2001).

Dressed carcass % values (Table, 3) indicated no differences between main effects of all treatments. However, the lowest percentage was obtained (64.4%) when both botanical extract and capsicum were combined in one diet (G5). White meat percentages were not different among treatment groups. On the contrary red meat % showed significant increase (G8) when chicks were fed diet contained all additives. This improvement was due to increased weight percentage of the thigh ($p<0.05$)**.** Interestingly, carcass taste panel results indicated that botanical extract combined with 5% oil (G6) was the most effective feed supplements to elicit improvement in taste, juicy muscle and overall consumer acceptability mainly in white meat but not the dark meat. However, negative impact on breast muscle taste was found due to capsicum treatment fed solely or combined with oil.

Sera analyses (Table, 4) showed significant reduction in cholesterol levels in chicks received either botanical extract (132.0mg/dl) with low level of oil (G2) or capsicum combined with 5% oil (122.8mg/dl) and borderline in botanical and capsicum fed group (138.2mg/dl). Also, the lowest concentrations of sera total lipids were obtained in group fed both botanical and capsicum due to interaction effect. Interestingly, the reduction in sera total lipids coincided with the lower value (data not shown) of body fat % recorded from body composition analyses (9.8 vs. 11.9% in G5 and G1, respectively). The effect of both botanical extract and capsicum on total lipids, probably due to decreased intestinal absorption of the lipids (Negulesco et al., 1985, Kawada et al., 1986).Normal enzyme activities implied no damage effect on liver function and safe levels of feed additives were used. No differences were found in triglycerides levels. Although sera total protein concentration were significantly different among treatment groups, values were within normal physiological range. The reduction of cecum total bacterial count (log10 CFUg-1 fluid) was highly implemented by dietary feed additives. Selected herbs, capsicum or botanical extract, are known to possess natural antibacterial qualities as well as other characteristics that could be useful in value added animal protein production. Botanical extract contains garlic which was reported to demonstrate a broad-Spectrum antimicrobial activity against many bacteria, viruses, parasite and fungi (Lundeen, 2001). Ironically, inclusion of oil negated the effect of botanical and capsicum on reducing the bacterial count (Table, 4). The results of economic efficiency ratio (EER) indicated that chicks received 5% oil (G4) and those received 5% oil and 150ppm botanical extract (G6) scored the lowest values 83.3% and 82.9%, respectively of EER/ kg gain. However, the highest value 98.2% of EER/ kg gain was scored in group of chicks received combination of botanical and capsicum at 150mg/ kg each (Table,5). In conclusion, there is possibility of using combination of botanical extract, capsicum and oil in broilers diet to improve performance.

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Table (1) Composition of the experimental diets

Ingredients	g/100g diet			
	Starter		Grower	
	control	5%oil	control	5%oil
Yellow Corn	57.65	51.01	61.30	55.10
Soybean 44%	25.89	36.72	31.18	33.62
Corn gluten	10.00	3.60	1.10	0.00
Commercial vegetable oil	2.50	5.00	3.10	5.00
Wheat bran	-	-	-	3.00
Limestone	1.28	1.25	1.17	1.18
Di calcium phosphate	1.70	1.63	1.41	1.35
Vitamin & minerals mixtur[1]	0.30	0.30	0.30	0.30
Sodium chloride	0.40	0.40	0.40	0.40
D-L Methionine	0.03	0.09	0.04	0.05
L- Lysine	0.25	-	-	-
Calculated analyses				
M E, (k cal/ kg)	3113	3104	3063	3076
Crude protein, %	22.98	22.93	19.82	20.10
Crude fiber, %	3.29	3.85	3.64	4.0
Crude fat, %)	5.15	7.32	5.71	7.45
Calcium, %	0.94	0.94	0.85	0.85
Available phosphorus, %	0.41	0.41	0.35	0.35
Lysine, %	1.25	1.23	1.07	1.14
Methionine, %	0.50	0.51	0.38	0.38

[1]Vitamin and minerals supplemented/kg concentrate, vit. A 130,000 IU. D3 26,000 IU ; vit. E 120 IU; vit B12 150 ug; vit. K3 MSB 16 mg; vit B2 50 mg; capantothenate B3 120 mg; nicotinic acid PP 250 mg ; Thiamine B1 25 mg; folic acid 15 mg; pyridoxine B6 15 mg; Betain-Choline-HCl 5000 mg; Mn 700 mg;Zn 600 mg; Fe 400 mg;Cu 40 mg; Iodine 7 mg; Co 2 mg; Se 1.5 mg; B.H.T. 1250 mg

Table (2). Effect of botanical extract (150ppm), capsicum (150ppm), oil (5%) and their interactions on body weight, daily body weight gain, feed conversion (FCR), protein conversion (PCR) and energy conversion ratios (MECR) of broiler chicks (X ± SE)

Variables	Average body weight (g)		Average daily gain (g)			Feed conversion		PCR (g protein/ g gain)		MECR (k cal ME / g gain)	
	3 Wks	6 Wks	0-3 Wks	3-6 Wks	0-6 Wks	0-3 Wks	3-6 Wks	0-3 Wks	3-6 Wks	0-3 Wks	3-6 Wks
G1	372±10.84^{c}	1485±33.26^{ab}	16±0.52^{c}	53±1.41	34±0.79ab	1.8±0.07^{ab}	2.0±0.06	0.41±0.02^{ab}	0.40±0.01^{b}	5.6±0.21^{ab}	6.2±0.18
G2	349±14.07^{c}	1432±37.74^{ab}	15±0.67^{c}	52±1.27	33±0.90^{ab}	2.0±0.10^{a}	2.1±0.05	0.46±0.02^{a}	0.41±0.01^{ab}	6.2±0.30^{a}	6.4±0.16
G3	379±13.46^{bc}	1465±38.73^{ab}	16±0.64^{bc}	52±1.51	34±0.92^{ab}	1.9±0.08^{ab}	2.1±0.06	0.43±0.02^{ab}	0.42±0.01^{ab}	5.8±0.25^{ab}	6.5±0.19
G4	417 ±11.66^{a}	1511±31.08^{a}	18±0.55^{a}	52 ±1.29	35±0.74^{a}	1.8±0.06^{ab}	2.2±0.06	0.41±0.01^{ab}	0.43±0.01^{ab}	5.5±0.20^{ab}	6.6±0.18
G5	361±11.12^{c}	1391±35.21^{b}	15.±0.53^{c}	49±1.37	32±0.84^{b}	1.8±0.07^{ab}	2.0±0.05	0.42±0.02^{ab}	0.40±0.01^{b}	5.7±0.21^{ab}	6.2±0.16
G6	409±13.21^{ab}	1448±39.16^{ab}	17±0.63^{ab}	50±1.61	33±0.93^{ab}	1.8±0.09^{ab}	2.2±0.09	0.41±0.02^{ab}	0.44±0.02^{a}	5.6±0.27^{ab}	6.8±0.27
G7	435±10.63^{a}	1517±34.32^{a}	19±0.51^{a}	52±1.42	35±0.82^{a}	1.7±0.06^{b}	2.1±0.07	0.39±0.01^{b}	0.42±0.01^{ab}	5.3±0.17^{b}	6.4±0.20
G8	436±11.92^{a}	1518±35.20^{a}	19±0.57^{a}	52±1.38	35±0.84^{a}	1.8±0.07^{ab}	2.1±0.04	0.41±0.02^{ab}	0.41±0.01^{ab}	5.5±0.21^{ab}	6.3±0.14

^{a,b} means with different superscript within column are significantly different ($p< 0.05$)

G1= control diet (contain 2.5, 3.1% oil at starter and grower, respectively), G2= control diet plus 150ppm botanical, G3=control diet plus 150ppm capsicum, G4=basal diet contained 5% oil, G5= control diet plus (150ppm botanical+ 150ppm capsicum), G6= basal diet contained 5% oil plus 150ppm botanical, G7= basal diet contained 5% oil plus 150ppm capsicum and G8= basal diet contained 5% oil plus (150ppm botanical+ 150ppm capsicum)

Table (3) Effect of botanical extract (150ppm), capsicum (150ppm), oil (5%) and their interactions on live body weight at slaughter, white and dark meat % and carcass panel test (white meat) of broiler chicks (X ± SE)

Variables	Dressed carcass %	White meat %	Dark meat %	Color	Odor	Juicy	Taste	Over all acceptability	Bitterness
G1	66.3±1.1^{ab}	28±0.42	16±0.45^{b}	5.7±0.32	4.6±0.42	4.1±0.48^{c}	5.0±0.23^{c}	5.8±0.45^{bc}	2.9±0.49
G2	66.3±1.4^{ab}	27± 0.66	17±0.64^{b}	6.4±0.49	5.9±0.46	5.9±0.46^{ab}	6.6±0.23^{ab}	6.6±0.23^{ab}	2.1±0.67
G3	66.8±1.3^{ab}	27±0.95	16±0.36^{b}	6.5±0.27	5.6±0.58	4.8±0.35^{bc}	5.0±0.54^{c}	5.5±0.48^{bc}	2.9±0.64
G4	69.1±0.9^{a}	27 ±0.46	17± 0.26^{b}	6.2±0.23	5.1±0.42	5.6±0.30^{abc}	5.4±0.57^{bc}	5.7±0.44^{bc}	2.7±0.89
G5	64.4± 1.3^{b}	27±0.18	16±0.44^{b}	5.4±0.29	4.7±0.66	4.1±0.59^{c}	4.3±0.58^{c}	4.5±0.24^{c}	2.4±0.69
G6	67.5±0.9^{ab}	28±0.60	16±0.67^{b}	6.2±0.42	6.1±0.42	6.6±0.62^{a}	7.0±0.29^{a}	7.2±0.30^{a}	1.9±0.76
G7	68.4±1.2^{a}	27±1.57	16±0.59^{b}	5.6±0.46	4.7±0.44	4.2±0.38^{c}	4.7±0.27^{c}	4.5±0.49^{c}	2.0±0.71
G8	68.2±0.8^{a}	27±1.39	18±0.81^{a}	5.8±0.38	5.4±0.29	5.5±0.69^{abc}	5.3±0.67^{c}	5.7±0.48^{bc}	2.0±1.09

^{a,b} means with different superscript within column are significantly different ($p< 0.05$)

Table (4) Effect of botanical extract (150ppm), capsicum (150ppm), oil (5%) and their interactions on blood total protein, GOT, cholesterol ,triglycerides and total lipids and total count of bacteria as log10 CFUg-1 fluid in broiler chicks (X ± SE)

Variables	Total protein (g/dl)	Got (u/l)	Cholesterol (mg/dl)	Triglycerides (mg/dl)	Total lipids (mg/ dl)	Total bacterial count(CFU)
G1	4.9±0.23^{ab}	120.3±7.91^{ab}	165.9±4.88^{a}	34.2 ±3.94	969.0±72.02^{a}	7.61±0.07^{b}
G2	3.4±0.64^{bc}	103.3±21.20^{ab}	132.0±7.68^{bc}	42.4±4.90	664.5±34.06b^{cd}	7.78±0.02^{a}
G3	3.1±0.33^{c}	154.5±35.01^{a}	155.1±15.10^{ab}	53.0±14.30	586.5±13.50^{cd}	7.21±0.02^{c}
G4	4.5±0.54^{abc}	126.3±10.00^{ab}	143.3±6.90^{abc}	69.1±21.65	741.0±67.28^{bc}	7.69±0.06^{ab}
G5	3.3±0.35^{bc}	126.3±7.82^{ab}	138.2±6.62^{abc}	55.5±9.02	511.5±43.98^{d}	6.92±0.05^{d}
G6	3.5±0.74^{bc}	91.5±12.35^{b}	155.3±7.13^{ab}	26.4±4.44	813.0±53.47^{ab}	7.24±0.03^{c}
G7	3.3±0.30^{bc}	123.0±13.18^{ab}	122.8±2.46^{c}	57.6±3.52	699.0±107.01^{bcd}	7.18±0.09^{c}
G8	5.2±0.77^{a}	115.5±19.12^{ab}	142.6±15.84^{abc}	60.3±22.26	636.0±43.34^{bcd}	7.35±0.03^{c}

^{a,b} means with different superscript within column are significantly different ($p< 0.05$)

Table (5) input and output analysis and economical efficiency as affected by different additives [1]

Item	Group (1)	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Feed intake (kg)	2.73	2.78	2.81	2.92	2.59	2.81	2.83	2.86
Price of kg feed (L.E)	1.08	1.08	1.08	1.16	1.08	1.16	1.16	1.16
Total feed cost (L.E)	2.94	2.99	3.03	3.39	2.79	3.26	3.29	3.31
Average live body weight (kg)	1.48	1.43	1.47	1.51	1.39	1.45	1.52	1.52
Price/kg live body weight (L.E)	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90
Total revenue (L.E)	10.25	9.88	10.11	10.43	9.60	9.99	10.47	10.47
Net revenue	7.31	6.89	7.08	7.04	6.81	6.73	7.18	7.16
Economic efficiency (EE)	2.49	2.30	2.34	2.08	2.45	2.07	2.19	2.16
Relative economical efficiency %	100.00	92.48	93.85	83.34	98.23	82.95	87.80	86.79

[1] calculated according to the following equations. ***Bayoumi (1980)***., Total feed cost = A x B = C, Total revenue =D x E = F, Net revenue =F – C = G, EE revenue =G/C, Where: A = average FI (kg/ bird), B = price / kg feed (PT), D = Average live body weight gain LBWG (kg/bird), E = selling price of kg gain