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Effects of phytobiotics on Cobb broiler production results, meatiness and chemical composition

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A b s t r a c t: In order to achieve better results for fattening broilers, various additives can be added to feed, including phytobiotics (phytogenic additives). Phytobiotics protect young broilers' health based on the principles of competitive exclusion and improved usability of nutrients, growth and feed efficiency. Due to the importance and actuality of this topic, it is scientifically justified and interesting to examine the effects of using natural growth stimulators on the performance of intensively bred broilers, as well as the suitability of these compounds for nutritional, health and economic aspects of broiler production.

In this study, 120 Cobb 500 broilers were divided into two groups, one control without and one experimental with a mixture of phytobiotics in their feed. At the beginning of the study, all broilers were of equal body mass. In some phases of fattening and at the end (after 42 days), body mass and total gain of the broilers receiving phytobiotics were significantly higher in than control broilers ($p<0.05$ and $p<0.01$, respectively). Total consumption of feed for the whole fattening period was higher in the control than in the phytobiotic-recieving broilers. A better feed conversion rate was determined in the broilers receiving phytobiotics than in the control broilers ($P<0.05$). The carcass meatiness was also improved in the broilers receiving phytobiotics ($p<0.01$). There was no significant difference between control and phytobiotic-receiving broilers with regard to meat chemical composition.

Keywords: *phytobiotics, production performance, feed conversion, meatiness, meat chemical composition.*

Introduction

The use of biologically active compounds as replacements for antibiotics has now been a current topic for some time. Instead of antibiotics and other drugs, contemporary animal feed production strives to use bioactive ingredients to maintain health and welfare and reduce stress effects from the environment on the immune systems and production results of farm animals in intensive production. Eubiosis in the digestive tract of animals is one of the most important factors for maintaining the health of animals and, therefore, production of high quality and safe animal-origin food. Phytobiotics (phytogenic additives) are secondary metabolites of plants with proven antimicrobial effects (*Lawrence and Reynolds,* 1984; *Windisch et al.,* 2008.). Phytobiotics' positive effects are based on maintaining and preserving eubiosis between microorganisms in the digestive tract (*Bakkali et al.,* 2008; *Windisch et al.,* 2008; *Stojkovic et al.,* 2013). Proper nutrition and hygienic conditions are very important for eubiosis maintenance. Phytobiotics, when added to poultry feed, reduce poultry immune stress (anti-inflammatory and antioxidant activity, antimicrobial, antiviral and anticoccidial effects) and increase intestinal availability for absorption of essential nutrients (enhancing flavour and food intake, stimulating secretion of digestive enzymes, increasing motility of stomach and intestine) (*Burt,* 2004; *Platel and Srinivasan,* 2004; *Giannenas et al.,* 2005; *Aksit et al.,* 2006; *Kirkpinar et al,* 2010; *Gregacevic et al.,* 2014). Phytobiotics may have potential in promoting production performance and impact on productivity and, thus, could be considered as natural growth stimulators (*Hashemi and Davoodi,* 2010). Although phytobiotics are a relatively new group of food additives, they are attracting a lot of attention in the animal feed production industry. Compared with synthetically derived antibiotics and inorganic chemical substances, phytobiotics are natural, proven less toxic and do not produce residues. Therefore, they could become ideal feed additives and successfully replace antibiotics as growth promoters in food

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(*Hashemi et al.,* 2008; *Gregacevic et al.,* 2014). The objective of this study was to determine the effect of phytogenic additives in broiler feed on the production performance of broilers, carcass meatiness and chemical composition, as well as the suitability of these compounds for use in intensive breeding of commercial broilers from nutritional, health and economic aspects.

Materials and Methods

One day old market broilers (n=120), of Cobb 500 provenance, were housed on a registered farm. Chickens were of both sexes, with average weight 46.59±3.48 g. Broilers were divided into two groups of 60 broilers each. Control group C received feed without added phytobiotics, while experimental group P had phytobiotics containing cumin, mint, clove and anise, at 150 g t^{-1}, in their feed. Broilers were fattened for 42 days, divided into three phases, during each of which they received appropriate feed for that phase. The first phase was 0−10 days, the second was 11−20 days and the third was 21−42 days.

Housing, keeping and feeding of broilers

Broilers were housed in a commercial broiler house on the floor. Before broilers were introduced, the floor was mechanically cleaned and sanitary washed and disinfection of equipment and floor was conducted with a biodegradable, broad spectrum agent. The pad was strewn with sawdust of 12 cm thickness. The broiler house was heated appropriately and all hygienic and microbial conditions were according to the breeder's guidelines. Broilers were introduced and fed with mixtures recommended for Cobb provenance broilers. Three mixtures were used that completely met the needs of broilers at the three phases of fattening (Table 1) (*NRC,* 1994). Feed and water were supplied *ad libitum*.

Production results

Broilers were weighed on electronic scales (accuracy 1g) at the start and after each phase (on days 1, 10, 11, 20, 21 and 42) of fattening. Average body mass was calculated at the end of each fattening phase and at the beginning and the end of the study.

Table 1. Ingredients and chemical composition of broiler diets (%)

Ingredients or chemical composition	Feed mixture for phase I	Feed mixture for phase II	Feed mixture for phase III
Ingredients			
Corn	50.85	44.15	44.95
Wheat	–	10.00	15.00
Soybean grits	15.00	17.00	20.00
Soybean meal	12.40	1.00	1.00
Soybean cake	17.00	23.30	14.70
Monocalcium phosphate	1.20	1.00	0.90
Cattle chalk	1.60	1.60	1.60
Cattle salt	0.35	0.35	0.35
Premix[a]	1.00	1.00	1.00
Lysine	0.20	0.20	0.10
Methionine	0.20	0.20	0.20
Adsorbent	0.20	0.20	0.20
Chemical composition			
Moisture	8.04	9.38	9.98
Proteins	24.98	22.17	20.91
Fat	6.09	7.03	5.44
Cellulose	2.04	2.16	2.38
Ash	5.45	4.88	4.76

Legend:[a]; Premix composition per kg: Vit. A 1,300,000 IJ, Vit. D3 250,000 IJ, Vit. E 3,000 mg, Vit. K3 300 mg, Vit. B1 250 mg, Vit. B2 800 mg, Vit. B6 350 mg, Vit. B12 2 mg, Biotin 10 mg, Ca-pantothenate 1,500 mg, Niacin 3,000 mg, Choline chloride 13,750 mg, Betaine 10,000 mg, Folic acid 100 mg, Vit. C 2,000 mg, Fe 4,000 mg, Cu 800 mg, Mn 8,000 mg, Zn 5,000 mg, I 75 mg, Se 15 mg, Co 25 mg, Helmox (antioxidant) 10,000 mg, Clinacox 0.2% 20,000mg.

Total gain per phase was calculated from the difference of body mass at the beginning and end of each phase. Total and daily gain was calculated based on the duration of each phase and the study. Quantity of feed eaten and wastage were measured at the end of each phase. Feed conversion rates were calculated from consumption and gain data for each phase, as well as for the whole study.

Carcass meatiness

Each individual broiler was measured before and after slaughter and chilling. Carcass yield was calculated from the live weight before slaughter and chilled carcass weight. Breasts and drumsticks with thighs were measured on electronic scales (±0.05 g) and their participation in the total carcass weight was calculated.

Chemical composition

The chemical composition (water content, protein, fat and minerals) of meat from breasts and thighs with drumsticks from both groups was determined 48 h after slaughter. Values were measured using standard reference methods (*SRPS*, 1992a; *SRPS,* 1992b; *SRPS,* 1998; *SRPS,* 1999).

Statistical analysis

Statistical analysis of the results was conducted using the software GraphPad Prism Version 5.00 for Windows (GraphPad Software, San Diego, California USA, www.graphpad.com). Mean values were calculated and the groups were compared with one-way ANOVA with Tukey's multiple comparison statistical test. Values of $p<0.05$ and $p<0.01$ were considered significant. The results are expressed as mean ± SD.

Results and Discussion

The average body mass of the Cobb broilers per day and total gain per phase by group are shown in Table 2.

The positive impact of the phytobiotics on broiler body mass can be seen in Table 2. Broilers from the control group (without phytobiotics) had significantly lower body mass ($p<0.05$ and $p<0.01$) than experimental group on days 20 and 42. Those results were in agreement with the results of other authors. According to *Soltan et al.* (2008), anise seed addition (0.5−0.75 g kg^{-1}) in feed for the broilers over 42 days resulted in higher body weight and gain. *El Tazi et al.* (2014) added different concentrations (0, 0.5, 0.75 and 1.0 %) of black pepper (*Piper nigrum* L.) to broiler feed. At the end of that study, the broilers with 1% black pepper in their feed had the highest body mass. The lowest body mass was measured in broilers without phytobiotics. *Qamar et al.* (2015) added different phytobiotics to broilers' drinking water and found significantly ($p<0.05$) the highest body mass in those broilers compared to others which did not intake phytobiotics.

Body mass of broilers is a good indicator of nutritive value and hygienic quality of feed, but total gain is better. Total gain usually is shown by phase of fattening or by whole fattening period. Our results (Table 2) showed that broilers receiving phytobiotics had significantly better total gain ($p<0.01$) than control broilers at the end of the fattening period. This is in agreement with the results of many authors, such as *Ghasemi et al.* (2014), *El Tazi et al.* (2014) and *Murugesan et al.* (2015). They all found that phytobiotics in broiler feed had positive impacts on broilers' total gain. *Cross et al.* (2007) found that adding thyme essential oils (1 g kg^{-1}) to broiler feed resulted in significantly higher total gain in those broilers.

Table 2. Average body mass (g) of Cobb broilers per day and total gain (g) per phase by group

Average body mass (g)			Total gain (g)		
Day	C	P	Phase (days)	C	P
1	46.80±3.27	46.33±3.57	1–10	207.83±16.26	211.03±23.90
10	254.63±16.78	257.37±23.97	11–20	489.43±80.59	520.77±51.56
20	744.07±81.95^{a}	778.37±44.24^{a}	21–42	1590.23±173.84	1682.60±189.60
42	2334.30±147.78^{A}	2460.97±190.89^{A}	1–42	2287.50±147.61^{A}	2414.63±190.12^{A}

Legend: Means within a row with a common superscript letter differ significantly: ^{a} $p<0.05$; ^{A} ($p<0.01$)

Table 3. Average daily feed consumption (g), total feed consumption (kg) and feed conversion (kg) during the fattening of broilers

	Daily feed consumption (g)		**Total feed consumption (kg)**		**Total feed consumption (kg)**	
Phase (days)	C	P	C	P	C	P
1–10	44.82	42.00	0.448	0.420	0.448	0.420
11–20	95.58	95.67	0.956	0.957	0.956	0.957
21–42	159.44	152.22	3.348	3.197	3.348	3.197
1–42	113.15	108.89	4.752	4.573	4.752	4.573

Results of average daily and total feed consumption and feed conversion are shown in Table 3.

Summing up the results (Table 3), phytobiotics in feed reduced the overall consumption of feed in relation to feed without phytobiotics. The same effect was seen by *Hashemi et al.* (2014) and *El Tazi et al.* (2014). Some authors (*Ocak et al.,* 2008; *Amad et al.,* 2011; *Banjo,* 2012; *Gadzirayi et al.,* 2012; *Qamer et al.,* 2015) showed that addition of phytobiotics to broiler feed or water had no impact on feed consumption. It should be noted that in similar studies, differences in phytobiotic use (composition and quantity) occur, producing differing results and effects on appetite and feed consumption.

Feed conversion, as well as the interaction of feed consumption and gain, is one of the best indicators of feed quality and cost of production. Our phytobiotic-receiving broilers had better feed conversion in all phases of fattening, than control broilers (without phytobiotics). *El Tazi et al.* (2014) also found similar results in broilers receiving different concentrations of black pepper in their feed. Adding different phytobiotics, such as garlic (*Allium sativum*), thyme (*Thymus vulgarus*), or echinacea (*Echinacea purpurea*) to broiler feed results in better feed conversion (*Aji et al.,* 2011; *Rahimi et al.,* 2011 and *Khan et al.,* 2012)

Average meatiness of carcasses resulting from the broilers is shown in Table 4.

The broilers with phytobiotics in feed produced more meaty carcasses than control broilers without phytobiotics (Table 4). Carcass yield was better in the phytobiotic broilers than in the control broilers. The same results were obtained by *Oleforuh-Okoleh et al.* (2014) – better carcass yield occurred in broilers which received phytobiotics in feed. *Zhang et al.* (2005) and *Abou-Elkhair et al.* (2014) also produced better carcass yields in broilers with phytobiotics

Table 4. Carcass yield, cold carcass weight, weight of breasts and thigh with drumsticks and their participation in carcass on in carcass of the broilers

Group	**Carcass yield (%)**	**Cold carcass weight (g)**	**Breast**		**Thigh with drumstick**	
			(g)	(%)	(g)	(%)
C	78.26	1826.82±200.60[a]	618.61±86.41[A]	34.93	491.42±43.61[A]	27.85
P	79.18	1948.66±161.99[a]	698.57±50.84[A]	36.43	544.36±30.49[A]	28.38

Legend: Means within a column with a common superscript letter differ significantly: [a] $p<0.05$; [A] $p<0.01$

Table 5. Chemical composition of broiler breast meat and thigh with drumstick meat (%)

Parameters	**Breast meat**		**Thigh with drumstick meat**	
	C	P	C	P
Protein	22.10±3.04	21.86±0.75	18.85±0.92	18.73±1.08
Water	73.42±2.50	73.85±1.31	72.07±1.81	73.35±3.20
Fat	3.49±1.08	3.25±0.92	8.10±1.70	6.90±2.11
Ash	0.99±0.03	1.04±0.02	0.98±0.05	1.02±0.03

added to feed. In our study, broilers receiving phytobiotics had better cold carcass weight than control broilers ($p<0.05$). The same effect was reported by *Oleforuh-Okoleh et al.* (2014) and *Erener et al.* (2011). Breast and thigh with drumstick weights and their participation in the carcass depends on many factors such as genetic, feed, fattening period, sex and age (*Bogosavljevic-Boskovic et al.,* 2011). We found a positive impact of the phytobiotics in feed on breast and thigh with drumstick weights ($p<0.01$), and on their participation in carcasses. *Khattak et al.* (2014) found similar effects in Ross 308 broilers.

The chemical composition of broiler breast meat and thigh with drumstick meat is shown in Table 5.

Chemical composition of meat depends on different factors such as provenance of broilers, sex, age, nutritional status and part of the carcass (*Strakova et al.,* 2002; *Suchy et al.,* 2002; *Araujo et al.,* 2004). There was no significant difference in chemical composition of the breast or thigh with drumstick meat between our broiler groups (Table 5). Results from some authors (*Al-Beitawi and El-Ghousein,* 2008; *Sarker et al.,* 2010) showed that phytobiotics in feed had an impact on chemical composition of the resultant meat.

Conclusion

Phytobiotics added to broiler feed had a positive impact on all production results and meatiness in the broilers. Broilers which received phytobiotics had higher body mass and total gain, lower feed consumption, better feed conversion and produced more meaty carcasses than broilers which did not consume phytobiotics.

Using phytobiotics in feed for poultry achieves similar effects as does the use of antibiotics, but phytobiotics do not result in tissue residues and they do not have a withdrawal period. Therefore, phytobiotics could become ideal feed additives and successfully replace antibiotics as growth promoters in broiler feed.

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