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Effects of *Andrographis paniculata* and *Orthosiphon stamineus* Supplementation in Diets on Growth Performance and Carcass Characteristics of Broiler Chickens

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Abstract

This study was conducted to evaluate the effects of different dosages of *Andrographis paniculata* and *Orthosiphon stamineus* (OS) in the diet of broiler chickens on their growth performance and carcass characteristics. Two hundred and eighty Cobb broiler chickens 3 to 6 weeks of age were divided into seven groups, with 40 chickens per group in a completely randomized design with seven dietary treatments. The dietary treatments were as follows: basal diet (BD, control), BD + 0.2% *A. paniculata* (2 g/kg AP), BD + 0.4% AP, BD + 0.8% AP, BD + 0.2% *O. stamineus* (2 g/kg OS), BD + 4 g/kg OS, and BD + 8 g/kg OS. Weight gain of broiler chickens fed on a diet supplemented with powdered OS was improved significantly over birds raised on a control diet. The highest weight gain was attained by broilers fed on a diet containing 8 g/kg OS. Abdominal fat component of broiler chickens was also reduced by OS. The results of this study showed that powdered OS was beneficial as a supplement in the broiler chicken diet and has the potential of replacing other conventionally used inorganic feed additives that may be unsustainable or hazardous.

Keywords: *Andrographis paniculata*; Body weight; Broiler chickens; Carcass characteristics; *Orthosiphon stamineus*

Introduction

In Malaysia, broiler production plays an important role in income generation of farmers. Antibiotics have been used widely to artificially increase broiler health and subsequently improve broiler production. However, this practice has led to the growth of multiple drug resistant bacteria (Wray and Davies, 2000). To prevent the risk of developing such pathogens and also to satisfy consumer demand for a food chain free of drugs, use of in-feed antibiotics in the European Community were totally banned in January 2006 (Council Regulation, 1998).

Currently, many laboratories are experimenting with different feed additives that may be used to alleviate the problems associated with the withdrawal of antibiotics from feed. One such alternative is the addition of medicinal plants in poultry diets. Unlike many synthetic antibiotics or inorganic compounds, these plant-derived products have low toxicity and are residue free. Not only are medicinal herbs consumed by people, they are thought to be ideal supplements in animal feeds to enhance the growth and health of the animals (Hashemi *et al*., 2008; Mahmood *et al*., 2009). Various commercial additives of plant origin, such as herbs, spices and various plant extracts have received increasing attention as possible substitutes for antibiotic-based growth promoters commonly used in the poultry to improve broiler performance (Hernandez *et al*., 2004; Mahmood *et al*., 2009; Babar *et al*., 2012; Raziq *et al*., 2012; Mushtaq *et al*., 2012).

Various herbs have been found to have antiviral and anti-oxidative properties; they also stimulate the endocrine and immune system. Fabricant and Farnsworth (2001) note that phytochemicals from medicinal plants showing antimicrobial activities have important potential in this respect because the molecular structures of the active compounds are different from those of the more studied microbial sources; therefore, their mode of action may similarly differ. For example, *Andrographis paniculata* (Andrographolide) has been traditionally used as an anti-inflammatory, hepatoprotective, antiviral, antioxidant, and immune enhancing agent (Prajjal *et al.*, 2003). An active component of this herb has been shown to have anti-cancer (Sheeja and Kuttan, 2007), and anti-HIV (Calabrese *et al.*, 2000) properties. Roy *et al*. (2010) reported that *A.*

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paniculata extract also contained antimicrobial activity.

Another herb, *Orthosiphon stamineus*, has been used to treat urinary lithiasis, edema, eruptive fever, influenza, rheumatism, hepatitis, jaundice and biliary lithiasis (Akowuah *et al.*, 2005). In addition, three main flavonoids founds in *O. stamineus*, *viz.* sinensitin, eupatorin and 3′–hydroxy-5,6,7,4′-tetramethoxyflavone, have also demonstrated cytotoxic, antifungal and antioxidant activities (Loon *et al.*, 2005). Studies by Ho *et al*. (2010) showed that rosmarinic acid found in *O. stamineus* extract had active antimicrobial and free radical scavenging characteristics. The antioxidant properties of natural antioxidants like *A. paniculata* and *O. stamineus* might decrease reactive oxygen species thus, decreasing protein oxidation that could affect poultry growth and N metabolism.

Keeping in view the medicinal potential of *A. paniculata* and *O. stamineus*, effect of these two herbs was investigated on the growth performance and carcass characteristics of broiler chickens.

Materials and Methods

Two hundred and eighty day-old male broiler chickens (Cobb 500) were obtained from a local hatchery. Broilers were randomly assigned into 35 cages with dimension of each cage at 122 cm (length) × 91 cm (width) × 50 cm (height). The chickens were maintained in cages, heated with 24 h lighting (for seven days) by two-incandescent light bulb (60 watts) located at each cage, and the temperature and humidity approximately recorded as 32°C and 62%, respectively. From 8-days-old to the end of experiment, no lighting was supplied and chicken were grown at ambient temperature and humidity (28°C and 60%, respectively). Broilers had *ad libitum* access to water and diet, and were fed a commercial broiler starter (0–6 days) and grower (7 – 20 days) diets. At the end of week 3, broilers were weighed and reassigned to seven different dietary treatments based on the average weight. Each treatment had five replicates containing eight broilers in each replicate. During 21–42 days of the experimental period, broilers were fed the following diets: basal diet (BD), which was the Control (the formulation for which is presented in Table 1), BD with 0.2% *A. paniculata* (AP; 2 g/kg), BD with 4 g/kg AP, BD with 8 g/kg AP, BD with 0.2% *O. stamineus* (OS; 2 g/kg), BD with 4 g/kg OS, BD with 8 g/kg OS. Dietary treatments were formulated according to the National Research Council (NRC, 1994). The feed was offered *ad libitum* and refilled at 08:30 and 17:30 daily, and the residual feed was collected and weighed on weekly basis. Dietary and nutrition-related chemical composition analyses were performed using AOAC International (1995) procedures (Table 1).

Fresh samples of cultivated AP and OS were obtained from the Herbal Farm in Universiti Putra Malaysia. The plant sample was authenticated by Gene Bank Centre, Faculty of Agriculture, Universiti Putra Malaysia. The leaves of these plants were collected and oven-dried at 60°C for 72 h. The dried plant were ground to obtain powder using a Willey mill (Thomas ® Willey cutting mill model 4) through a 1 mm screen and stored at 4°C until further use.

Table 1: Ingredients in the basal diet and nutritional analysis

Ingredients	%
Corn	61
SBM (44%)	25
Fish Meal	6.41
Palm Oil	5
Limestone	1.26
Salt	0.28
DCP	0.1
Mineral Mix[a]	0.25
Vitamin Mix[b]	0.25
L-Lysine	0.2
DL-Methionine	0.15
Choline cloride	0.1
Chemical analysis (%)	
ME Kcal/kg	3201
Crude Protein, %	20.00
Crude Fibre, %	4.35
Crude Fat, %	3.21
Calcium, %	0.99
Available P, %	0.33

[a] Premix provided per kg of diet: Mg 56 mg; Fe 20 mg; Cu 10 mg; Zn 50 mg; Co 125 mg; I 0.8 mg

[b]Premix provided the following per kg of diet: Vitamin A 50.000MIU, Vitamin D_3 10.000MIU, Vitamin E 75.000, Vitamin K 20.000 g, VitaminB1 10.000 g, Vitamin B2 30.000 g, Vitamin B6 20.000 g, Vitamin B12 0.100 g, Calcium D-Panthothenate 60.000 g, Nicotinic acid 200.000 g, Folic acid 5.000 g, Biotin 235.000 mg

The measured indices of performance were live body weight, feed intake, weight gain (calculated as a difference between the final and initial birds weight) and feed conversion ratio (FCR) (determined as weight of feed intake per bird divided by weight gained per bird). These indices were determined weekly. The mortality rate was also recorded.

Two birds (42 days of age) were sampled per replicate group for carcass characteristics. Birds were individually weighed to the nearest gram and slaughtered by severing the carotid artery and jugular veins (Islamic method). After 5 minutes of bleeding, each bird was dipped in hot water for 20 sec and mechanically defeathered for 30 sec. The feet, head and viscera were then removed manually. The birds were then dressed, opened up and the gizzard heart, liver and intestine were removed and weights. The dressed carcass was weighed and was cut into carcass part including thigh, drumstick and breast. After that, the meat and bone parts were separated from the carcass and weighed.

A fecal digestibility trial was conducted at the end of experiment. Feed intake and excreta voided were recorded during the last 5 days. The collected excreta was dried in an oven at 60°C for 72 h, weighed and finely ground for determination of energy and protein. The ground excreta

samples were analysed for dry matter, crude protein and gross energy. The digestibility of nutrients was computed as:

$$\%\text{Digestibility} = \frac{\text{Nutrient intake (g) - Nutrient in excreta (g)}}{\text{Nutrient intake (g)}} \times 100$$

Data were analyzed by one-way analysis of variance (ANOVA). When differences were found among dietary treatments, Duncan's test was used to compare the mean differences using SPSS software (SPSS version 18, Chicago, IL, USA), with statistical significance set at $P<0.05$.

Results and Discussion

Growth Performance

Weekly live weights of broilers fed different experimental diets from week-4 until week-6 are presented in Table 2. By day-28, supplementation of OS at 4 g/kg performed best, with the broilers achieving an average weight of 1211.6 g as compared with the weight of the control birds that averaged 1114.6 g. At day-35, the live weights of broiler chickens fed on diets with medicinal plants was significantly increased ($P<0.05$) with the supplementation of 8 g/kg OS (1715.1 g mean weight) as compared with the control (1613.1 g mean weight) and 4 g/kg AP (1607.8 g mean weight) dietary treatments. Supplementation with 8 g/kg OS maintained its position as the best performing diet on day-42. The birds reached a mean weight of 2215.3 g as compared with 1986.8 g attained by the control broilers. In general, the supplementation of medicinal plants, *A. paniculata* and *O. stamineus* at various dosages in diets were comparable and even better live weights as compared to control diets or conventional diets.

In terms of cumulative weight gain increase over 42 days, the dose of 8 g/kg OS achieved the highest gain of 1450.1 g as compared with cumulative weight gain from the control diet (1218.0 g) (Table 2). Feeding of *A. paniculata* did not improve the body weight gain compared to control diet. This finding was supported with earlier report by Mathivanan *et al*. (2006) who observed no response in average weight gain among *A. paniculata* and controls groups.

Possible antimicrobial properties (Ho *et al*., 2010) might explain the promotion of broiler chicken live body weight by OS supplementation in the present study. Gaskin (2001) observed that a host animal infected with bacterial pathogen would have its nutrient uptake compromised; impaired nitrogen metabolism could lead to fermentation of amino acids resulting in the production of toxic metabolites which could affect intestinal cell turnover and reduce growth. It is, hence, possible that, in the present study, the herbal additives in the diet controlled and limited the growth and colonization of pathogenic and non-pathogenic bacteria in the gut. In addition Roy *et al*. (2010) reported that *A. paniculata* could be used for treatment of gastrointestinal tract infections. The present study revealed the best improvement in the growth of broiler chickens when the birds were fed on a diet supplemented with 8 g/kg OS. A 19% increase in live body weight was recorded in this group of chickens as compared with the control group. This study also found lesser, but still significant, increases in growth from the supplementation of OS in diet at selected dosages.

The cumulative feed intake was not statistically influenced by the supplementation of either *A. paniculata* or *O. stamineus* (Table 3). This showed that broiler chickens adapted well to the dietary supplements. However, Sapcota *et al*. (2005) found that feeding of *A. paniculata* increased the feed intake on dose dependent pattern in broilers. At 6 weeks, the FCR was significantly lower in 8 g/kg OS (1.70) as compared to control (2.47) and 2 g/kg AP (2.47) diets. However, the FCR in 8 g/kg OS diet was similar with 4g/kg OS (1.87), 2 g/kg OS (2.00), 8 g/kg AP (2.10) and 4 g/kg AP (1.90) ($P<0.05$). This finding was supported by several reports (Sapcota *et al*., 2005; Mathivanan *et al*., 2006) indicating that *A. paniculata* improved the FCR in chicken. Improved FCR in fed groups might be due to better utilization of nutrients, by reduced pH, viscosity and intestine thickness in gastrointestinal tract of broiler. Unfortunately, no other reports are available on the effect of *O. stamineus* on bird growth performance. Low mortality rates in almost all dietary treatments with AP and OS as compared with control diet and with several commercially produced broiler at 2 to 7% mortality (Teguia and Beynen, 2004), may have been resulted from the beneficial attributes of medicinal plant supplement in broiler's diet which improved growth performance with lower FCR.

Carcass and Organ Weights

There were no significant differences ($P>0.05$) in dressing percentage between the two herbal treatments or their varying dosages. However, the meat bone ratio of birds fed on 8 g/kg OS and 4 g/kg OS were significantly different ($P<0.05$) as compared to 2 g/kg OS, 2 g/kg AP, 4 g/kg AP and control diet (Table IV). Abdominal fat of broiler chicken fed on 4 g/kg and 8 g/kg OS was also reduced significantly at 1.55% and 1.40%, respectively as compared with the measurement from the control (2.74%) and 2 g/kg AP (2.52%) diets. To our knowledge, this is the first report of a reduction in abdominal fat in broiler chickens raised on a diet supplemented with *O. stamineus*. No significant effect in all dietary treatments was noticed in the skin weight of broiler chickens.

The present study did not find any change in the weight of the heart, gizzard and intestine following treatment with the medicinal plants, *A. paniculata* and *O. stamineus* (Table 5). The weights of liver of birds fed on diet supplemented with 8 g/kg OS and 4 g/kg OS differed significantly ($P<0.05$) from other dietary treatments. The excessive gain in liver weight indicated active activity in

Table 2: Live body weight and weight gain of broilers fed different diets for three weeks

Performance	Control	*A. paniculata*			*O. stamineus*		
		2 g/kg	4 g/kg	8 g/kg	2 g/kg	4 g/kg	8 g/kg
Live weight (g)							
Initial (day 21)	765.7±19.29	764.3±23.26	768.0±19.98	761.4±20.28	762.7±22.77	765.9±22.13	762.2±12.4
Week 4 (day 28)	1114.6±21.39^{b}	1161.3±25.52^{ab}	1138.1±27.96^{ab}	1125.9±34.33^{ab}	1173.75±26.04^{ab}	1211.6±25.31^{a}	1191.1±28.74^{ab}
Week 5 (35 day)	1613.1±30.50^{b}	1682.9±32.40^{ab}	1607.8±25.86^{b}	1659.3±27.56^{ab}	1688.5±30.37^{ab}	1651.5±25.83^{ab}	1715.1±43.50^{a}
Final (42 day)	1986.8±28.55^{b}	2032.1±31.67^{b}	2068.8±42.42^{ab}	2085.1±39.08^{ab}	2104.9±54.9^{ab}	2112.5±63.16^{ab}	2215.3 ±60.70^{a}
Cumulative Weight gain	1218.0±48.39^{b}	1264.8±67.47^{ab}	1258.8±55.79^{ab}	1320.8±57.57^{ab}	1339.28±119.34^{ab}	1343.6±48.54^{ab}	1450.1±57.81^{a}
Gain in Week 4	348.9±22.48	397.0±30.33	367.7±38.99	364.6±35.99	411.1±37.67	445.6±40.20	429.0±20.09
Week 5	498.5±38.32	521.6±31.60	472.1±50.32	533.4±35.06	514.8±59.54	440.1±34.32	523.9±29.82
Week 6	370.6±26.10^{ab}	346.1±57.51^{b}	419.0±42.44^{ab}	422.9±28.83^{ab}	413.4±46.41^{ab}	457.8±42.46^{ab}	497.2±26.99^{a}

Table 3: Feed intake, FCR and mortality of broilers fed different diets for three weeks

Performance	Control	*A. paniculata*			*O. stamineus*		
		2 g/kg	4 g/kg	8 g/kg	2 g/kg	4 g/kg	8 g/kg
Cumulative Feed intake	2404.4±40.30	2352.0±40.22	2375.9±73.26	2392.7±51.51	2323.9±82.93	2323.9±44.46	2366.7±33.09
Intake in Week 4	691.4±34.58	669.5±35.06	685.4±34.58	670.5±15.48	671.5±15.49	702.9±23.18	730.8±35.27
Week 5	803.2±36.28	834.9±39.92	827.8±32.72	855.0±32.02	845.9±32.87	800.1±10.86	800.0±30.51
Week 6	909.9±21.78	847.5±27.91	862.8±46.78	867.2±43.88	867.5±41.94	821.1±33.20	836.3±37.1
Cumulative FCR	2.05±0.10^{a}	1.94±0.05^{ab}	1.91±0.17^{ab}	1.87±0.12^{ab}	1.83±0.15^{ab}	1.78±0.05^{ab}	1.65±0.06^{b}
FCR in Week 4	2.03±0.18	1.72±0.12	1.96±0.25	1.92±0.22	1.70±0.18	1.61±0.10	1.72±0.10
Week 5	1.65±0.11	1.62±0.1	1.87±0.27	1.63±0.12	1.78±0.29	1.86±0.14	1.55±0.09
Week 6	2.47±0.08^{a}	2.47±0.09^{a}	1.90±0.08^{b}	2.10±0.06^{b}	2.00±0.06^{b}	1.87±0.20^{b}	1.70±0.13^{b}
Mortality (%)	0.71	0	1.07	0	0	1.07	0.71

Table 4: Carcass characteristics of broilers fed experimental diets (42 days)

Characteristics	Control	*A. paniculata*			*O. stamineus*		
		2 g/kg	4 g/kg	8 g/kg	2 g/kg	4 g/kg	8 g/kg
Dressing percentage (%)	70.10±2.14	70.24±2.05	70.87±2.80	71.17±2.11	71.05±1.66	71.49±1.90	71.56±1.25
Meat/bone ratio	3.74±0.13^{b}	3.93±0.20^{b}	4.07±0.18^{b}	4.31±0.08^{ab}	4.01±0.14^{b}	4.67±0.13^{a}	4.72±0.37^{a}
Abdominal fat (%)	2.74±0.31^{a}	2.52±0.36^{a}	2.26±0.31^{ab}	1.95±0.35^{ab}	2.02±0.22^{ab}	1.55±0.09^{b}	1.40±0.12^{b}
Skin (%)	10.54±0.76	10.21±0.64	10.87± 0.58	10.27±0.92	10.15±0.88	10.91±0.77	10.29±0.42

Table 5: Organs weight expressed as percentage of Live-weight (42 days)

Organ	Control	*A. paniculata*			*O. stamineus*		
		2 g/kg	4 g/kg	8 g/kg	2 g/kg	4 g/kg	8 g/kg
Liver	2.25±0.11^{bc}	1.89±0.12^{c}	2.03±0.11^{bc}	2.13±0.13^{bc}	2.28±0.08^{b}	2.38±0.16^{ab}	2.71±0.12^{a}
Heart	0.47±0.02	0.45±0.03	0.42±0.03	0.42±0.02	0.44±0.03	0.43±0.03	0.42±0.02
Gizzard	2.34±0.08	2.20±0.08	2.27±0.11	2.34±0.16	2.30±0.10	2.54±0.03	2.53±0.04
Intestine	5.28±0.13	5.05±0.16	5.06±0.14	5.28±0.37	5.06±0.19	5.10±0.35	5.23±0.17

Table 6: Digestibility of dry matter, crude protein and apparent metabolizable energy of the experimental diets

Organ	Control	*A. paniculata*			*O. stamineus*		
		2 g/kg	4 g/kg	8 g/kg	2 g/kg	4 g/kg	8 g/kg
Dry matter (%)	70.70±2.36^{b}	79.84±2.47^{ab}	74.14±3.60^{ab}	85.04±2.19^{a}	80.18±5.87^{ab}	82.34±1.86^{ab}	79.00±5.43^{ab}
Crude Protein (%)	60.42±2.13^{b}	62.71±2.26^{b}	65.80 ±1.15^{ab}	67.32 ±3.10^{ab}	61.41± 3.82^{b}	66.94 ±3.06^{ab}	72.28 ± 4.10^{a}
Apparent Metabolizable Energy (MJ/kg)	12.72±0.08^{c}	12.91±0.01^{bc}	13.17±0.02^{ab}	12.63±0.09^{c}	12.56±0.02^{c}	13.06±0.29^{ab}	13.29±0.03^{a}

Means with different letter between the columns are significantly different at 0.05 levels

hepatic metabolism. This observation is comparable to that made by Debersac *et al*. (2001) when rats fed with the rosemary extract showed enhanced hepatic metabolism and increased liver weight. Several herbs and herb-based products cause hepatic toxicity (Saad *et al*., 2006). For example, Fenton (2002) documented hepatic toxicity arising from the consumption of mushroom and stone fruits that could result in fatality. The increase of protein synthesis within hepatocytes and the proliferation of smooth endoplasmic reticulum could also result in the increase of the liver weight. According to Schulte-Hermann (1979), increase in the liver weight in short term experiments could not usually be attributed to pathologic or regenerative changes but appeared to be due to a combination of

hypertrophy and hyperplasia as shown by increase of total DNA content, parenchymal DNA synthesis and mitotic activity. Therefore, histopathological studies on the liver should be performed in future investigations on the effect of *A. paniculata* and *O. stamineus* supplementation.

Digestibility

The digestibility of nutrients in terms of dry matter (DM) and crude proteins (CP) is shown in Table VI. Nutrient digestibility in terms of DM, CP and energy were significantly different for each dietary treatment. The digestibilities of DM were significantly different between diet 8 g/kg AP and the control diet. The digestibilities of CP for birds fed diet 8 g/kg OS were significantly higher ($P<0.05$) when compared with that of birds on the 2 g/kg AP, 2 g/kg OS and control diets. Nutrient digestibility in terms of Apparent Metabolizable Energy (AME) for birds fed diet 8 g/kg OS was significantly higher ($P<0.05$) when compared with that of chickens on the control, 8 g/kg AP and 2 g/kg OS diets.

The increase in Apparent Metabolizable Energy (AME) upon supplementation with *O. stamineus* may be associated with improved digestive enzyme secretion. It has been reported that incorporation of essential oil extracted from thyme in poultry diets enhanced the secretion of digestive enzymes, thereby increasing AME (Jang *et al*., 2007). Hernandez *et al*. (2004) reported that extracts from some herbal plants such as sage (*Salvia officinallis*), thyme (*Thymus vulgaris*) and rosemary (*Rosemaryinus officinalis*), and a blend of carvacrol, cinnamaldehyde and capsaicin improved feed digestibility in broilers. The authors attributed the positive effects of plant extracts to nutrient digestibility, better appetite and digestion-stimulating properties and antimicrobial effects. Increased feed intake and digestive secretions were also observed in animals given herbal supplemented feed (Jamroz *et al*., 2003). In this study it was concluded that the increase in feed digestibility led to an increase availability of nutrients, which account for the significant increase in growth rate and feed efficiency.

Conclusion

Growth performance in terms of weight gain was improved in broiler chicken fed on a diet supplemented with the *O. stamineus*. Supplementation of the diet with 8 g/kg OS resulted in the most improved rate of weight gain because of increase in feed digestibility led to an increase availability of nutrients. Nevertheless, the reason for increased liver weight of broiler chickens on this treatment requires further investigation. It is important to undertake histo-pathological studies to ascertain that this change is not associated with any negative effect on the overall health of broiler chickens. The present study also found that powdered OS could reduce abdominal fat in the carcass component of broiler chickens. Broilers fed on either medicinal plant suffered very low mortality in the course of the study. It is concluded here, therefore, that powdered *O. staminues* or commonly known as "misai kucing" or cat whiskers is beneficial as a supplement in the broiler chicken diet. As an organic compound, it has the potential to replace inorganic compounds in conventional use that may be unsustainable or hazardous.

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References

Akowuah, G.A., Z. Ismail, I. Norhayati and A. Sadikun, 2005. The effects of different extraction solvents of varying polarities on polyphenols of *Orthosiphon stamineus* and evaluation of the free radical-scavenging activity. *Food Chem*., 93: 311–317

AOAC International, 1995. *Official Methods of Analysis*, 16th edition. AOAC International, Arlington Virginia, USA

Babar, W., Z. Iqbal, M.N. Khan and G. Muhammad, 2012. An inventory of the plants used for parasitic ailments of animals. *Pak. Vet. J*., 32: 183–187

Calabrese, C., S.H. Berman, J.G. Babish, X. Ma, L. Shinto, M. Dorr, K. Wells, C.A. Wenner and L.J. Standish, 2000. A Phase I trial of andrographolide in HIV positive patients and normal volunteers. *Phytotherapy Res*., 14: 333–338

Council Regulation 98/2821/CEE, 1998. *Official Gazette of European Community*. No. L 351. 29 December 1998. Office for Official Publications of the European Communities. Luxembourg

Debersac, P., M.F. Vernevaut, M.J. Amiot, M. Suschetet and M.H. Siess, 2001. Effect of a water-soluble extract of rosemary and its purified component rosmarinic acid on xenobiotic metabolizing enzymes in rat liver. *Food Chem. Toxicol*., 29: 109–117

Fabricant, D.S. and N.R. Farnsworth, 2001. The value of plants used in traditional medicine for drug discovery. *Environm. Heal. Perspect.*, 109: 69–75

Fenton, J.J., 2002. *Toxicology: A Case-Oriented Approach*, pp: 17–20. CRC Press, New York, USA

Gaskin, H.R., 2001. Intestinal Bacteria and their Influence on Swine Growth. *In: Swine Nutrition*, 2nd edition, pp: 585–608. Lewis, A.J. and L.L. Southern (eds.). CRC Press, Boca Raton, Florida, USA

Hashemi, S.R., I. Zulkifli, M. Hair-Bejo, A. Farida and M.N. Somchit, 2008. Acute toxicity study and phytochemical screening of selected herbal aqueous extract in broiler chickens. *Int. J. Pharmacol*., 4: 352–360

Hernandez, F., J. Madrid, V. Gargia, J. Orengo and M.D. Megias, 2004. Influence of two plant extracts on broiler performance, digestibility and digestive organ size. *Poult. Sci*., 83: 169–174

Ho, C.H., I. Noryati, S.F. Sulaiman and A. Rosma, 2010. *In vitro* antibacterial and Antioxidant activities of *Orthosiphon stamineus* Benth extracts against food-borne bacteria. *Food Chem*., 122: 1168–1172

Jamroz, D., J. Orda, C. Kamel, A. Wiliczkiewicz, T. Wertelecki and J. Skorupinska, 2003. The influence of phytogenetic extracts on performance, nutrient digestibility, carcass characteristics and gut microbial status in broiler chickens. *J. Anim. Feed Sci*., 12: 583–596

Jang, I.S., Y.H. Ko, S.Y. Kang and C.Y. Lee, 2007. Effect of a commercial essential oil on growth performance, digestive enzyme activity and intestinal microflora population in broiler chickens. *Anim. Feed Sci. Technol*., 134: 304–315

Loon, Y.H., J.W. Wong, S.P. Yap and K.H. Yuen, 2005. Determination of flavanoids from *Orthosiphon stamineus* in plasma using a simple HPLC method with ultraviolet detection. *J. Chromatogr. B*, 816: 161–166

Mahmood, S., M.M. Hassan, M. Alam and F. Ahmad, 2009. Comparative efficacy of *Nigella sativa* and *Allium sativum* as growth promoters in broilers. *Int. J. Agric. Biol.*, 11: 775–778

Mathivanan, R., S.C. Edwin, R. Amutha and K. Viswanathan, 2006. Panchagavya and *Andrographis paniculata* as alternatives to antibiotic growth promoter on broiler production and carcass characteristics. *Int. J. Poult. Sci*., 5: 1144–1150

Mushtaq, M., F.R. Durrani, N. Imtiaz, U. Sadique, A. Hafeez, S. Akhtar and S. Ahmad, 2012. Effect of administration of *Withania somnifera* on some hematological and immunological profile of broiler chicks. *Pak. Vet. J*., 32: 70–72

National Research Council (NRC), 1994. *Nutrient Requirements of Poultry*, 9th edition. National Academy Press, Washington DC, USA

Prajjal, K., S. Singhaa, S. Royb and Deya, 2003. Antimicrobial activity of *Andrographis paniculata*. *Fitoterapia*, 74: 692–694

Raziq, F., S. Khan, N. Chand, A. Sultan, M. Mushtaq, Rafiullah, S.M. Suhail and A. Zeb, 2012. Effect of water based infusion of *Aloe barbedensis, Pimpinella anisum, Berberis lycium, Trigonella foenum-graecum* and *Allium sativum* on the performance of broiler chicks. *Pak. Vet. J*., 32: 593–596

Roy, S., K. Rao, C. Bhuvaneswari, A. Giri and L.N. Mangamoori, 2010. Phytochemical analysis of *Andrographis paniculata* extract and its antimicrobial activity. *World J. Microbiol. Biotechnol*., 26: 85–91

Saad, B., S. Dakwar, O. Said, G. Abu-Hijleh, F. Al Battah, A. Kmeel and H. Aziazeh, 2006. Evaluation of medicinal plant hepatotoxicity in co-cultures of hepatocytes and monocytes. *Evidence-based Compleme. Altern. Med*., 3: 93–98

Sapcota, D.R., Islam and A.K. Medhi, 2005. Efficacy of *Andrographis paniculata* in ameliorating aflatoxicosis in broilers. *Ind. Vet. J*., 82: 529–532

Sheeja, K. and G. Kuttan, 2007. Activation of cytotoxic T lymphocyte responses and attenuation of tumor growth *in vivo* by *Andrographis paniculata* extract and andrographolide. *Immunopharmacol. Immunotoxicol*., 29: 81–93

Schulte-Hermann, R., 1979. Adaptive Liver Growth Induced by Xenobiotic Compounds: Its Name and Mechanism. *In*: *Mechanism of Toxic Action on some Target Organs*, pp: 113–124. Chambers, P.L. and P. Günzel (eds.). Springer-Verlag, Berlin, Germany

Teguia, A. and A.C. Beynen, 2012. *Nutritional Aspects of Broiler Production in Small-holder Farms in Cameroon*. Livestock Research for Rural Development. http://www.lrrd.org/lrrd16/1/tegu161.htm. 2004. Accessed on July 2, 2012

Wray, C. and R.H. Davies, 2000. Competitive exclusion - An alternative to antibiotics. *J. Vet*., 59: 107–108

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