Original Research

Dietary Supplementation of Dried Curry, Drumstick and Pepper Leaves on the Performance and Serum Characteristics of Broiler Chicken

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Abstract

A study was conducted to determine the growth performances, carcass and serum characteristics of broiler chicken fed diets supplemented with curry leaves (Murraya koenigii), drumstick leaves (Moringa oleifera) and pepper leaves (Piper nigrum) powder. Experiment was conducted with day old, one hundred and sixty broiler chicks. The growth performance, carcass characteristics and serum lipid profile of broilers were evaluated. Results of the study revealed that supplementation with drumstick and pepper leaves significantly improved ($P < 0.05$) the body weights of broilers. Feed conversion ratio was significantly lower ($P < 0.05$) in drumstick and curry leaf powder supplemented birds. The carcass weight was significantly higher ($P < 0.05$) in the birds fed with pepper leaf powder. Pepper leaf powder significantly improved the serum HDL cholesterol level compared to the drumstick leaf powder fed chicken. The dietary supplementation of curry, drumstick and pepper leaves improve the growth performances, carcass and serum characteristics of broiler chicken.

Key words: Broilers, Curry Leaves, Drumstick leaves, Growth Performance, Pepper

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Introduction

Poultry sector is the fastest growing sector in Sri Lanka among livestock sub-sectors. The rapid growth in the poultry sector demands a large quantity of good quality concentrate feeds. More than 70% of total expenses in broiler management is accounted in the form of feed management. Therefore, efficiency in feeding is one of the key factors for successful poultry production. Also, chicken meat is relatively cheaper

compared to other animal products thus made it most consumed animal protein sources in the average Sri Lankan diets (DAPH, 2016). However, the demand is mainly dependent on consumers' perceptions and meat quality. Today, meat quality plays a greater significance on public attention and the demand is based on high in lean content, low in fat, cholesterol and calories.

In Sri Lanka, different types of feed ingredients are used for the formulation of broiler feeds. Cereals, cereal by-products, oil meals, and animal by-products are the commonly used ingredients. In addition, different additives such as antibiotic-based growth promoters are incorporated into the ration. However, the use of antibiotic-based growth promoters is controversial due to the development of microbial resistance and their potential harmful effects on human health (Hao *et al.*, 2014). Utilization of natural growth promoters as an alternative eliminates these negative effects of antibiotics (Ciftci *et al.*, 2009; Greathead, 2007; Moorthy *et al.*, 2009; Rahmatnejad *et al.*, 2009). Curry leaves (*Murraya koenigii*), drumstick leaves (*Moringa oleifera*) and black pepper (*Piper nigrum*) are the medicinal herbs used in human diet and these can be used in poultry industry as growth promoters.

Literature reveals some notable pharmacological activities of the curry leaves plant such as activity on heart, anti-diabetic and cholesterol reducing property, antimicrobial activity, antiulcer activity, anti-oxidative property, cytotoxic activity, anti-diarrhea activity, anti-inflammatory and phagocytic activity (Kumar *et al.*, 1999; Rajendran *et al.*, 2014; Saini and Reddy, 2015; Syam *et al.*, 2011). It can be one of potential and alternative antimicrobial growth promoter (AGP) sources for broilers. Some of the published studies show that dietary supplementation of drumstick leaves has effect on growth performance, blood characteristics and immune response of broilers (Divya *et al.*, 2014; Du *et al.*, 2007; Hassan *et al.*, 2016; Portugaliza and Fernandez, 2012). Further, it has been reported that, black pepper improves the growth performances of broilers when providing as an additive (Tazi *et al.*, 2014). In addition, the bioactive molecule, piperine, enhances the thermogenesis of lipid and accelerates energy metabolism in the body (Malini *et al.*, 1999). Many researchers have proved the improvement in the body weight and feed conversion ratio by using black pepper leaf powder in broilers diets (Moorthy *et al.*, 2009).

Therefore, the objective of this study was intended to evaluate the effect of dietary supplementation of curry leaf, drumstick leaf and pepper leaf powder as natural feed additive on performance indicators and serum and carcass characteristics of broiler chicken.

Materials and Methods

Location

Field works were conducted at Livestock Experiment Unit, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka. Laboratory analysis were conducted at the Animal

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Science Laboratory, Faculty of Agriculture and National Institute of Fundamental Studies (NIFS), Kandy, Sri Lanka.

Birds and Experimental Design

One hundred and sixty, days old (Cobb 500) chicks were purchased from a commercial hatchery. The chicks were randomly assigned to four treatment groups including the control (T1 - broiler ration + 0.5% curry leaf powder, T2 - broiler ration + 0.5% drumstick leaf powder, T3 - broiler ration + 0.5% pepper leaf powder and T4 - broiler ration + 0% inclusion/control) and four replicates were maintained for each treatment. Ten (10) chicks were assigned for each replicate. Experiment was conducted in a Complete Randomized Design (CRD).

Preparation of Experimental Diets and Feeding

Three diets were prepared by mixing three herbal leaf powder (curry leaves, drumstick leaves, pepper leaves) separately to commercial broiler feed ration without adding antibiotics. The leaf powders were added to each diet at the rate of 0.5% (w/w). Leaves were dried and subsequently, ground separately by using a grinder to get the leaf powder. Powder was sieved using stainless steel mesh sieve and stored in airtight containers to avoid contamination and spoilage. Dried leaf powder was incorporated to basal broiler diet and mixed well. Fourth experimental group was fed with basal diet as the control.

Feeding was done according to the Veterinary Research Institute (VRI) recommendations (Table 1). Broiler starter diets were fed from day 1 to day 21 and after 21 days of feeding, starter diet was changed to the finisher diet until they were slaughtered at the age of 42 days. Proximate composition of the feed as given by the feed manufacturer, is presented in Table 2. Feeding was practiced twice per day, in the morning and evening. Water was provided *ad libitum.*

Table 1: Feeding recommendations for broilers by Veterinary Research Institute

Age (wks.)	Amount Required (g)/bird	Ration
1	15	Starter
2	40	Starter
3	55	Starter
4	80	Finisher
5	110	Finisher
6	140	Finisher

(Source: Department of Animal Production and Health, 2015)

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Table 2: Nutritional composition of commercial feeds

Nutrients	Starter	Finisher
Protein (%)	22	20
Fat (%)	6	7
Ash (%)	7	7.5
Fiber (%)	4.5	4.5
Calcium (%)	9.5 - 1.2	0.9 - 1.2
Phosphorous (%)	0.7 - 1	0.7 - 1
Metabolizable Energy (kcal / kg)	3000	3100

(Source: CIC Agri-Business, 2017)

Other Management Practices

Brooder unit was thoroughly cleaned before the arrival of chicks. Day old broiler chicks were randomly introduced into brooders and they were provided with Vitamin E (Selvite-E) and glucose solution with drinking water to reduce the stress. During 7 days of brooding period, initial heating and lighting were provided by a 100 W electric bulbs and chicks were reared under good hygienic conditions. All birds were vaccinated against infectious bursal disease (IBD) at the age of 7 and 14 days. All other standard general management practices were followed until the birds were slaughtered.

Slaughtering of Birds

At the end of the study period, birds were subjected to feed deprivation for 12 hours prior to slaughtering. After the antemortem inspections, five birds from each replicate were randomly selected and their live weights were recorded. Thereafter, they were slaughtered by cutting the major blood vessels (carotid arteries and jugular veins). They were kept for bleeding at least for 2 minutes and scaled in hot water (56^0C) for 2-5 minutes. Feathers were removed by de-feathering machine and remained feathers were shaved by a shape knife. Then, abdominal cavity was opened by a cut made at the end of the abdomen and manual evisceration was followed.

Data Collection and Calculations

Growth Performance Evaluation

Feed intake was recorded daily and body weights were recorded weekly from day 1 to slaughter. Average feed intake, average weight gain and feed conversion ratio (FCR) of birds were calculated. Mortality was recorded for each treatment separately throughout the study. Live and carcass weights were recorded and dressing percentage was calculated. Back fat weight at tail area and weight of abdominal fat were measured.

Serum Cholesterol and Glucose Level

Blood samples were collected at slaughtering from each bird to evaluate serum parameters. The samples were collected without any anticoagulant and serum was separated by centrifugation at 1500 x g for 20 min

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(Labnet Int. - C0060-240V, USA). Three serum samples from each replicate were tested for serum glucose, total cholesterol and high density lipoproteins (HDL) as per the manufacturers' guidelines (Stanbio Laboratory, Texas, USA) using Thermo Scientific Multiskan GO Microplate Reader.

Statistical Data Analysis

Data were analyzed by Analysis of variance (ANOVA) using the General Linear Models (GLM) procedures of Statistical Analysis System ver. 9.0 (SAS, 2002). Differences between the means were tested by Turkey's Standardized Range Test (TSRT) and significant difference was declared at $P < 0.05$.

Results and Discussion

Growth Performances

The effect of supplementation of different dried herbal leaf powders on the mean body weight of broiler chicken is presented in Table 3.

Table 3: Effect of the supplementation of curry, drumstick and pepper leaf powders on the mean body weight of broiler chicken

Age (days)	Treatments (body weights, g/bird)			
	Curry leaf	Drumstick leaf	Pepper leaf	Control
14	528 ± 6^{b}	558 ± 31^{a}	511 ± 7^{bc}	494 ± 8^{c}
21	778 ± 10^{a}	808 ± 10^{a}	735 ± 16^{b}	738 ± 33^{b}
28	1165 ± 48^{b}	1595 ± 195^{a}	1115 ± 34^{b}	1103 ± 118^{b}
35	1624 ± 76^{b}	1895 ± 90^{a}	1541 ± 76^{b}	1461 ± 178^{b}
42	2256 ± 39^{b}	2378 ± 113^{a}	2367 ± 169^{a}	2237 ± 119^{b}

$^{a, b, c}$ *means within the same row with different superscripts are significantly different ($P < 0.05$)*

The results revealed that, the body weight of the birds fed with drumstick leaf powder supplement significantly improved ($P < 0.05$) from initial growth stage to slaughtering stage. Portugaliza and Fernandez (2012) also observed higher body weights of broilers given with varying concentrations of *Moringa oleifera* Lam. aqueous leaf extract compared to the control treatment. As they discussed, some growth stimulation compounds of drumstick leaves may enhance the live weight of broilers.

Group supplemented with pepper leaf powder showed significantly increased ($P < 0.05$) final body weight at slaughtering stage compared to the birds fed with curry leaves supplement and control. These results were in line with the findings of Mansoub (2011), Safa *et al.* (2014) and Hossein *et al.* (2013) who showed greater growth performance in broilers when fed with different levels of black paper. It might be due to increased digestion and suppression of infectious bacteria in the gut. In addition, pepper increases the performance of digestive enzymes and absorption power. Also it decreases material transit velocity (Galib *et al.*, 2011). These enhance the digestion and absorption of nutrients, which ultimately lead to increase the weight gain of the birds. However, no any significant difference ($P < 0.05$) was observed between the final

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body weights of the birds fed with curry leaf powder supplement and the control. The feed conversion ratio (FCR) of broilers (Table 4) fed with drumstick and curry leaf powder supplements were significantly lower ($P < 0.05$) than other treatments. There are less amount of anti-nutritional factors present in the drumstick leaves and they are not negatively affected on the bioavailability of nutrients and growth promoting substances in drumstick leaves (Foidl *et al.*, 2001).

Table 4: Feed conversion ratio (FCR) of broiler chickens fed with curry, drumstick and pepper leaf powder

Age (days)	Treatments			
	Curry Leaf	Drumstick Leaf	Pepper Leaf	Control
14	1.24 ± 0.02^{b}	1.18 ± 0.06^{c}	1.28 ± 0.02^{ab}	1.33 ± 0.02^{a}
21	1.34 ± 0.03^{b}	1.29 ± 0.02^{b}	1.42 ± 0.03^{a}	1.41 ± 0.06^{a}
28	1.38 ± 0.06^{a}	1.31 ± 0.12^{b}	1.44 ± 0.05^{a}	1.47 ± 0.15^{a}
35	1.46 ± 0.07^{a}	1.35 ± 0.06^{b}	1.54 ± 0.08^{a}	1.64 ± 0.09^{a}
42	1.49 ± 0.03^{b}	1.41 ± 0.07^{b}	1.62 ± 0.11^{a}	1.70 ± 0.08^{a}

$^{a, b, c}$ *means within the same row with the same superscripts are not significantly different ($P < 0.05$)*

Some of the studies reported the improvement of growth performance of broilers fed with a diet supplemented with curry leaf powder. Moorthy *et al.* (2009) observed the enhanced body weight gain in broilers fed with curry leaf powder, either in supplement alone or in combination with ginger. This growth enhancement might be resulted from improved nutrient digestibility and antioxidant properties of curry leaves. Curry leaves are rich in essential oils such as α-pinene and β-pinene (Rajeswara Rao *et al.*, 2011) and carbazole alkaloids which have radical scavenging activity (Jain *et al.*, 2012). Hence, improved growth performance by reducing FCR in curry leaves supplemented birds in the present study may result from improved nutrient digestibility and absorption by the means of stimulating digestive enzymes and enhanced oxidative stability.

Carcass Characteristics

Dressed weight was significantly higher ($P < 0.05$) in birds fed with pepper leaf powder supplement compared to the control. There were no significant effects ($P > 0.05$) of the supplementation of each leaf powders on the dressing percentage, weight of giblets, abdominal fat weight and back fat weight of broiler chickens (Table 5).

Table 5: Effects of supplementation of curry, drumstick and pepper leaf powders on the carcass parameters of broiler chickens

Parameters	Treatments			
	Curry Leaf	Drumstick Leaf	Pepper Leaf	Control
Dressed weight (g)	1718 ± 158^{b}	1753 ± 130^{ab}	1876 ± 160^{a}	1697 ± 102^{b}
Dressing percentage (%)	76 ± 4	74 ± 4	77 ± 6	76 ± 5
Weight of giblets (g)	85 ± 20	93 ± 14	84 ± 13	85 ± 8
Abdominal fat weight (g)	45 ± 8	48 ± 6	26 ± 5	61 ± 15
Back fat weight (g)	26 ± 6	20 ± 6	25 ± 6	27 ± 5

$^{a, b, c}$ *means within the same row with the same superscripts are not significantly different ($P < 0.05$)*

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Some of the results of present study are similar with the findings of previous work. Moorthy *et al.* (2009) reported no effect of dietary curry leaf powder on carcass measurements of 6 weeks-old broilers. In addition, several studies have suggested that influence of dietary herbal essential oils on the carcass yield in poultry (Denli *et al.*, 2004). Nevertheless, this result agreed with the study of Hossein *et al.* (2013) who observed that chicks fed on basal diet with using black pepper extract on their water (2 mg mL^{-1}), produce higher carcass yield percentage as compared to the control group. Similar results have been shown by Al-Kassie *et al.* (2012). According to them, the inclusion of mixture of hot red pepper and black pepper at the levels of 0.75% and 1% in the diets significantly improved the dressing percentage of broilers. However, Symeon George *et al.* (2014) revealed that the used concentrations of cinnamon oil did not improve broiler growth performance.

Some researchers reported that inclusion of black pepper at different levels significantly reduced the abdominal fat percentage (Safa *et al.*, 2014). Birds fed on black paper diets produced the lowest abdominal fat weight, while those fed with control diet produced the highest abdominal fat. This result was in line with the finding of Hossein *et al.* (2013) who found that, the use of black pepper extract in broiler water (2 mg mL^{-1}) significantly reduced abdominal fat percentage. The result coincided with the finding of Shahverdi *et al.* (2013) who reported that, inclusion of black pepper in broilers diet (0.02%) significantly reduced abdominal fat percentage.

No significant difference ($P > 0.05$) was observed in weight of liver, heart and gizzard (edible giblets) among the different treatments. These results are in agreement with those reported by Al-Kassie *et al.* (2012) who found that, the inclusion of different levels of black pepper had no significant effect on the percentage of edible giblets. This result was in contrary with Shahverdi *et al.* (2013) and Hossein *et al.* (2013) who mentioned that, inclusion of black pepper in broilers diet (0.02%) significantly increased the liver and gizzard percentage.

Serum Cholesterol and Glucose Level

The effects of the supplementation of different dried herbal leaf powders on the serum cholesterol and glucose level of broiler chickens are presented in Table 6.

Table 6: Effects of the supplementation of curry, drumstick and pepper leaf powders on the Serum cholesterol and glucose level of broiler chickens

Parameters (mg/dL)	Treatments			
	Curry Leaf	Drumstick Leaf	Pepper Leaf	Control
Glucose	339 ± 45	340 ± 51	317 ± 56	340 ± 45
Total cholesterol	179 ± 31	170 ± 21	175 ± 16	184 ± 29
HDL	78 ± 15^{bc}	72 ± 18^{c}	94 ± 16^{ab}	101 ± 26^{a}

$^{a, b, c}$ *means with the same superscript letter are not significantly different (P < 0.05)*

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No significant effect (P > 0.05) of the supplementation of each leaf powders on the serum glucose and the total cholesterol levels of the broilers were observed in the present study (Table 6). Birds fed with Drumstick leaf powder and curry leaf powder supplements had significantly lower (P > 0.05) serum HDL cholesterol level compared to the control. Reason for this observation was not clear and the findings were not in line with previous findings showing that these herbals exhibit hypoglycemic potential and antihypertensive properties by reducing blood serum cholesterol level (Moorthy *et al.*, 2009). Curry leaves possess significant hypoglycemic potential and appears to be more effective than Glibenclamide, a known anti-diabetic drug (Arulselvan *et al.*, 2006). It was found that increasing supplementation of *Moringa oleifera* decreases contents of triglycerides in the serum of broiler chickens (Du *et al.*, 2007).

Black pepper was found to be rich in piperine which enhances the thermogenesis of lipid and accelerates the energy metabolism in the body (Malini *et al.*, 1999). Therefore, it causes to reduce the serum cholesterol level of the broilers when it is provided as a feed supplement.

Conclusion

Dietary supplementation of curry, drumstick and pepper leaves improves the growth performances and carcass quality of broiler chicken.

References

1. Al-Kassie, G.A.M., Ghassan, Y., Butris, S.J.A. and Ajeena, J., (2012). The potency of feed supplemented mixture of hot red pepper and black pepper on theperformance and some hematological blood traits in broiler diet. *Interernational Journal of Advanced Biological Research*, 2, 53-57.
2. Arulselvan, P., Senthilkumar, G.P., Sathish Kumar, D. and Subramanian, S., (2006). Anti-diabetic effect of Murraya koenigii leaves on streptozotocin induced diabetic rats. *Pharmazie*, 61, 874-877.
3. Ciftci, M., Dalkilic, B., Cerci, I.H., Guler, T., Ertas, O.N. and Arslan, O., (2009). Influence of dietary cinnamon oil supplementation on performance and carcass characteristics in broilers. *Journal of Applied Animal Research*, 36, 125-128.
4. DAPH, (2016). Report, Department of Animal Production and Health, Peradeniya, Sri Lanka.
5. Denli, M., Okan, F. and Uluocak, A.N., (2004). Effect of dietary supplementation of herb essential oils on the growth performance, carcass and intestinal characteristics of quails. *South African Society for Animal Science*, 34, 174-179.
6. Divya, Mandal, A.B., Biswas, A., Yadav, A. and Biswas, A., (2014). Effect of dietary moringa oleifera leaves powder on growth performance, blood chemistry, meat quality and gut microflora of broiler chicks. *Animal Nutrition and Feed Technology*, 14, 349-357.
7. Du, P.L., Lin, P.H., Yang, R.-Y., Fan, Y.K. and Hsu, J.C., (2007). Effects of dietary supplementation of Moringa oleifera on growth performance, blood characteristics and immune response in broilers. *Journal of the Chinese Society of Animal Science*, 36, 135 – 146.
8. Foidl, N., Makkar, H.P.S. and Becker, K., (2001). The potential of Moringa oleifera for agricultural and industrial uses. 45-76, https://miracletrees.org/moringa-doc.
9. Galib, A.M.A., Mamdooh, A.M.A. and Saba, J.A., (2011). Use of black pepper (Piper nigrum) as feed additive in broilers diet. *Roavs*, 1, 169-173.
10. Greathead, H., (2007). Plants and plant extracts for improving animal productivity. *Proceedings of the Nutrition Society*, 62, 279-290.

 DOI 10.5455/ijlr.20180421095950

11. Hao, H., Cheng, G., Iqbal, Z., Ai, X., Hussain, H.I., Huang, L., Dai, M., Wang, Y., Liu, Z. and Yuan, Z., (2014). Benefits and risks of antimicrobial use in food-producing animals. *Frontiers in Microbiology*, 5, 288.
12. Hassan, H.M.A., El-Moniary, M.M., Hamouda, Y., El-Daly, E.F., Youssef, A.W. and El-Azeem, N.A.A., (2016). Effect of different levels of *Moringa oleifera* leaves meal on productive performance, carcass characteristics and some blood parameters of broiler chicks reared under heat stress conditions. *Asian Journal of Animal and Veterinary Advances*, 11, 60-66.
13. Hossein, G., Javad, N., Frashid, K., Yasamin, M. and Yaser, R., (2013). Effect of use virginiamycin as probiotic, black pepper extract as phytogenic feed additive on performance of broiler chicks. *Journal of Agricultural Science*, 2, 521-525.
14. Jain, V., Momin, M. and Laddha, K., (2012). Murraya Koenigii: An Updated Review. *International Journal Of Ayurvedic And Herbal Medicine*, 2, 607:627
15. Kumar, V., Sharma, A., Tiwari, R. and Kumar, S., (1999). Muraya koenigii (curry leaf): A Review. *Journal of Medicinal and Aromatic Plant Science*, 21, 1139–1141.
16. Malini, T., Arunakaran, J., Aruldhas, M.M. and Govindarajulu, P., (1999). Effects of piperine on the lipid composition and enzymes of the pyruvate-malate cycle in the testis of the rat in vivo. *Biochemestry and Molecular Biology International*, 47, 537-545.
17. Mansoub, N.H., (2011). Comparison of Using different level of black pepper with probiotic on performance and serum composition of broiler chickens. *Journal of Basic and Applied Scientific Research*, 1, 2425-2428.
18. Moorthy, M., Ravi, S., Ravikuma, M., Viswanathan, K. and Edwin, S.C., (2009). Ginger, pepper and curry leaf powder as feed additives in broiler diet. *International Journal of Poultry Science*, 8, 779-882".
19. Portugaliza, H.P. and Fernandez, T.J., (2012). Growth performance of Cobb broilers given varying concentrations of Malunggay (Moringa oleifera Lam.) aqueous leaf extract. *Online Journal of Animal and Feed Research*, 2, 465-469.
20. Rahmatnejad, E., Roshanfekr, H., Ashayerizadeh, O., Mamooee, M. and Ashayerizadeh, A., (2009). Evaluation the effect of several non-antibiotic additives on growth performance of broiler chickens. *Journal of Animal and Veterinary Advances*, 8, 1757-1760.
21. Rajendran, M.P., Pallaiyan, B.B. and Selvaraj, N., (2014). Chemical composition, antibacterial and antioxidant profile of essential oil from Murraya koenigii (L.) leaves. *Avicenna Journal of Phytomedicine*, 4, 200-214.
22. Rajeswara Rao, B.R., Rajput, D.K. and Mallavarapu, G.R., (2011). Chemical diversity in curry leaf (Murraya koenigii) essential oils. *Food Chemistry*, 126, 989-994.
23. Safa, M.A., Tazi1, E., Mukhtar, M.A., Mohamed, K.A. and Tabidi, M.H., (2014). Effect of using black pepper as natural feed additive on performance and carcass quality of broiler chicks. *Global Advanced Research Journal of Agricultural Science*, 3, 113-118.
24. Saini, S.C. and Reddy, G.B.S., (2015). A Review on curry leaves (Murraya koenigii): Versatile multi-potential medicinal plant: A Review. *American Journal of Phytomedicine and Clinical Therapeutics*, 3, 363-368.
25. SAS, (2002). Statistical Analysis System. Users Guide Statistics, SAS Institute Inc. Cary, North Carolina, USA.
26. Shahverdi, A., Kheiri, F., Faghani, M., Rahimian, Y. and Rafiee, A., (2013). The effect of use red pepper (*Capsicum annum* L) and black pepper (*Piper nigrum* L) on performance and hematological parameters of broiler chicks.
27. Syam, S., Abdul, A.B., Sukari, M.A., Mohan, S., Abdelwahab, S.I. and Wah, T.S., (2011). The growth suppressing effects of girinimbine on Hepg2 Involve induction of apoptosis and cell cycle arrest. *Molecules*, 16, 7155.
28. Symeon George, K., Athanasiou, A., Lykos, N., Charismiadou Maria, A., Goliomytis, M., Demiris, N., Ayoutanti, A., Simitzis Panagiotis, E. and Deligeorgis Stelios, G., (2014). The effects of dietary

 DOI 10.5455/ijlr.20180421095950

cinnamon (*Cinnamomum Zeylanicum*) oil supplementation on broiler feeding behaviour, growth performance, carcass traits and meat quality characteristics, In: Annals of Animal Science, p. 883.

29. Tazi, S.M.A.E., Mukhtar, M.A., Mohamed, K.A. and Tabidi, M.H., (2014). Effect of using black pepper as natural feed additive on performance and carcass quality of broiler chicks. *International Journal of Pharmaceutical Research & Analysis*, 4, 108-113.

DOI 10.5455/ijlr.20180421095950