IJAS Iranian Journal of Applied Animal Science

# Effects of Black Plum (*Vitex doniana)* Leaf Meal Inclusion on Performance, Haematology and Serum Biochemical Indices of Cockerels

Research Article

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Received on: 30 Nov 2016
Revised on: 19 Mar 2017
Accepted on: 15 Apr 2017
Online Published on: Sep 2017

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Online version is available on: www.ijas.ir

## ABSTRACT

A total of 105, 14 weeks old cockerels weighing 1.49 ± 0.023 kg were used to investigate the effects of *Vitex doniana* leaf meal (VDLM) on performance, haematological and serum biochemical parameters in cockerels over a seven-week experimental trials. The cockerels were divided into three (3) treatment groups of 0%, 5% and 10% inclusion levels of VDLM in a completely randomized design layout. The result showed significant increase ($P<0.05$) in final body weight, average daily weight gain and feed to gain ratio. There was no significant difference ($P>0.05$) in all haematological parameters except for the absolute content of granulocyte which, significantly increased ($P<0.05$) with increase in VDLM inclusion. Serum total protein significantly increased ($P<0.05$) with increase in VDLM inclusion while serum potassium in the control was significantly ($P<0.05$) higher compared to 5% and 10% VDLM inclusions It was concluded that VDLM could be included up to 10% in cockerels diet with an improvement in performance and without detrimental alteration in haematological and serum biochemical parameters.

KEY WORDS cockerels, haematology, performance, *Vitex doniana*.

## INTRODUCTION

The inclusion of leaves in diet of poultry is becoming adaptable due to its availability and phytochemical constituents responsible for medicinal or organoleptic properties of the plant (Ugwu *et al.* 2013). Profitable livestock enterprise depends on availability and affordability of feedstuff (Adeyina *et al.* 2014). Surprisingly, the cost of producing conventional feed that supports improved performance, haematology and serum biochemistry of animal has been on the increase in Nigeria over the last three decades. This is attributable to inadequate production of grains coupled with competition between man, industry and livestock over the available feed materials. With increasing interest in foliage plant as feed ingredient, several plants have been assessed with respect to their effects on performance and blood parameters in poultry. Some of which are *Napoleon imperialis*, *Ipomea asorfolia* and *Ipomea purpurea* (Adeyina *et al.* 2014). With the current emphasis on improvement of livestock production in Nigeria, foliage plants have found an application without compromising nutritional standard. In the list of possible alternatives are *Leucaena leucocephala*, *Lablab purpureus*, *Tithonia diversifolia*, to mention but a few (Ekenyem *et al.* 2003). *Vitex doniana* is among plant leaves with potential for improving animal productive performance, haematology and serum parameters. It is an indigenous tropical plant distributed across tropical sub-saharan, Africa's coastal savannas and

savanna woodland. The tree is none domesticated, but it is often found at the centre of West African villages. There is little scientific information on the tree but African horticulturist and livestock stand to benefit from output of research and commercial development in Nigeria. *Vitex doniana* is commonly known as Black plum (English), 'Dinya' (Hausa), 'Oriri' (Yoruba) and 'Uchakoro' (Igbo) where the bark, leaves and roots of the plant are used in ethnomedicine for the management and treatment of numerous disorders such as microbial infection, cancer, rheumatism, hypertension and inflammatory diseases (Atawodi, 2005). The bark of the stem is aromatic and serves as blood tonic (Sofowora, 1993). An extract of *Vitex doniana* plant lowered blood pressure in rat (Olusola *et al*. 1997). These attributes make *Vitex doniana* one of the potential plants that may depict significant influence on animal. In view of this, performance haematological and serum biochemical parameters of cockerels fed *Vitex doniana* leaf meal (VDLM) were examined.

## MATERIALS AND METHODS

The experiment was conducted at the Teaching and Reasearch Farm, University of Ilorin, Kwara State, Nigeria with an average mean temperature of 32.5 ˚C and annual rainfall of about 900 mm.

Fresh matured leaves were harvested from *Vitex doniana* trees located within the study location premises in the month of February, 2015. The leaves were identified at the herbarium, Department of Plant Biology, University of Ilorin. The leaves were sun-dried in the open field for three days. The leaves were later milled using a burr mill machine to get desired particle size for inclusion in experimental diet. Samples of sun-dried leaf meal were analyzed for proximate composition (Table 1). The leaf meal was then used in formulating the experimental diets.

Three diets with comparable energy and protein content were formulated with *Vitex doniana* leaf meal at 0%, 5% and 10% levels of inclusion (Table 3) in a completely randomized design. One hundred and five, 14-weeks-old cockerels from Teaching and Research Farm, University of Ilorin were used for the experiment. The birds were allocated at random to the three dietary treatments in battery cages. Each treatment group consisted 5 replicates with 7 birds in a replicate. Experimental diets and water were offered to the birds *ad libitum* under the natural day length of 14 hours over a period of seven weeks.

At the end of the experiment, blood samples were collected from the vein under the wingweb of two birds per replicate into bottles containing ethylenediaminetetraacetic acid (EDTA) for haematological parameters and into bottles without EDTA for some serum biochemical indices.

**Chemical analysis**

Analysis of the nutrients composition of the leaf meal was carried out by the methods of AOAC (2000). Metabolizable energy of VDLM was calculated according to the method of Pauzenga (1985) and nutrient composition of the experimental diets was calculated using nutrients table (Aduku, 1993).

Haematological indices were determined using haematology analyzer (HA) model 6000. Analysis of the biochemical indices was conducted using the clinical chemistry semi-auto-analyser and a commercial biochemical assay kit.

Enzyme activities of aspartate amino transferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were analyzed by the spectrophotometric linked reaction methods (Reiching and Kaplan, 1988). Serum electrolytes were determined by the method of Young (2001).

Qualitative and quantitative phytochemical screening of the leaf meal was carried out by the methods of Trease and Evans (1989).

**Statistical analysis**

All data obtained were subjected to statistical analysis procedure using analysis of variance (ANOVA) following a completely randomized design (SAS, 1999) and level of significance ($P<0.05$) were seperated using Duncan multiple-range test (Duncan, 1955).

## RESULTS AND DISCUSSION

The proximate composition of dried *Vitex doniana* leaf meal (VDLM) and the phytochemical analysis are shown in Tables 1 and 2. VDLM contained crude protein (11.66%) which is similar to 10% reported by Nnamani *et al*. (2007) and crude fibre (7.41%). These nutrients in VDLM are comparable to wheat offal and maize bran. This suggests that VDLM has potential as good feed ingredient for cockerels. The phytochemical analysis revealed that VDLM is rich in phenol as well as saponin, tannin and flavenoids which corroborated Adejumo *et al.* (2013) who had also reported that VDLM contains tannin, saponin and flavonoids.

The performance parameters of cockerels on experimental diets are shown in Table 4. The average feed intake of cockerels on experimental and control diets are comparable indicating that VDLM based diets are acceptable and palatable to the cockerels.

According to Cheeke and Skull (1985), reduction in feed intake in poultry occurred due to unpalatability and poor acceptability of meal which contained saponin that had bitter taste.

**Table 1** Proximate composition of sun-dried *Vitex doniana* leaf meal (VDLM)

| Parameters | Sun-dried VDLM (%) |
|---|---|
| Dry matter | 88.99±0.05 |
| Crude protein | 11.10±0.08 |
| Crude fibre | 7.20±0.01 |
| Ether extract | 2.52±0.02 |
| Ash | 9.51±0.05 |
| Nitrogen free extract | 58.42±0.06 |
| Calculated nutrient* | |
| Metabolizable energy (kcal/kg) | 2691 |

* Calculated value (37×crude protein) + (81.8×ether extract) + (35.5×nitrogen free extract).

**Table 2** Phytochemical composition of *Vitex doniana* leaf meal (VDLM)

| Phytochemicals | Qualitative | Quantitative (mg/100 g) |
|---|---|---|
| Alkaloids | Present | 2.61 |
| Saponins | Moderately present | 6.48 |
| Tannins | Present | 1.45 |
| Flavonoids | Moderately present | 20.82 |
| Terponids | Present | 0.21 |
| Phenols | Highly present | 96.14 |
| Steroids | Present | 2.02 |
| Anthraquinones | Present | 0.04 |

**Table 3** Dietary composition of experimental diets

| Ingredients/VDLM inclusion(%) | 0% | 5% | 10% |
|---|---|---|---|
| Maize | 38.25 | 38.25 | 38.25 |
| Groundnut cake | 11 | 11 | 11 |
| Palmkernel cake | 16 | 16 | 16 |
| Wheat offal | 20 | 20 | 20 |
| Maize milling waste | 10 | 5 | 0 |
| VDLM | 0 | 5 | 10 |
| Methionine | 0.25 | 0.25 | 0.25 |
| Lysine | 0.25 | 0.25 | 0.25 |
| Bonemeal | 3 | 3 | 3 |
| Vitamin and mineral premix* | 0.5 | 0.5 | 0.5 |
| Salt | 0.5 | 0.5 | 0.5 |
| Palm oil | 0.25 | 0.25 | 0.25 |
| Total | 100 | 100 | 100 |
| **Calculated nutrient** | | | |
| Crude protein (%) | 16.16 | 16.17 | 16.17 |
| Metabolizable energy (kcal/kg) | 2600 | 2601 | 2606 |

* Premix supplied: vitamin A: 30789 IU; vitamin: D 36 IU; vitamin E: 115 IU; vitamin K: 77 mg; Thiamine: 39 mg; Pyridoxine: 39 mg; Riboflavin: 115 mg; Calcium panthothenate: 173 mg; Nicotinic acid: 346 mg; vitamin $B_{12}$: 0.31 mg; Folic acid: 19 mg; Manganese: 3 g; Zinc: 2 g; Iron: 1 g; Copper: 115 g; Iodine: 38 mg; Cobalt: 8 mg; Selenium: 4 mg; Antioxidant: 4 g and Chloride: 8 g.

The saponin and other phytochemicals in VDLM based diets did not affect the feed intake of the cockerels. There was a significant ($P<0.05$) increase in final weight with VDLM inclusion. Cockerels fed VDLM had higher final weight compared to cockerels on control diet. The improvement in weight of birds on VDLM based diets could be as a result of better utilization of the feed and availability of growth improvement factors such as vitamins and micro-minerals contained in VDLM as reported by Nnamani *et al.* (2007) as well as phytochemicals. There was a significant ($P<0.05$) decrease in Feed:Gain ratio (F:G) with the control diet having the highest F:G compared to VDLM based diets.

The decreased values of F:G for cockerels fed VDLM based diet suggests better feed utilization as activated by the presence of tolerable levels of phytochemicals. According to Oleszek *et al.* (2001), constituents of phytochemical may contribute to the beneficial properties of VDLM in feed improvement.

Saponin and polyphenols are anti-inflammatory agents that reduce formation of cytokines and diversion of nutrients from growth to immune response.

The saponin and phenols in VDLM could have shifted nutrient from the synthesis of cytokine to body mass production in the cockerels to effects growth performance and feed conversion efficiency.

**Table 4** Effect of *Vitex doniana* (VDLM) on performance of cockerels

| Parameters/VDLM inclusion (%) | 0% | 5% | 10% | SEM |
|---|---|---|---|---|
| Initial weight (g) | 1491 | 1471 | 1521 | 50.0 |
| Final weight (g) | 1814$^{b}$ | 1951$^{a}$ | 1960$^{a}$ | 82.4 |
| Weight gained (g) | 323$^{c}$ | 480$^{a}$ | 439$^{b}$ | 4.2 |
| Average weight gained (g/bird/day) | 6$^{c}$ | 9$^{a}$ | 8$^{b}$ | 2.3 |
| Average feed intake (g//bird/day) | 122 | 122 | 120 | 1.3 |
| Feed:gain | 18$^{a}$ | 12$^{b}$ | 13$^{b}$ | 2.1 |

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

**Table 5** Effect of *Vitex doniana* (VDLM) on haematological and serum biochemical parameters of cockerels

| Parameters/VDLM inclusion (%) | 0% | 5% | 10% | SEM |
|---|---|---|---|---|
| WBC ($\times10^{9}$/L) | 149.20 | 147.10 | 153.80 | 4.09 |
| GRAN* (cell/µL) | 29.16$^{a}$ | 37.26$^{b}$ | 37.68$^{b}$ | 1.91 |
| RBC ($\times10^{12}$/L) | 2.81 | 3.23 | 3.51 | 0.29 |
| Hb (g/L) | 173.80 | 167.20 | 180.60 | 12.82 |
| MCV (f/L) | 119.20 | 116.00 | 115.40 | 1.93 |
| PCV (%) | 38.60 | 36.40 | 43.00 | 7.75 |
| Total protein (g/dL) | 46.75$^{ab}$ | 42.00$^{a}$ | 47.75$^{b}$ | 1.520 |
| Albumin (g/dL) | 24.50 | 22.00 | 25.25 | 1.510 |
| ALT (IU/L) | 11.50 | 9.75 | 10.00 | 3.290 |
| AST (IU/L) | 10.75 | 17.25 | 15.75 | 2.21 |
| Potassium (mmol/L) | 5.63$^{b}$ | 5.00$^{a}$ | 5.30$^{ab}$ | 0.181 |

* GRAN: absolute content of granulocyte.
WBC: white blood cell; RBC: red blood cell; Hb: haemoglobin; MCV: mean corpuscular volume; PCV: packed cell volume; ALT: alanine aminotransferase and AST: aspartate aminotransferase.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The influence of dietary treatment of VDLM based diet on the haematological and serum biochemical parameters of cockerels is shown in Table 5.

Dietary treatment did not significantly (P>0.05) alter the parameters observed except for the value of absolute content of granulocyte where there was significant (P<0.05) increase with increase in VDLM.

Lack of dietary effect of VDLM based diets and control on the values of haemoglobin (Hb) across the treatments is an indication that inclusion of VDLM up to 10% did not inhibit oxygen availabilty in the blood. Haemoglobin is known to function as oxygen and carbon dioxide carrier within the body of the animal and low level of hemoglobin indicates anaemic condition. The values of Hb observed in this study implies that the cockerels are not anaemic since the values are within the normal range (70-186 g/L) reported for chickens (Mitruka and Rawnsley, 1977).

The hemoglobin and RBC values obtained in this study indicated that the birds were healthy and not anemic. This is in line with Akan and Sodipo (2012) who reported that albino rats administered with aqueous root-back extract of *Vitex doniana* were not anaemic.

Packed cell volume (PCV) which is also an indicator of anaemia was similar in the experimental birds across the treatments. This indicates that oxygen circulation was not inhibited in birds fed 5% and 10% VDLM. These values are within the range(38.4%-40.67%) for healthy chickens reported by Sebastian *et al*. (2013).

The values Mean Corpuscular Volume (MCV) observed were also in agreement with the recommended range of 90.00-140.00 fL (Bounous and Stedman, 2000).

White blood cells (WBC) are cells in the blood concerned with the recognition and subsequent removal or deactivation of foreign bodies and dead cells in the body.

The values of WBC in experimental birds remained within the normal range as stated by Bounous and Stedman, (2000). This implies that VDLM is not toxic to cockerels. This increase in absolute content of granulocyte could be as a result of possible stimulation of immune system (Kashinath, 1990).

Lack of dietary effect on the values of platelets with increase in inclusion level of VDLM is an indication that the plant did not affect the blood clotting ability of the birds. There was no significant difference (P>0.05) in serum biochemical parameters examined except for total protein and potassium. The change in serum protein could have been caused by a change in globulin. This observation signifies balanced nutritional status of birds fed VDLM based diets. Blood serum examination plays an important role in the physiology, nutritional and pathological status of an animal (Aderemi, 2004). The ALT and AST values of birds fed 5% and 10% VDLM inclusion levels are comparable to that of the control. These enzymes usually respond to the presence of toxic substances in diet (Iyayi, 1994). The observed values indicate the ability of the birds to tolerate the phytochemicals in VDLM. This suggests that the liver and bone

of the birds are not affected. The mean values for most of heamatological and serum biochemical indices are within the normal range for chicken.

## CONCLUSION

The result of this study established that *Vitex doniana* leaf meal (VDLM) produced improvement in growth, feed:gain and other parameters compared with the control. Based on these findings, it is apparent that VDLM is an available novel plant ingredient with potentials that can be utilized in cockerels' diet without negative effect on haematological and serum biochemical parameters.

## ACKNOWLEDGEMENT

The authors are acknowledges the support and assistance of Mr Famolu and Mr Adebiyi of the Teaching and Research Farm, University of Ilorin especially during the feeding trials.

## REFERENCES

Adejumo A.A., Alaye S.A., Ajagbe R.O., Abi E.A. and Adedokun F.T. (2013). Nutritional and anti-nutritional composition of black plum (*Vitex doniana*). *J. Nutr. Sci.* **l3,** 144-148.

Aderemi F.A. (2004). Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biochemistry of pullet chicks. *Trop. J. Anim. Sci.* **7,** 147-153.

Adeyina A.O., Akanbi A.S., Sanusi S.B., Olaniyi B.T., Adegoke A.G., Hassan K.T., Olaoye T.S., Salako A.O. and Adeyina O.A. (2014). Reproductive response to inclusion of graded levels of *Ipomea purpurea* leaf meal (*Morning glory*) in diets of laying chickens. *J. Agric. Sci. Environ.* **14,** 36-41.

Aduku A.O. (1993). Tropical Feedstuff Analysis Table. Ahamadu Bello University, Zaria, Nigeria.

Akan J.C. and Sodipo O.A. (2012). Effect of aqueous root-bark extract of *Vitex doniana* sweet on haematological parameters in rats. *Int. J. Chem.* **1,** 13-20.

AOAC. (2000). Official Methods of Analysis. Vol. I. 18th Ed. Association of Official Analytical Chemists, Arlington, VA, USA.

Atawodi S.E. (2005). Comparative *in vitro* trypanocidal activities of petroleum ether, chloroform, methanol and aqueous extracts of some Nigerian savannah plants. *African J. Biotechnol*. **4,** 177-182.

Bounous D.I. and Stedman N.L. (2000). Normal avian hematology: chicken and turkey. Pp. 1147-1154 in Schalm´S Veterinary Hematology. B.F. Feldman, J.G. Zinkl and N.C. Jain, Eds. Williams And Wilkisn, Lippincott, Philadelphia.

Cheeke P.R. and Skull L.R. (1985). Natural Toxicant in Feed and Poisonous Plants. AUI Publishing Company, Westport, USA.

Duncan D.B. (1955). Multiple range and multiple F-tests. *Biometrics*. **11,** 1-42.

Ekenyem B.U., Iheukwumere F.C., Iwuji T.C., Akanmu N. and Nwugo O.H. (2003). Evaluation of *Microdermis puberula* leaf meal as feed ingredients in broiler chicks production. *Pakistan J. Nutr*. **5(1),** 46-50.

Iyayi E.A. (1994). Supplemented effects of low and high cyanide cassava on performance, nutrient digestibility and serum metabolites of growing pigs. *J. Agric. Trop. Subtrop*. **95,** 199-205.

Kashinath R.T. (1990). Hypolipimedic effect of disulphide in rat fed with high lipid and / or ethanol. Ph D. Thesis. University of Bangalore, Bangalore, India.

Mitruka B.M. and Rawnsley H.M. (1977). Clinical, Biochemical and Haematological Reference Values in Normal Experimental Animal and Normal Humans. Masson Publishing, USA.

Nnamani C.V, Oselebe H.O. and Okporie E.O. (2007). Ethnobotany of indigenous leafy vegitables of Izzi clan in Ebonyi State, Nigeria. Pp. 111-114 in Proc. 20th Ann. Natal Conf. Biotechnol. Soc. Abakaliki, Nigeria.

Oleszek W., Sitek M., Stochmal A., Placente S., Pizza C. and Cheeke P. (2001). Relationship between saponin content in alfalfa and other browse folders. *J. Agric. Food Chem.* **49,** 747-752.

Olusola L., Zebulon S.C. and Okoye F.U. (1997). Effects of *Vitex doniana* stem bark on blood pressure. *Nigerian J. Nat. Prod. Med*. **1,** 19-20.

Pauzenga U. (1985). Feeding parent stock. *Zootec. Int*. **11,** 22-24.

SAS Institute. (1996). SAS®/STAT Software, Release 6.11. SAS Institute, Inc., Cary, NC. USA.

Sebastian K., Detro-Dassen S., Rinis N., Fahrenkamp D., Muller-Newen G., Merk H.F., Schmalzing G., Zwadlo-Klarwasser G. and Baron J.M. (2013). Characterization of SLCO5A1/OATP5A1 a solute carrier transport protein with non classical function. *PLoS One*. **8(12),** e83257.

Sofowora A.E. (1993). Medicinal plants and traditional medicine in Africa. Spectrum Books Ltd., Nigeria.

Trease G.E. and Evans W.C. (1989). Trease and Evans Pharmacology. Bailliere Press, London, United Kingdom.

Ugwu Okechukwu P.C., Nwodo Okwesili F.C., Joshua, Parker E., Bawa Abubakar, Ossai Emmanuel C. and Odo Christain E. (2013). Pyto chemical and anti toxicity study of Moringa Olifera Ethanol leaf extract. *Int. J. Life Sci. Biotechnol. Pherma Res*. **2(2),** 66-70.

Young D.S. (2001). Effect of Diseases on clinical laboratory test. American Association of Clinical Chemistry Press, Washington, D.C., USA.