

# Dietary Supplementation of Rauvolfia Vomitoria Root Extract as a Phytogetic Feed Additive in Growing Rabbit Diets: Haematology and Serum Biochemical Indices

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**Abstract:** The objective of the present study was to determine effect of dietary supplementation of Rauvolfia vomitoria root extract (RVME) as a phytogetic feed additive in growing rabbit diets: haematology and serum biochemical indices. Thirty (30) weaned rabbits of mixed breed and sex between 6-7 weeks with an average weight of 530.9 and 533.0 grams were divided into five treatments with three replicates per treatment consisting of 2 rabbits per replicate in a completely randomized design. Rabbits in treatment 1 (T1) were fed basal diet with 0 % RVME while T2, T3, T4 and T5 were given RVME at 20 ml, 40ml, 60 ml, and 80 ml/litre of water respectively. The experiment lasted for 12 weeks; food and water were provided ad libitum and all other management were strictly observed. Data collected were used to evaluate the some haematological and serum biochemical indices of animals. Haematological parameters covered pack cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC) and its differentials while serum analysis contained total protein (Tp), globulin, albumin, creatinine, urea, calcium, phosphorus, sodium, chloride, aspartate serum aminotransferase (AST), alanine amino transferase (ALT) and alanine phosphatase (ALP). All the haematological parameters were significantly ( $P < 0.05$ ) different among the treatment. Creatinine, urea and chloride ions not influenced by the dietary treatments ( $P > 0.05$ ) while the other serum biochemical parameters were significantly ( $P < 0.05$ ) affected by RVME. Increasing the level of RVME from 20 ml to 80 ml tended to reduce ALP, AST and ALT values. It was concluded that feeding rabbits RVME at 80 ml/ liter did not cause any negative effect on the health of the animals; the data revealed that all values were within the physiological reference range for rabbits.

**Keywords:** Rabbits, Rauvolfia vomitoria root, performance, haematology, serum

## INTRODUCTION

The indiscriminate use of antibiotics in livestock production has led to antimicrobial resistance, multiple drug resistance and harmful residual toxicity in livestock products. This has prompted a new research into developing safer and more natural feed additives, thus improving productivity, strengthening the immune system, reducing mortality and other ailments in human and animals (Alagbe, 2020; Oetting, 2005). Plants and their extracts are being used in animal nutrition as appetizers, digestive and physiological stimulants and antioxidants for the prevention and treatment of certain pathological conditions due to the presence of phytochemicals in them (Dalle et al., 2016). The use of plant extracts is more suitable for rabbits and human health care with the benefits of low cost, effectiveness and total safety (Oluwafemi et al., 2020; Olafadehan et al., 2020). Phytochemicals can be classified by their therapeutic values (anti-inflammatory, antifungal, antiviral, hypolipidemic, antioxidants, anticancer etc.) and preparation modes (syrup, decoction, tincture, infusion, maceration and inhalation) (Dalle et al., 2016; Olafadehan et al., 2020; Agostini et al., 2012; Shah et al., 2014).

Plant extracts which is reported to have immunomodulatory and physiological activity includes: *Allium sativum* (garlic), *Rosmarinum officinalis* (rosemary), *Piliostigma thonningii*, *Daniellia oliveri*, *Curcuma longa*, *Syzygium aromaticum* (clove), *Thymus vulgaris* (thyme), *Curcuma longa* (turmeric), *Origanum vulgare* (oregano), *Moringa olifera*, *Azadirachta indica*, *Indigofera zollingifera* and most recently *Rauvolfia vomitoria* root (Martins et al., 2000; Barreto et al., 2007; Alamer and Basiouni, 2005; Shittu and Alagbe, 2020; Abd-El-Hady, 2014; Akintayo and Alagbe, 2020; Alcicek et al., 2003, 2004; Al-Turki, 2007; Barug et al., 2006; Omer et al., 2012; Placha et al., 2013).

*Rauvolfia vomitoria* belong to the family Apocynaceae and it is widely distributed in Asia (China, Japan, Pakistan, Korea and India) and tropical Africa (widespread from Senegal through Cameroon, Central African Republic, Sudan to Uganda, south to Angola, DR Congo and Tanzania) (Ibironke and Olusola, 2013). It can grow to about 8 m (26 ft) high and the tree branches grow in whorls, and the leaves grow from swollen nodes in groups of three. The leaf blades are broadly lanceolate or elliptical, tapering to a long point. The small, fragrant flowers are followed by globular red fruit. All parts of the plant, except the mature wood, contain latex (Neffati et al., 2017). Traditionally, the leaves and stem bark are used for the treatment of convulsions, fever, weakness, inability to sleep, mental disorders, pain, arthritis, cancer, high blood pressure, diabetes, and health of the stomach, intestines, and liver (Olajumoke et al., 2012). *Rauvolfia vomitoria* is widely used in traditional medicine in Africa and has also become a major source of a number of compounds used in the pharmaceutical industry, particularly reserpine, reserpinine, deserpidine, ajmalicine and ajmaline. It contains in total between 40 - 80 different indole alkaloids, most of which occur in very small amounts and several are disputed. Most alkaloids occur in an unstable complex, and seasonal variation is present as well. The leaves contain 0.03 - 0.8% total alkaloids; the stem bark about 0.6%; the roots 0.15 - 0.2%; and the root bark from 1.5 - 2% (Akeem, 2019). According to Alagbe (2021), proximate composition of *Rauvolfia vomitoria* root revealed the presence of crude protein (10.04 %), crude fibre (17.11 %), ether extract (1.33 %), ash (14.57 %) and carbohydrates (51.33 g/100g). Vitamins contained  $\beta$ -carotene (1.73 mg/100g), B1 (18.11 mg/100g), B2 (0.33 mg/100g), B3 (0.25 mg/100g), B12 (0.30 mg/100g), C (41.03 mg/100g), D (0.10 mg/100g), E (0.41 mg/100g) and K (0.12 mg/100g) respectively.

Nutrients are known to influence the responses of rabbits to a disease challenge; a timely evaluation of the blood provides an opportunity to examine the physiological, nutritional and pathological status of an animal. Therefore, this study was carried out to determine the effect of dietary supplementation of *Rauvolfia vomitoria* root extract as a phyto-genic feed additive in growing rabbit diets: haematology and serum biochemical indices.

## **MATERIALS AND METHODS**

### **STUDY AREA**

The experiment was carried out at Division of Animal Nutrition, Sumitra Research Institute, Gujarat, India during the month of April to June, 2020.

### **COLLECTION AND IDENTIFICATION OF RAUVOLFIA VOMITORIA ROOT EXTRACT (RVME)**

Fresh roots from mature *Rauvolfia vomitoria* tree were harvested from different plants within Sumitra Research Institute Gujarat, India and authenticated by a certified crop taxonomist (Dr. Maureen Sharma).

### **PREPARATION OF RAUVOLFIA VOMITORIA ROOT EXTRACTS (RVME)**

The roots thoroughly washed with running tap water to remove dirt and later cut into bits and allowed to dry under shade for 10 days to retain the bioactive chemicals in the sample. The dried samples was blended into fine powder using mortar and pestle and stored in a well labeled air tight container for further analysis. *Rauvolfia vomitoria* extract was prepared by soaking 200 g of the sample in 1000 liters of water in the refrigerator at 4°C for 48 hours. The mixture was filtered using WhatMan No 1 filter paper to obtain the filtrate *Rauvolfia vomitoria* root extract (RVME).

## **ANIMAL AND THEIR MANAGEMENT**

Thirty (30) weaned rabbits of mixed breed and sex between 6-7 weeks with an average weight of 530.9 and 533.0 grams were used for the experiment; they were sourced from an open market in India. The animals were housed in an all wired cage measuring (15 × 12 × 25 cm) and equipped with feeders and drinkers. Prior to the commencement of the experiment, pen and cages were properly disinfected and all other biosecurity measures were strictly observed. They were divided into five treatments with three replicates per treatment of 2 rabbits per replicate in a completely randomized design. Rabbits were allowed two weeks adjustment period during which they were fed with basal diet (morning and evening) and given prophylactic treatment with Oxytetracycline administered intramuscularly and Ivermectin given subcutaneously adhering strictly to the package insert. Animals were fed twice daily between 7:30 am and 3:30 pm. Fresh feed and water were provided ad libitum and all other management practices were strictly observed throughout the experiment which lasted for 84 days.

## **DIET FORMULATION**

The basal diet was formulated to meet the nutrient requirements of growing rabbits according to NRC (1977).

Treatment 1: Basal diet + 0 % RVME

Treatment 2: Basal diet + 20 ml/litre RVME

Treatment 3: Basal diet + 40 ml/litre RVME

Treatment 4: Basal diet + 60 ml/litre RVME

Treatment 5: Basal diet + 80 ml/litre RVME

## **DATA MEASURED**

Feed intake (g) was determined by subtracting feed left over from feed served, it was estimated for each of the replicate daily.

## **BLOOD ANALYSIS**

At the end of the experiment blood samples were collected very early in the morning (8:00 Am) from three (3) randomly selected rabbit per replicate for haematological and serum analysis, the animals were not stressed to prevent oxygenated blood from becoming deoxygenated. About 5 ml of the sample was emptied into a labeled ethylene diamine tetraacetate (EDTA) bottle for haematological analysis. Pack cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC) and its differentials (lymphocytes, neutrophils and eosinophils) were determined according to the methods outlined by Coles (1986). Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated as:

$$\text{MCV (fl)} = \text{PCV} \times 10 / \text{RBC mm}^3$$

$$\text{MCH (pg)} = \text{Hb in g/100 ml blood} \times 10 / \text{RBC mm}^3$$

$$\text{MCHC (\%)} = \text{Hb in g/100 ml blood} \times 10 / \text{PCV}$$

Blood sample for serum biochemistry were collected into bottles without EDTA. Total protein, albumin, globulin, glucose, creatinine, urea, sodium, chloride, aspartate serum aminotransferase (AST), alanine amino transferase (ALT) and alanine phosphatase (ALP) were determined using commercial test kits (GST- 4509 A model, Punjab, India).

## **CHEMICAL ANALYSIS**

Proximate analysis of experimental diet was carried out according to methods outlined by AOAC (1990). Amino acid analysis was carried out using methods reported by Kundan (2017).

## STATISTICAL ANALYSIS

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (23.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955). Significant was declared if  $P \leq 0.05$ .

Table 1: Percentage composition of experimental diet

| Ingredients      | Quantity (Kg) |
|------------------|---------------|
| Maize            | 29.40         |
| Wheat offal      | 55.00         |
| Palm kernel meal | 4.25          |
| Soya bean meal   | 10.00         |
| Bone meal        | 0.40          |
| Limestone        | 0.20          |
| Lysine           | 0.10          |
| Methionine       | 0.10          |
| *Growers Premix  | 0.25          |
| Salt             | 0.30          |
| Total            | 100.00        |

## CALCULATED ANALYSIS (%)

|                 |        |
|-----------------|--------|
| Crude protein   | 17.08  |
| Crude fibre     | 9.87   |
| Ether extract   | 3.52   |
| Calcium         | 0.61   |
| Phosphorus      | 0.33   |
| Ca :P ratio     | 1.50   |
| Lysine          | 0.82   |
| Meth + Cystiene | 0.66   |
| ME: kcal/kg     | 2500.1 |

\* Premix supplied per kg diet :- Vit A, 7,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg ; Vit B12, 16mg ; Choline chloride, 120mg ; Mn, 5.2mg ; Zn, 25mg ; Cu, 2.6g ; Folic acid, 2mg ; Fe, 5g ; Pantothenic acid, 10mg ; Biotin, 30.5g ; Antioxidant, 56mg

Table 2: Amino acid composition of Rauvolfia vomitoria root

| Constituents  | Composition (%) |
|---------------|-----------------|
| Glutamic acid | 1.53            |
| Aspartic acid | 1.18            |
| Glycine       | 0.41            |
| Serine        | 1.28            |
| Alanine       | 9.72            |
| Histidine     | 1.01            |
| Lysine        | 0.06            |
| Methionine    | 0.02            |
| Tyrosine      | 2.04            |
| Leucine       | 3.11            |
| Isoleucine    | 1.38            |
| Threonine     | 0.02            |
| Phenylalanine | 0.36            |
| Arginine      | 10.13           |
| Proline       | 1.18            |
| Valine        | 2.50            |

Table 3: Haematological parameters of growing rabbits fed Rauvolfia vomitoria root extracts

| Parameters                        | T1                 | T2                 | T3                 | T4                 | T5                 | SEM  |
|-----------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
| PCV (%)                           | 30.28 <sup>c</sup> | 36.92 <sup>b</sup> | 39.11 <sup>a</sup> | 40.93 <sup>a</sup> | 47.02 <sup>a</sup> | 1.94 |
| Hb (g/dL)                         | 9.11 <sup>c</sup>  | 10.28 <sup>b</sup> | 11.03 <sup>b</sup> | 12.64 <sup>a</sup> | 13.39 <sup>a</sup> | 0.61 |
| RBC ( $\times 10^6/\text{mm}^3$ ) | 2.94 <sup>c</sup>  | 3.02 <sup>b</sup>  | 3.85 <sup>b</sup>  | 4.03 <sup>a</sup>  | 5.21 <sup>a</sup>  | 0.03 |
| MCV(fl)                           | 43.40 <sup>c</sup> | 50.18 <sup>b</sup> | 59.40 <sup>b</sup> | 61.28 <sup>a</sup> | 65.33 <sup>a</sup> | 1.80 |
| MCH (pg)                          | 18.22 <sup>c</sup> | 21.10 <sup>b</sup> | 23.81 <sup>b</sup> | 24.04 <sup>b</sup> | 27.10 <sup>a</sup> | 0.03 |
| MCHC (%)                          | 27.18 <sup>c</sup> | 30.01 <sup>b</sup> | 31.72 <sup>b</sup> | 35.22 <sup>a</sup> | 35.71 <sup>a</sup> | 0.01 |
| WBC ( $\times 10^3/\text{mm}^3$ ) | 7.83 <sup>b</sup>  | 8.25 <sup>b</sup>  | 9.73 <sup>b</sup>  | 10.06 <sup>a</sup> | 12.55 <sup>a</sup> | 0.05 |
| Differentials(%)                  |                    |                    |                    |                    |                    |      |
| Lymphocytes                       | 47.92 <sup>c</sup> | 51.40 <sup>b</sup> | 59.40 <sup>b</sup> | 62.04 <sup>a</sup> | 65.27 <sup>a</sup> | 2.06 |
| Monocytes                         | 0.41 <sup>b</sup>  | 0.97 <sup>b</sup>  | 1.03 <sup>a</sup>  | 1.21 <sup>a</sup>  | 1.34 <sup>a</sup>  | 0.04 |
| Eosinophils                       | 0.28 <sup>c</sup>  | 0.56 <sup>b</sup>  | 0.72 <sup>a</sup>  | 0.83 <sup>a</sup>  | 0.91 <sup>a</sup>  | 0.01 |

Means in the same row with different superscript are significantly different ( $P < 0.05$ ) Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC), Haemoglobin (Hb) and Pack cell volume (PCV).

Table 4: Serum biochemical indices of growing rabbits fed Rauvolfia vomitoria root extracts

| Parameters                  | T1                 | T2                 | T3                 | T4                 | T5                 | SEM  |
|-----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
| <b>Total protein (g/dl)</b> | 5.33 <sup>c</sup>  | 6.28 <sup>b</sup>  | 6.73 <sup>b</sup>  | 7.01 <sup>a</sup>  | 7.10 <sup>a</sup>  | 0.24 |
| <b>Albumin (g/dl)</b>       | 3.00 <sup>b</sup>  | 3.10 <sup>b</sup>  | 3.40 <sup>a</sup>  | 3.71 <sup>a</sup>  | 3.70 <sup>a</sup>  | 0.03 |
| <b>Globulin (g/dl)</b>      | 2.33 <sup>b</sup>  | 3.18 <sup>a</sup>  | 3.33 <sup>a</sup>  | 3.30 <sup>a</sup>  | 3.40 <sup>a</sup>  | 0.01 |
| <b>Creatinine (mmol/L)</b>  | 0.10               | 0.13               | 0.15               | 0.17               | 0.18               | 0.01 |
| <b>Urea (mmol/L)</b>        | 0.04               | 0.02               | 0.03               | 0.04               | 0.05               | 0.02 |
| <b>Ca (mmol/L)</b>          | 2.62 <sup>b</sup>  | 2.88 <sup>b</sup>  | 3.03 <sup>a</sup>  | 3.56 <sup>a</sup>  | 3.94 <sup>a</sup>  | 0.10 |
| <b>P (mmol/L)</b>           | 0.98 <sup>b</sup>  | 1.33 <sup>a</sup>  | 1.41 <sup>a</sup>  | 1.51 <sup>a</sup>  | 1.78 <sup>a</sup>  | 0.12 |
| <b>Na (mmol/L)</b>          | 126.2 <sup>c</sup> | 130.3 <sup>b</sup> | 140.1 <sup>a</sup> | 142.8 <sup>a</sup> | 143.1 <sup>a</sup> | 3.08 |
| <b>Cl (mmol/L)</b>          | 100.2              | 103.3              | 108.4              | 110.2              | 115.6              | 5.02 |
| <b>ALP (U/L)</b>            | 23.11 <sup>a</sup> | 19.70 <sup>a</sup> | 17.65 <sup>a</sup> | 15.56 <sup>b</sup> | 14.05 <sup>b</sup> | 1.71 |
| <b>AST (U/L)</b>            | 15.56 <sup>a</sup> | 10.22 <sup>a</sup> | 9.44 <sup>b</sup>  | 9.03 <sup>b</sup>  | 8.94 <sup>c</sup>  | 0.08 |
| <b>ALT (U/L)</b>            | 10.96 <sup>a</sup> | 9.33 <sup>b</sup>  | 9.03 <sup>b</sup>  | 7.93 <sup>c</sup>  | 7.62 <sup>c</sup>  | 0.02 |

Means in the same row with different superscript are significantly different ( $P < 0.05$ )

Ca: calcium, P; phosphorus, Na: sodium, Cl: chloride, AST: aspartate serum aminotransferase, ALT: alanine amino transferase, ALP: alanine phosphatase

## RESULTS AND DISCUSSION

The percentage composition of experimental diet and amino acid analysis of Rauvolfia vomitoria root is presented in Table 1 and 2 respectively. The feed was formulated to meet the nutritional requirement of rabbits according to NRC (1977). Inadequate energy, protein or micronutrients in the diet may impair performance of rabbits (Niyi, 1997). According to Aduku and Olukosi (1990), rations for dry does, bucks and growing rabbits should contain 12-17 % protein. Energy requirement for rabbits at the growing phase is within 2600-2700 kcal/kg metabolizable energy (Fielding 1991). Fibre is also an important nutrient component which rabbits require in their ration for efficient digestion, prevention of coronary heart diseases and reduction in serum cholesterol level (Alagbe et al., 2020; Fasola et al., 2011; Alagbe, 2021). Rabbits require a level of crude fibre in excess of 9% for normal growth and to reduce incidence of enteritis and diarrhoea. Low fibre level of below 10% leads to hypomotility which predisposes the animal to diarrhoea (Champ and Maurice, 1983; Alagbe and Oluwafemi, 2019; Musa et al., 2020; Alagbe, 2017).

Fats are essential in diets for energy, they increase the palatability of feeds by absorbing and retaining their flavours (Alagbe and Motunrade, 2019; Onuegbu and Iwu, 2020). Rabbits have the ability to withstand high levels of calcium in their diet without adverse effects (Gillespie 1992, 1998; Ajayi and Raji, 2012; Alagbe, 2019). Levels of phosphorus greater than 1% of the diet reduces palatability of the ration and may lower feed intake.

The amino acid components of *Rauvolfia vomitoria* root revealed the presence of glutamic acid (1.53 %), aspartic acid (1.18 %), glycine (0.41 %), serine (1.28 %), alanine (9.72 %), histidine (1.01 %), lysine (0.06 %), methionine (0.02 %), tyrosine (2.04 %), leucine (3.11 %), isoleucine (1.38 %), threonine (0.02 %), phenyl alanine (0.36 %), arginine (10.13 %), proline (1.18 %) and valine (2.50 %) respectively. Amino acids are vital in the synthesis of proteins, precursors in the formation of secondary metabolism molecules, synthesis of hormone, physiological processes, gene expression and homeostatis regulation (Dioguardi, 2011; Nicastro et al., 2011). The amino acid of profile of *Rauvolfia vomitoria* root is similar to the values reported by Kundan (2017) who evaluated the amino acid and antioxidant composition of *Pavetta indica*. Inadequate amount of tyrosine could lead to a deficiency of nor-epinephrine in the brain which causes depression (Elango et al., 2009). Arginine has an effect on protein synthesis, hormone secretion, neurotransmission, growth vasodilation and antioxidant activities (Cuin and Shabala, 2007). Alanine and glutamic acid are vital for healthy nervous and cardiovascular system (Pèrez et al., 2009). Cysteine is used for protein synthesis, co-enzyme A synthesis and glutathione (Wu, 2009; Vanisree et al., 2004). Glycine is necessary for central nervous system and healthy prostrate (Muhammed et al., 2017). Lysine, glutamic acid and threonine are vital in the maintenance of the intestinal integrity of an animal, thus influencing retention time of feed in animals (Rhoads et al., 2009; Wang and Qiao, 2009; Vivanco et al., 2005). Valine, serine, proline, lysine and methionine are maintains the balance of branched chain amino acids, transfer of methyl groups within the body, synthesis of collagen, cell division and oxidative damage (Wu, 2009; Akram et al., 2011; Vazquez – Ortiz et al., 1995). Phenylalanine is necessary for glucose secretion and fat oxidation (Ramamoorthy et al., 2011; Prasad and Bisht, 2003; Alagbe, 2020).

The haematological characteristics of growing rabbits fed different levels of *Rauvolfia vomitoria* root is presented in Table 3. Packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values ranged between 30.28 – 40.93 %, 9.11 – 12.64 g/dL,  $2.94 – 5.21(\times 10^6/\text{mm}^3)$ , 43.40 – 61.28 fl, 18.22 – 24.04 pg and 27.18 – 35.22 % respectively. The parameters follow similar trend as the values were highest in T4 and T5, intermediate in T2, T3 and lowest in T1 ( $P < 0.05$ ). White blood cell (WBC), lymphocytes, monocytes and eosinophils ranged between  $7.83 – 12.55 (\times 10^3/\text{mm}^3)$ , 47.92 – 62.04 %, 0.41 – 1.21 % and 0.28 – 0.83 % respectively. All the parameters were significantly different ( $P < 0.05$ ) among the treatments. PCV are responsible for the transportation of oxygen and absorbed nutrients in the body of animals (Isaac et al., 2013), thus a higher PCV values in birds fed T4 and T5 is an indication of a better nutritional status. Packed Cell Volume, haemoglobin and mean corpuscular haemoglobin are major indices for evaluating circulatory erythrocytes, and are significant in the diagnosis of anaemia and also serve as useful indices of the bone marrow capacity to produce red blood cells as in mammals (Chineke et al., 2006). Haemoglobin has the physiological function of transporting oxygen to tissues of the animal for oxidation of ingested food so as to release energy for the other body functions as well as transport carbon dioxide out of the body of animals (Soetan et al., 2013). According to Isaac et al. (2013) red blood cell is involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs (Ugwuene, 2011; Isaac et al, 2013). Mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration indicate blood level conditions. A low level is an indication of anaemia (Aster, 2004). Mitruka and Rawnsley (1977) reported the normal range of value for rabbits as follows: PCV: 30 – 35%, Hb: 9.3 – 19.3g/dl and RBC: 4.00 – 8.60 ( $\times 10^6/\text{mm}^3$ ). Postgraduate Committee in Veterinary Sciences [PCVS] (1990); Merck manual (2012) stated a standard WBC range of values of 2.5 – 12.5 ( $\times 10^3/\text{mm}^3$ ). White blood cell (WBC) and its differentials are responsible for the production of

antibodies and strengthening the immune system of animals (Alagbe, 2017, Alagbe et al., 2018; Schalm et al., 1975). High WBC is an indication that animals in T4 and T5 have a high degree to resist diseases. However, all the values were within the normal physiologic range for rabbits reported by Research Animal Resources [RAR] (2009); Burke (1994).

Serum biochemical indices of growing rabbits fed different levels of *Rauvolfia vomitoria* root is presented in Table 4. Total protein, albumin, globulin, creatinine, urea, calcium, phosphorus, sodium, chloride ranged between 5.33 – 7.10 (g/dl), 3.00 – 3.71 (g/dl), 2.33 – 3.40 (g/dl), 0.10 -0.18 (mmol/L), 0.02 – 0.04 (mmol/L), 2.62 – 3.56 (mmol/L), 0.98 – 1.51 (mmol/L), 126.2 – 142.8 (mmol/L) and 100.2 – 110.2 (mmol/L) respectively. Total protein, albumin, globulin, calcium, phosphorus and sodium were significantly ( $P < 0.05$ ) influenced by *Rauvolfia vomitoria* root extract (RVME). Creatinine, chloride and urea values were not significantly different among the treatments ( $P > 0.05$ ). Aspartate serum aminotransferase (AST), alanine amino transferase (ALT) and alanine phosphatase (ALP) ranged between 9.03 – 15.56 (UL), 7.62 – 10.96 (UL) and 15.56 – 23.11 (U/L). ALT, AST and ALP values were highest in T1 and T2, intermediate in T3, T4 and lowest in T5 ( $P < 0.05$ ). High values in the serum total protein in T4 and T5 is an indication that the diets are safe and it contains adequate nutrients necessary for the growth of the animals (Gboshe et al., 2020; Omokore and Alagbe, 2019). According to Altman et al. (1979), total albumin that is less than the normal physiological values usually indicate hypoalbuminemia which may result from deficient intake of protein, deficient synthesis of albumin, excess protein breakdown, chronic liver diseases or starvation and chronic gastro intestinal diseases with their interference with protein digestion and absorption. Saad et al. (2017); Henry et al. (2017); Ozkan et al. (2012) reported the normal range of value for rabbits as follows: total protein (2.42 – 9.45 g/dl), albumin (2.01 – 3.81 g/dl), globulin (1.50 – 2.95 g/dl), calcium (2.55 – 4.43 mmol/L), phosphorus (1.07 – 1.85 mmol/L), sodium (132.56 – 149.81 mmol/L), chloride (101.43 – 118.37 mmol/L), creatinine (0.01 – 0.15 mmol/L), AST (7.34 – 17.52 U/L), ALT (4.69 – 9.93 U/L) and ALP (12.63 – 24.89 U/L). Normal creatinine and urea values in rabbits are clear signs that the integrity of the kidney and liver are not compromised (Alagbe et al., 2020). This result is in agreement with the findings of Ajayi and Raji (2012) who examined the haematological and serum biochemical indices of pre pubertal male rabbits fed graded level of blood wild sunflower forage meal mixture. Calcium, phosphorus, sodium and chloride ion levels obtained in this experiment were within the reference range for rabbits reported by Melillo et al. (2007); Silva et al. (2005). Excessive sodium and chloride ion in the blood could damage the kidney and other internal organs. AST, ALT and ALP values follow similar pattern, the values increased significantly ( $P < 0.05$ ) as the level of *Rauvolfia vomitoria* root extract increases. This signifies that the animals were able to tolerate the levels of antinutrients in RVME. According to Alagbe (2021), *Rauvolfia vomitoria* root is a medicinal plant which contains several bioactive chemicals or phytochemicals that performs multiple biological functions in animals. They are also huge reservoir for various chemical substances with potential therapeutic properties and are being increasing utilized to treat wide variety of clinical diseases (Gupta et al., 2004).

## CONCLUSION

*Rauvolfia vomitoria* root extract is loaded with phytochemicals and it exerts several pharmacological properties like anti-inflammatory, antioxidants, hepatoprotective, antihyperglycaemic, antifungal, antiviral, hypolipidaemic, cytotoxic etc. They are relatively cheap, safe, and effective and could be used to bridge the gap between food safety and production. Feeding rabbits *Rauvolfia vomitoria* root extract at 80 ml/liter had no deleterious effect on the blood profile of animals.

## REFERENCES

- [1] Onuegbu N. C. and Iwu C. A. (2020). Physical and Nutritional Properties of *Coula edulis*. International Journal of Life Sciences. 9(3): 46-55.



- [2] Aduku, A. O. and Olukosi, J. O. (1990) Rabbit Management in the Tropics: Production Processing, Utilization, Marketing, Future Prospects. Abuja, Nigeria Living Books services
- [3] Fielding, D. (1991). Rabbits. The Tropical Agriculturist CTA Macmillan Publishers.
- [4] Niyi, A. (1997). Prospects of Commercial Rabbit Keeping in Nigeria Livestock Echo April- June Pp. 51-54.
- [5] NRC, (1977) Nutrient Requirement of Domestic Animal, Nutrient Requirement of Rabbits. Second Edition National Academy of Science Washington D.C.
- [6] Champe, K. A. and Maurice, D. V. (1983). Research Review Response Early Weaned Rabbit to Source and Level of Dietary Fibre. The Journal of Appl. Rabbit Research 6(2) 64-67.
- [7] Alagbe, J.O. (2019). Performance and haemato-biochemical parameters of weaner rabbits fed diets supplemented with dried water melon (rind) meal. Journal of Dairy and Veterinary Sciences. 8(4):001-007.
- [8] Gillespie, J. R. (1992). Rabbit Raising in Modern Livestock and Poultry Production.
- [9] Gillespie, J. R. (1998). "Rabbit Raising" Animal Science. Demar Publisher Pp. 1018-1041.
- [10] Fasola, T.R., Adeyemo, F.A., Adeniji, J.A and Okonko, I.O. (2011). Antiviral potentials of Enantia chlorantha extracts on Yellow fever virus. Nature and Science, 9(9): 99-101.
- [11] Alagbe, J.O and Adegbite Motunrade Betty (2019). Haematological and serum biochemical indices of starter broiler chicks fed aqueous extract of Balanites aegyptiaca and Alchornea cordifolia bark mixture. International Journal of Biological, Physical and Chemical Studies. 1(1): 8-15
- [12] Musa, B., Alagbe, J.O., Adegbite Motunrade Betty, Omokore, E.A. (2020). Growth performance, caeca microbial population and immune response of broiler chicks fed aqueous extract of Balanites aegyptiaca and Alchornea cordifolia stem bark mixture. United Journal for Research and Technology, 2(2):13-21.
- [13] Alagbe, J.O and Oluwafemi, R.A. (2019). Hematology and serum biochemical indices of growing rabbits fed diet supplemented with different levels of Indigofera zollingeriana leaf meal. Progress in Chemical and Biochemical Research. 2(4): 170-177.
- [14] Kundan, P. (2017). HPLC analysis of amino acid and antioxidant composition of three medicinal plants of (Pithoragarh) Uttarakhand Himalayas. Journal of Analytical and Pharmaceutical Research, 6(5):1-8.
- [15]
- [16] Alagbe, J.O (2020). Chemical evaluation of proximate, vitamin and amino acid profile of leaf, stem bark and roots of Indigofera tinctoria. International Journal on Integrated Education. 3(10): 150-157.
- [17]
- [18] Chineke, C. A., Ologun, A. G., & Ikeobi, C. O. N. (2006). Haematological parameters in rabbit breeds and crosses in humid tropics. Pakistan Journal of Biological Sciences, 9(11), 2102-2106.
- [19]
- [20] Isaac, L. J., Abah, G., Akpan, B and Ekaette, I. U. (2013). Haematological properties of different breeds and sexes of rabbits (p.24-27). Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria
- [21]
- [22] Soetan KO, Akinrinde AS and Ajibade TO (2013) Preliminary studies on the haematological parameters of cockerels fed raw and processed guinea corn (Sorghum bicolor). Proceedings of 38th Annual Conference of Nigerian Society for Animal Production. River State University of Science and Technology 49-52.
- [23]
- [24] Aster, J. C. (2004). Anaemia of diminished erythropoiesis. In V. Kumar, A. K. Abbas, N. Fausto, S. L. Robbins, & R. S. Cotran (Eds.), Robbins and Cotran Pathologic Basis of Disease (7th ed., p.638-649). Saunders Co. Philadelphia.

- [25]
- [26] Ugwuene, M. C. (2011). Effect of Dietary Palm Kernel Meal for Maize on the Haematological and Serum Chemistry of Broiler Turkey. *Nigerian Journal of Animal Science*, 13, 93-103
- [27]
- [28] Postgraduate Committee in Veterinary Sciences [PCVS] (1990, September 24-28). Rabbits & rodents laboratory animal science. Proceedings No.142., Postgraduate Committee in Veterinary Science, University of Sydney, Australia. Retrieved from <http://openagricola.nal.usda.gov/Record/CAT92986046>.
- [29]
- [30] Merck Manual (2012). Haematologic reference ranges. *Merck Veterinary Manual*. Retrieved from <http://www.merckmanuals.com/>.
- [31]
- [32] Alagbe, J.O. (2017). Studies on growth performance, nutrient utilization and haematological characteristics of broiler chickens fed different levels of Azolla-Moringa olifera mixture. *Greener Journal of Agricultural Sciences*. 7(6):145-156.
- [33] Alagbe, J.O., Omokore, E. A and Tijani, T.D. (2018). Effect of dietary supplementation of dried Spondias mombin Linn leaf on the performance and blood profile of broiler chickens. *Pacific International Journal*. 2(2):46-58.
- [34] Burke, J. (1994). Clinical care and medicine of pet rabbit (p.49-77). *Proceedings of the Michigan Veterinary Conference*.
- [35]
- [36] Research Animal Resource [RAR]. (2009). Reference values for laboratory animals: Normal haematological values. RAR Websites, RAR, University of Minnesota. Retrieved from <http://www.ahc.umn.edu/rar/refvalues.html>.
- [37] Schalm, O. W., Jain, N. C., & Carroll, E. J. (1975). *Veterinary haematology* (3rd ed., p.15-218). USA: Lea & Fabiger, Philadelphia
- [38]
- [39] Gboshe, P.N., Ebiloma, S.O., Shettima, I., Boyi, P.U and Netala, J. (2020). Haematological traits and serum biochemistry of grass cutters fed Elephant grass supplemented with concentrate. *Animal and Veterinary Science*, 8(1): 29-35.
- [40] Altman, R.B (1979) *Avian Clinical Pathology, Radiology, Parasitic and Infectious Diseases*, Proceedings of Amer Amin Hosp Assoc South Bend, W.
- [41]
- [42] Alagbe, J.O. (2020). Performance, hematology and serum biochemical parameters of weaner rabbits fed different levels of fermented Lagenaria brevifera whole fruit extract. *Advances in Research and Reviews*, 2020, 1:5.
- [43] Alagbe, J.O and Oluwafemi, R.A. (2019). Growth performance of weaner rabbits fed Noni (*Morinda citrifolia*) and Moringa olifera leaf mixture as partial replacement of soya bean meal. *International Journal of Advanced Biological and Biomedical Research*. 7(2): 185-195
- [44] Omokore, E.O and Alagbe, J.O. (2019). Efficacy of dried Phyllanthus amarus leaf meal as an herbal feed additive on the growth performance, haematology and serum biochemistry of growing rabbits. *International Journal of Academic Research and Development*. 4(3): 97-104.
- [45] Duncan, D.B. (1955). Multiple range and multiple F-test. *Biometrics* 11(1):1-42
- [46] Alagbe, J.O., Agubosi, O.C.P., Ajagbe, A.D, Shittu, M.D and Akintayo Balogun, O.M (2020). Performance, haematology and serum biochemical parameters of growing grass cutters fed Phyllanthus amarus and Piliostigma thonningii leaf meal mixture as partial replacement for Soya bean meal. *United International Journal for Research and Technology*, 2(1): 14-23.
- [47] Neffati, Mohamed; Najjaa, Hanen; Máthé, Ákos (2017). *Medicinal and Aromatic Plants of the World - Africa*. Springer. pp. 253–256. ISBN 978-94-024-1120-1.

- [48] Olajumoke, O.O., Soretwa, S.A and Lawrence, O.O. (2002). Phytochemical screening, anti-nutrient composition, proximate analysis and the antimicrobial activities of the aqueous and organic extracts of bark of *Rauvolfia vomitoria* and leaves of *Peperomia pellucida*. *International Research Journal of Biochemistry and Bioinformatics*, 2(6): 127-134.
- [49] Olafadehan, O.A., Oluwafemi, R.A and Alagbe, J.O. (2020). Carcass quality, nutrient retention and caeca microbial population of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. *Journal of Drug Discovery*. 14(33):146-154
- [50] Olafadehan, O.A., Oluwafemi, R.A and Alagbe, J.O. (2020). Performance, haemato-biochemical parameters of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. *Advances in Research and Reviews*, 2020, 1:4
- [51] Akintayo Balogun Omolere. M and Alagbe, J.O (2020). Probiotics and medicinal plants in poultry nutrition: A review. *United International Journal for Research and Technology*, 2(1): 7-13.
- [52] Shittu, M.D and Alagbe, J.O. (2020). Phyto-nutritional profiles of broom weed (*Sida acuta*) leaf extract. *International Journal of Integrated Education*. 3(11): 119-124
- [53] Ibrinke, A.A and Olusola, O.O. (2013). Chemical composition of ten medicinal plant seeds from South west Nigeria. *Advances in Life Sciences and Technology*, 10(1): 1-7.
- [54] Oluwafemi, R.A., Egwuiyi. G.N and Alagbe, J.O. (2020). Effect of feeding *Polylathia longifolia* leaf meal as partial replacement of wheat offal. *European Journal of Agricultural and Rural Education*. 1(1), 8-16.
- [55] Silva, T.D.O., Kreutz, L.C., Barcellos, L.J.G., Borella, J., Soso, A.B and Souza, C. (2005). Reference ranges for (*Chinchilla laniger*) blood cells and serum biochemical parameters. *Cienc. Rural*, 35:602-606. doi: 10.1590/S010384782005000300017.
- [56] Melillo, A. (2007). Rabbit clinical pathology, *J. Exot. Pet. Med.* 16:135-145.
- [57] Özkan, C., Kaya, A and Akgul, Y. (2003). Normal values of haematological and some serum biochemical parameters in serum and urine of New Zealand white rabbits. *World Rabbit Science*, 20:253-259.
- [58] Mohammed, Y.M., Shovon, S.B., Abida, S., Shukanta, B., Ashish, K.S., Shujit, C.P and Asaduz, Z. (2017). Evaluation of amino acid profile of Jack fruit seed and its utilization for the development of protein enriched supplementary food. *J. Noakhali. Sci and Tech. Uni*, 1(1): 77-78.
- [59] Elango, R., Ball, R.O., Pencharz, P.B. (2009). Amino acid requirement in humans with special emphasis on the metabolic availability of amino acids. *Amino Acids*, 37:19-27.
- [60] Dalle, Z., Celia, C and Szendro, Zs. (2016). Herbs and spices inclusions as feedstuff or additive in growing rabbits diets and as additive in rabbit meat: A review. *Livestock Science*, 189(16):82-90.
- [61] Berreto, M.S.R., Menten, J.F.M., Racanicci, A.M.C., Pereira, P.W.Z and Razzo, P.V. (2008). Plants extracts used as growth promoters in broilers. *Brazilian Journal of Poultry Science*, 10(2): 109-115.
- [62] Oetting, L.L. (2005). Extratos vegetais come promotores do crescimento de leitões recém-desmamados [tese] Piracicaba (SP) Escola Superior de Agricultura “Luiz de Queiroz”.
- [63] Saad, M.S., Mohammad, A.M and Khalif, H. (2017). Some haemato-biochemical values in White New Zealand Rabbits. *IOSR Journal of Agriculture and Veterinary Science*, 10(7): 40-44.
- [64] Henry, A.J., Ozung, P.O and Udoh, P.I. (2017). Haematological profile and serum biochemical indices of weaned rabbits fed pawpaw leaves as supplements to Corn-Soya meal based diets. *Global Journal of Pure and Applied Sciences*, 23 (17): 21-25.
- [65] Ajayi, A and Raji, Y. (2012). Haematological and serum biochemical indices of prepubertal male rabbits fed with graded level of blood –wild sunflower forage meal mixture. *African Journal of Biotechnology*, 11(35):8730-8734.
- [66] Pérez-Urria CE, Avalos García A. (2009). Metabolismo secundario de plantas. *REDUCA*. 2: 119-145.

- [67] Cuin TA, Shabala S. (2007). Amino acids regulate salinity-induced potassium efflux in barley root epidermis. *Planta*. 225: 753-761
- [68] Wu G. (2009). Amino acids: metabolism, functions, and nutrition. *Amino Acids*. 37: 1-17.
- [69] Dioguardi FS. (2011). Clinical use of amino acids as dietary supplement: pros and cons. *J Cachexia Sarcopenia Muscle* 2011: 1-6.
- [70] Vivanco JM, Cosio E, Loyola-Vargas VM, Flores HE. (2005). Mecanismos químicos de defensa en las plantas. *Investigación y Ciencia* . 341: 68-75.
- [71] Vanisree M, Lee C-Y, Lo S-F, Nalawade SM, Lin CY, Tsay H-S. (2004). Studies on the production of some important secondary metabolites from medicinal plants by plant tissue cultures. *Bot Bull Acad Sin*. 45: 1-22.
- [72] Vázquez-Ortiz FA, Caire G, Higuera-Ciapara I, Hernández G. (1995). High performance liquid chromatographic determination of free amino acids in shrimp. *J Liq Chrom*. 18: 2059-2068.
- [73] AOAC. (1990). Official Methods of Analysis of Association of Official Analytical Chemists, 15th ed.; AOAC: Arlington, VA, 1990; methods 988.05.
- [74] Akram M, Asif H, Uzair M, Akhtar N, Madni A, Shah SMA, ul Hasan Z, Ullah A. (2015). Amino acids: A review article. *J Med Plants Res*. 5: 3997-4000.
- [75] Rhoads MJ, Wu G. Glutamine, arginine, and leucine signaling in the intestine. *Amino Acids* 2009; 37: 111- 122.
- [76] Wang W, Qiao S, Li D. (2009). Amino acids and gut function. *Amino Acids* 37: 105-110
- [77] Kundan Prasad (2017). HPLC Analysis of Amino Acid and Antioxidant Composition of Three Medicinal Plants of (Pithoragarh) Uttarakhand Himalayas. *Journal of Analytical & Pharmaceutical Research*. 6(5):00186.
- [78] Abd-El-Hady, A.M. (2014). Performance, physiological parameters and slaughter characteristics in rabbits as affected by herbal feed additives. *Agric. Food*, 2:353-365.
- [79] Agostini, P.S., Sola-Oriol, D., Nofrarias, M., Barroeta, A.C., Gasa, J., Mazanilla, F.G. (2012). Role of in feed clove supplementation on growth performance, intestinal microbiology and morphology in broiler chickens. *Livestock Sci*. 147: 113-118.
- [80] Alcicek, A., Bozkurt, M and Cubuk, M. (2003). The effect of an essential oil combination derived from selected herbs growing wild in turkey performance. *S.Afr. J. Ani. Sci*. 33:89-94.
- [81] Alcicek, A., Bozkurt, M and Cubuk, M. (2004). The effect of a mixture of herbal essential oil an organic acid or a probiotic on broiler performance. *S.Afr. Anim. Sci*. 34:217-222.
- [82] Al-Turki, A. (2007). Antibacterial effect of thyme, peppermint, sage, black pepper and garlic hydrolysis against *Bacillus subtilis* and *Salmonella*. *J. Food Agric. Environ*. 5:92-94.
- [83] Shah, M.A., Bosco, S.J.D and Mir, S.A. (2014). Plant extracts as natural antioxidants in meats and meats product. *Meat Sci*. 98:21-33.
- [84] Placha, I., Chrastinova, I., Laukova, A., Cobanova, K., Takacova, V et al. (2013). Effect of thyme oil on small intestinal integrity and antioxidant status, phagocytic activity and G.I.T of rabbits. *Acta. Vet. Hung*. 61:197-208.
- [85] Omer, H.A.A., Ibrahim, A.M., Abedo, A.A., Ali, F.A.F. (2012). Growth performance of rabbits fed diets containing different levels of energy and mixture of some medicinal plants. *J.Agric. Sci*. 4:201-212.
- [86] Alagbe, J.O. (2017). Nutrient evaluation of sweet orange (*Citrus sinensis*) fruit peel as a replacement for maize in the diets of weaner grass cutters. *Scholarly Journal of Agricultural Science*. 6(8):277-282