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# Evaluating growth performance, haematological indices, and serological responses in weaner rabbits fed flesh coontail leaf (*Ceratophyllum demersum*)

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**Abstract**

Effect of fresh coontail leaf (FCL) feeding on growth performance, haematology indices, and serological responses was assessed in weaned rabbits. A total of 120 unsexed crossbred rabbits with an average initial weight of 650 g were allocated to 5 dietary treatment groups with three replicates each and 24 rabbits per group. In a fully randomised design, the inclusion percentages for FCL were 0 % (control), 30 %, 50 %, 70 %, or 100 % of the basal diet. The results show that feeding a diet with 50 % FCL significantly improved total weight gain, while complete feeding of FCL decreased total weight gain compared to the control. Feeding FCL at 30, 50, and 70 % of the diet significantly increased total feed intake compared to the control or 100 % FCL feeding. Feed conversion ratio was significantly the best with 50 % FCL of the diet. Haematological measurements indicated that white blood cell (WBC) counts were significantly higher when feeding FCL 30 or 50 % of the diet, red blood cell (RBC) counts were significantly higher when feeding FCL at 30, 50, or 70 % of the diet, while mean corpuscular volume (MCV) was significantly higher when feeding FCL at 50 % of the diet. It could be recommended to feed FCL up to 50 % of the diet to weaning rabbits without a negative effect on growth performance.

*Keywords:* micro livestock, animal protein, blood indices, growth performance

## 1 Introduction

A large percentage of Nigerians' diet are severely deficient in animal protein. Rabbit meat has been identified as the cheapest source of animal protein among livestock in Nigeria due to its prolificacy, short generation interval, and ease of management (Udeh *et al*., 2007; Ade *et al*., 2023a; Sanubi *et al*., 2023). The gestation period of rabbits is approximately 31 days, and with proper care, a doe can produce 5 to 6 litters per year, with an average of 6 kittens per litter (Cheeke, 1986; Udeh *et al*., 2007). Rabbits can be raised solely on forages, but growth can be enhanced by combining it with agricultural by-products and kitchen waste (Shaahu *et al*., 2022). Aside from providing nutrients, forage feeding satisfies the chewing habits of rabbits and improves the overall growth of the animal (Saxmose *et al*., 2020). *Panicum maximum, Purearia phaseloides, Centrosema pubescens, Mucuna cochinchinensis, Sida acuta*, and *Telfairia occidentalis* are some of the regular forages used to feed rabbits (Ugwuene, 2003, Udeh *et al*., 2007, Sanubi *et al*., 2023). Many of these forages are accessible in agricultural areas.

The term "aquatic vegetation" refers to the "moss" found in ponds and other bodies of water. Unfortunately, many individuals have a negative attitude towards aquatic vegetation, with coontail (*Ceratophyllum demersum*) being a typical example. Coontail and duckweed, on the other hand, have recently become popular as livestock feed materials in broiler and fish diets (Irabor *et al*., 2022, Ade *et al*., 2023b; Ümmühan *et al*., 2023). Coontail is a submerged aquatic species, which means it develops below the surface of the water. It is a rootless, free-floating, perennial aquatic plant that can establish heavy colonies that cover significant amounts of water (Syed *et al*., 2018; Ade *et al*., 2023b). The green, forked, serrated leaves are stiff and joined in whorls on the

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tips of the stems. These leaves seem like a raccoon's tail, which is most likely how coontail obtained its name (Kurugundla, 2023). Ponds, lakes, and streams are all habitats for the plant. It reproduces through fragmentation and not many seeds. When a piece of a plant breaks off and establishes a new plant, this is called fragmentation. Coontail and other aquatic plants spread to new spots when reservoirs containing the plants overflow into other bodies of water, or when wild birds, boats, and fishing activities carry seeds or parts (Travis & Brown, 2014).

Several factors influence the physiology, haematology, and serology of farm animals, the most important of which is the diet (Ajao *et al*., 2013, Sanubi *et al*., 2023). Haematological evaluations aid in determining feed toxicity, especially when it comes to feeding components that affect farm animals' blood and health (Wilujeng *et al*., 2020). Freshly coontal leaf could be an attractive dietary feed for rabbits due to its low cost of harvesting, processing, availability, and nutritional composition. The aim of this study is to evaluate the growth performance, haematology, and serum profile of rabbits fed different levels of flesh coontal leaf (FCL) up to 100 % of the diet.

## 2 Materials and methods

### *2.1 Location of study*

The experiment was conducted at Dennis Osadebay University's Teaching and Research Farm (Poultry Unit). Asaba, Nigeria which is in the tropical rain-forest vegetation zone at longitude 6°45' East and latitude 6°12' North. The climate at the site is hot and humid, with maximum temperatures ranging between 27 °C and 34 °C. The site experiences a rainy season that lasts from March to November (Asaba Metrological Out-Station 2023).

### *2.2 Experimental design*

A total of 120 crossbred weaner rabbits with an initial average weight of approximately 650 g were purchased from a reputable farm in Benin, Edo state, Nigeria. The rabbits were seven weeks old when they were subjected to adapt to this new environment for three weeks. The rabbits were housed in well-ventilated individual hutches with feed and fresh, clean water available at all times. After the adaptation period, the 120 rabbits were randomly assigned to one of five dietary treatment groups; each treatment was replicated three times with eight rabbits per replicate. Feed portions were adjusted to reflect the typical daily intake of approximately 5 % of body weight in dry matter, or around 50 g per rabbit per day. The adjusted feed quantities for each treatment group were as follows:

- Control (0 % FCL): 50 g of poultry growers mash (PGM) per rabbit per day;
- 30 % FCL: 35 g PGM + 15 g FCL per rabbit per day;
- 50 % FCL: 25 g PGM + 25 g FCL per rabbit per day;
- 70 % FCL: 15 g PGM + 35 g FCL per rabbit per day;
- 100 % FCL: 50 g FCL per rabbit per day.

Fresh coontail leaf (FCL) was harvested daily from the Anwai River and fed to the rabbits according to the inclusion level of their treatment group. Feeding quantities were based on dry matter weight to ensure consistency with dietary intake guidelines. Proximate analysis of the flesh coontail leaf and poultry growers mash feeds was performed following the Official Methods of Analysis (AOAC, 1990).

**Table 1:** *Proximate composition of the feeds flesh coontail leaves (FCL) and poultry growers mash (PGM) used in this study.*

| *Components (in %)* | *FCL* | *PGM* |
|---|---|---|
| Crude protein | 15.08 | 15.00 |
| Ether extract | 2.40 | 0.90 |
| Crude fibre | 5.5 | 15.32 |
| Nitrogen-free extract | 27.31 | 65.13 |
| Ash | 10.2 | 2.82 |
| Moisture | 40.51 | 1.00 |

### *2.3 Growth data collection*

The body weight was recorded weekly using a digital weighing scale (Table Camry 20 kg weighing scale) for five (5) randomly selected rabbits per replicate. Daily feed intake was calculated as the difference between the feed offered and leftovers per replicate group. Other management procedures included daily washing of the water bowls and troughs, cleaning and desinfection of the hutches.

### *2.4 Blood profile*

At the end of the experimental period, two rabbits were randomly selected from each treatment group for blood sample collection. These blood samples were taken from the marginal ear vein using a 19-23-gauge butterfly needle and collected into two types of tubes: one set in sterile bottles containing ethylene diamine tetra-acetic acid (EDTA) for haematological analysis and another set in plain tubes for serum biochemical analysis. An automatic haematology analyser (Portable Auto Blood Analyzer YSTE680) was employed to test the EDTA samples for full blood count (red blood cells (RBC), haemoglobin (Hb), packed cell volume (PCV), platelets, lymphocytes, and white blood cells

**Table 2:** *Performance of weaner rabbits fed different percentages of flesh coontal leaf (FCL,* Ceratophyllum demersum*) and poultry growers' mash (n = 24 rabbits per treatment).*

| *Parameters* | *0 % FCL* | *30 % FCL* | *50 % FCL* | *70 % FCL* | *100 %FCL* |
|---|---|---|---|---|---|
| IBW (g) | 651.20 ± 26.59 | 650.24 ± 26.57 | 650.48 ± 26.62 | 651.00 ± 27.57 | 650.54 ± 26.21 |
| FBW (g) | $1352.21 \pm 51.30^{c}$ | $1500.24 \pm 74.60^{ab}$ | $1600.34 \pm 71.18^{a}$ | $1490.57 \pm 54.21^{b}$ | $1300.30 \pm 48.32^{c}$ |
| Weight gain (g) | $701.01 \pm 24.71^{b}$ | $850.23 \pm 48.03^{b}$ | $949.86 \pm 44.56^{a}$ | $839.57 \pm 26.64^{b}$ | $649.76 \pm 22.11^{c}$ |
| Feed intake (g) | $1012.15 \pm 0.14^{c}$ | $1213.05 \pm 0.13^{b}$ | $1315.12 \pm 0.08^{a}$ | $1200.18 \pm 0.12^{b}$ | $1000.56 \pm 0.17^{c}$ |
| FCR | $1.44^{b}$ | $1.43^{b}$ | $1.28^{c}$ | $1.43^{b}$ | $1.54^{a}$ |

IBW= initial live weight; FBW: final live weight; FCR: feed conversion ratio. $^{abc}$: means in the same row with different superscripts are significantly different at $p < 0.05$.

**Table 3:** *Haematological measurements at the end of the x weeks feeding trial with rabbits fed different percentages of flesh coontal leaf (FCL,* Ceratophyllum demersum*) and poultry growers' mash (n = 24 rabbits per treatment).*

| *Parameters* | *0 % FCL* | *30 % FCL* | *50 % FCL* | *70 % FCL* | *100 %FCL* |
|---|---|---|---|---|---|
| WBC ($\times 10^9$ L$^{-1}$) | $6.06 \pm 0{,}23^{b}$ | $7.10 \pm 0.24^{a}$ | $7.14 \pm 0.26^{a}$ | $6.08 \pm 0.23^{b}$ | $5.03 \pm 0.12^{c}$ |
| RBC ($\times 10^{12}$ L$^{-1}$) | $5.23 \pm 0.07^{c}$ | $5.37 \pm 0.75^{b}$ | $5.73 \pm 0.54^{b}$ | $5.53 \pm 0.62^{a}$ | $5.20 \pm 0.16^{c}$ |
| PCV (%) | 33.12 ± 0.10 | 33.30 ± 0.12 | 33.25 ± 0.12 | 33.32 ± 0.12 | 33.13 ± 0.11 |
| Hb (g dl$^{-1}$) | $11.39 \pm 0.13^{c}$ | $12.45 \pm 0.14^{b}$ | $12.84 \pm 0.15^{a}$ | $12.42 \pm 0.14^{b}$ | $10.00 \pm 0.10^{c}$ |
| MCH (pg) | 20.50 ± 0.12 | 21.01 ± 0.12 | 20.29 ± 0.13 | 20.30 ± 0.13 | 20.45 ± 0.12 |
| MCV (%) | $61.72 \pm 0.20^{b}$ | $62.67 \pm 0.23^{ab}$ | $63.01 \pm 0.27^{a}$ | $62.54 \pm 0.23^{ab}$ | $61.58 \pm 0.21^{b}$ |
| MCHC (%) | 31.07 ± 0.13 | 31.10 ± 0.12 | 31,12 ± 0.12 | 31.16 ± 0.11 | 31.14 ± 0.13 |

WBC: white blood cells; RBC: red blood cells; PCV: packed cell volume; Hb: haemoglobin; MCH: mean corpuscular haemoglobin; MCV: mean corpuscular volume; MCHC: mean corpuscular haemoglobin concentration; $^{abc}$: means in the same row with different superscripts are significantly different at $p < 0.05$.

(WBC)). According to Ade *et al*. (2023b), serum blood parameters were determined after blood samples were allowed to stand for one to two hours at room temperature and centrifuged for ten minutes at 3500 rpm.

### *2.5 Statistical analysis*

All data were analysed using one-way ANOVA with IBM SPSS Statistics version 29 (2023), and the differences between the means were sperated using Duncan's multiple range test (Duncan, 1955).

## 3 Results

### *3.1 Performance of rabbits fed different percentages of flesh coontail leaf (FCL) and poultry grower's mash (PGM)*

The result from table 2 showed that the inclusion of FCL in the diet of weaner rabbits at different levels significantly ($p < 0.05$) influenced all growth parameters. However, the inclusion of 50 % FCL had the highest increase in final live weight and weight gain compared to the other diets offered. This diet increased the rabbits' feed intake and had the best feed conversion ratio. Therefore, a balanced combination of FCL and poultry grower mash (PGM) promotes optimal nutrient utilisation and growth in weaner rabbits due to the combination of fibre and nutrients.

The haematological indices of the weaner rabbits fed different levels of FCL are shown in Table 3. All the haematological parameters were affected by the FCL diet except the packed cell volume (PCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC). White blood cell (WBC) counts were highest at the 30 % and 50 % FCL levels, suggesting that moderate FCL levels promote optimal blood health and improve immunological functions.

The effect of the diet on the serological markers is presented in Table 4. All the serological markers except for albumin and urea were significantly ($p < 0.05$) influenced by FCL inclusion levels, indicating that FCL had no effect on these metabolic health indicators. However, total protein and cholesterol levels varied significantly ($p < 0.05$), with moderate FCL diets resulting in higher protein and lower cholesterol levels.

**Table 4:** *Serological measurements at the end of the x weeks feeding trial with rabbits fed different percentages of flesh coontal leaf (FCL,* Ceratophyllum demersum*) and poultry growers' mash (n = 24 rabbits per treatment).*

| *Parameters* | *0 % FCL* | *30 % FCL* | *50 % FCL* | *70 % FCL* | *100 %FCL* |
|---|---|---|---|---|---|
| Total protein ($g\,L^{-1}$) | $67.15 \pm 0.55^{c}$ | $70.56 \pm 1.00^{a}$ | $70.48 \pm 1.00^{a}$ | $69.47 \pm 0.72^{b}$ | $67.29 \pm 0.51^{c}$ |
| Albumin ($g\,L^{-1}$) | $53.78 \pm 0.69$ | $53.64 \pm 0.67$ | $53.81 \pm 0.65$ | $53.61 \pm 0.65$ | $53.65 \pm 0.65$ |
| Glucose ($mmol\,dl^{-1}$) | $4.27 \pm 0.17^{c}$ | $5.30 \pm 0.18^{ab}$ | $5.50 \pm 0.18^{a}$ | $5.35 \pm 0.17^{ab}$ | $4.52 \pm 0.17^{b}$ |
| Cholesterol ($mmol\,dl^{-1}$) | $1.54 \pm 0.08^{a}$ | $0.70 \pm 0.02^{b}$ | $0.53 \pm 0.02^{bc}$ | $0.35 \pm 0.01^{c}$ | $0.31 \pm 0.01^{c}$ |
| Urea ($mmol\,dl^{-1}$) | $2.12 \pm 0.43$ | $2.32 \pm 0.43$ | $2.30 \pm 0.43$ | $2.14 \pm 0.43$ | $2.24 \pm 0.43$ |
| Globulin ($g\,L^{-1}$) | $13.51 \pm 0.15^{c}$ | $14.00 \pm 0.15^{b}$ | $14.02 \pm 0.15^{ab}$ | $14.13 \pm 0.15^{ab}$ | $14.26 \pm 0.15^{a}$ |

$^{abc}$: means in the same row with different superscripts are significantly different at $p < 0.05$.

## 4 Discussion

### *4.1 Growth performance of weaner rabbits fed flesh coontail leaf*

The significant improvements in final live weight, weight gain, feed intake, and feed conversion ratio seen in 50 % FCL could be related to the availability of protein and fiber content in the diet, which consisted of 50 % poultry growers mash and 50 % FCL. This is consistent with the findings of (Udeh *et al*., 2007, Mako *et al*., 2016) that growing rabbits adjust their feed intake based on the energy and crude fiber content of their ration. The inferior growth of rabbits fed with 100 % FCL could be attributed to the diet's low acceptability, palatability, and digestibility. This is consistent with the findings of (Atchade *et al*., 2019, and Sanubi *et al*., 2023) that rabbits respond well to a mixed diet of concentrate and forage.

### *4.2 Haematological indices of weaner rabbits fed flesh coontail leaf*

The influence of nutrition on the physiological responses and pathological soundness or well-being of the animals can be assessed through haematological evaluation (Shousha *et al*., 2017). The haematological indices values in this investigation are within the normal ranges. RBC: 5.46–7.94 $\times 10^{12}\,l^{-1}$; WBC: 5.5–12.5 $\times 10^{9}\,l^{-1}$; PCV: 33–50 %; Hb conc.: 9.4–17.4 $g\,dl^{-1}$; MCV: 50–75 fl; MCH: 16–23 pg; MCHC: 33–50 $g\,l^{-1}$ (Zimmerman, 2015; Adeyeye *et al*., 2017). The fact that the PCV, MCH, and MCHC indices were not significantly ($p > 0.05$) impacted across the experimental diets suggests that nutritional adequacy and diet composition support normal haempoiesis in rabbits (Adeyeye *et al*., 2017). The study's findings on WBC demonstrate that animals fed FCL were significantly ($p < 0.05$) impacted in the 30 % FCL and 50 % FCL treatments and fell within the range of (5.5–12.5 $\times 10^{3}$ml) (Zimmerman, 2015). The WBC plays a role in fighting infections, protecting any foreign body from invasion, and producing antibodies in an immune response. The results of this study indicate that the rabbits were healthy because the WBC level was within the normal range, which indicates that there was no infection, allergic conditions, or parasitism (Ayo-Ajasa, 2020). The RBC values reported in this study varied from (5.20-5.73 $\times 10^{12}$ L) in rabbit-fed FCL and poultry growers mash, with 50 % FCL recording the highest value (5.73 $\times 10^{12}$ L). The results found in this investigation, on the other hand, are within the normal range of 5.46–7.94 $\times 10^{12}\,l^{-1}$ reported for rabbits (Zimmerman, 2015). Hb affects oxygen delivery from respiratory organs to peripheral tissues (Zhang *et al*., 2021). The MCV values were also within the standard range (50–75 %) but within the value range of (61.81–62.98 %) as cited Adeyeye *et al*., (2017). This study's range is (60.58–63.01 %) in 100 % FCL and 50 % FCL, respectively. According to Abbas *et al*. (2017), a drop in MCV value indicates the existence of small red blood cells (microcytes), which may be related to the low value of MCV found in 100 %FCL in this investigation.

### *4.3 Serological indices of weaner rabbits fed flesh coontail leaf*

Serum biochemical analysis is performed to detect the extent of heart, liver, and kidney damage (Harper *et al*., 1999). Total protein levels in rabbits fed 0 % and 50 % FCL ranged from 67.15 to 70.48 $g\,dl^{-1}$. These levels are within the normal range (54–75 $g\,dl^{-1}$) reported by Melillo, (2007) and are also lower than the findings of Adeyeye *et al*., (2017) at (67.02–70.91 $g\,dl^{-1}$). Cholesterol is an effective indicator of health since it is found in all bodily cells and is transported into the bloodstream via lipoprotein. The progressive drop in cholesterol levels in rabbits with higher FCL in this study shows that the dietary treatments reduced cholesterol uptake. The stability of serum albumin, glucose, urea, and globulin in rabbits fed the dietary treatment confirmed the safety of each level of diet inclusion and their support for the rabbits' normal physiological function (Adeyeye *et al*., 2017).

## 5 Conclusion

To conclude this research, it was observed that introducing Fresh Coontail Leaf (FCL) into weaner rabbit diets can significantly improve growth performance, haematological indices, and serological markers. A 50 % FCL diet produced the best weight gain, feed efficiency and stable blood parameters, thus indicating a well-balanced nutritional profile for growth. In contrast, a diet consisting entirely of FCL resulted in slower growth when compared to the other treatments, emphasizing the importance of combining forage (FCL) with other feeds (poultry grower mash). We recommend using up to 50 % inclusion level of FCL which provides a cost-effective and nutritionally adequate feed option, particularly in regions with limited access to traditional feeds. Also, future research should look into the long-term impacts of increasing FCL levels to determine their sustainability as a sustainable feed choice for rabbit farming in resource-limited areas.

*Conflict of interest*

The authors declare that they have no conflict of interest.

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