EFFECT OF COONTAIL (*Ceratophyllum demersum*) AS A REPLACEMENT FOR WHEAT OFFAL IN BROILER CHICKENS DIETS

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Abstract

A six week feed trial was investigated on 192 Marshall strain day-old birds fed Coontail meal (CM) at varied inclusion levels as a replacement for wheat offal. Proximate analysis and phytochemical composition of the Coontail meal showed that 24.8% crude protein, 2.4% either extract, 17.6% crude fiber, 4.90% crude fat, 39.5% nitrogen-free extract, 14.2% ash, and 1.5% moisture. It also contains 1.5% Alkaloids, 11.5% tannins, 21.8% saponins, and 1.46% flavonoids. The birds were allotted randomly into four dietary treatments where T1 had no CM and served as the control, while T2 had 32.43%CM, T3 67.57%CM, and T4 had 100%CM. Data were collected on the growth performance, haematology, and serum characteristics of broiler chickens fed experimental diets. The results on the performance characteristics of birds showed that the test diet significantly ($p<0.05$) affected the final live weight (1062.46g and 2310.22g), weight gain (1022.46g and 1269.83g), and feed intake (1.40g and1.82g) on T3 at starter and finisher phases respectively. The total protein and its fractions, as well as blood glucose, were significantly ($P<0.05$) impacted by the tested ingredient (Coontail meal). The results on serum biological indices showed that the values remain within the normal recommendation range for broiler chickens. However, it was concluded that broiler chickens could be fed up to 67.57% CM as a replacement for wheat offal without exerting any detrimental effects on the growth performance and blood profile of broiler chickens.

Keywords: Broilers, Blood indices, Coontail, Feed utilization, Growth performance

Introduction

One of the biggest issues the feed industry is currently dealing with is the availability of ingredients for feed and the capacity to manufacture high-quality products at a reasonable cost (Chauynarong *et al.,* 2009). The expansion and sustainability of the current levels of chicken production in emerging nations have been significantly impacted by this situation. Most medium-scale farmers struggle to find and afford conventional ingredients (Ogungbesan *et al.*, 2013). This results in an increase in the price of finished feed, which accounts for about 80 percent of the total cost of production, (Akpodiete *et al.,* 2014). The significant increase recorded in the prices of feeds recently has led to a decrease in poultry production in developing nations (Zanu *et al.,* 2012), and the inability to consume the recommended 63 grams of domestic animal protein per capita recommended by FAO (2022).

Aquatic plant plants such as macrophytes e.g. *Lemna minor* (duckweed) and *Ceratophyllum demersum* (coontail), have been used as feed additives/supplements recently in broiler and fish diets (Irabor *et al.,* 2021b; Irabor *et al.,* 2022a). Several authors have reported the uses of these aquatic macrophytes as alternative feed ingredients for some cultured fish species like catfish and tilapia, with various degrees of success (Sońta *et al.*,2019; Roman *et al.*,2021).

Coontail *(C. demersum)* is an inexpensive, safe, widely available, and environmentally friendly carbohydrate source. *C. demersum* has been reported to have a significant amount of nutrients and could be effectively used to replace some conventional energy sources without adversely affecting the performance of experimental animals. Also, oxygen weeds, water velvet, and pondweeds were the most prevalent macrophytes that were examined (Mondal *et al.,* 2018). Macrophytes have been utilized as either a whole, fresh food, or as a part of a dry food diet. Moreover, they have substitute protein or energy sources in pelleted meals, either partially or entirely (Balkhasher *et al.,* 2021). These macrophytes (Coontail) have not yet been investigated as feed ingredients, despite the potential they may represent in poultry. Thus, the goal of the current study was to assess the potential of dry C. *demersum* as a substitute for wheat offal in broiler chicken diets.

Materials and Methods

The experiment was carried out at Dennis Osadebay University's Teaching and Research Farm (Poultry Unit). Anwai, Asaba is sited at longitude 6°45′ East and latitude 6°12′ North in the tropical rain-forest vegetation zone. The site's climate is hot and humid, with maximum temperatures between 27°C and 30°C. Every year, the location experiences a rainy season that lasts from March – November (Asaba Metrological Out-Station 2023).

Preparation of Coontail (CM)

This was done following the steps outlined by Malik *et al.,* (2013). Coontail was harvested from Okija Lake, located adjacent to the Niger River at the beginning of the hot season, with an average length of 12cm. The plant was washed with clean water thoroughly to remove any undesirable items (river debris and unnecessary materials), and they were sun-dried for three days until it was crispy. To create the coontail meal, the dried Coontail plant was first ground in a hammer mill and then sieved through a 1mm sieve. Proximate analysis and anti-nutritional factors were conducted on the leaf meal to ascertain its nutrient and biochemical profiles (Table 1). The coontail meal was kept in a large plastic container and labeled prior to its usage.

Chemical Analysis

Using A.O.A.C. (2016) standard practices, the chemical composition of the Coontail meal was determined.

Experimental Procedure

The experimental birds were fed with the experimental diets on arrival and replicated. For the starter phase and finisher phase, the experimental diets were served *ad libitum* with each bird's own diet.

Birds and Plan of Nutrition

One hundred and ninety-two day-old birds were procured from a reputable hatchery. The birds were randomly distributed into four treatments and each was replicated thrice with sixteen (16) birds. The birds were housed in a deep litter system with 3x3x5 meters' floor space. The test diets (0%, 33.3%, 66.6%, and 100%) were fed to the birds in a Completely randomized design.

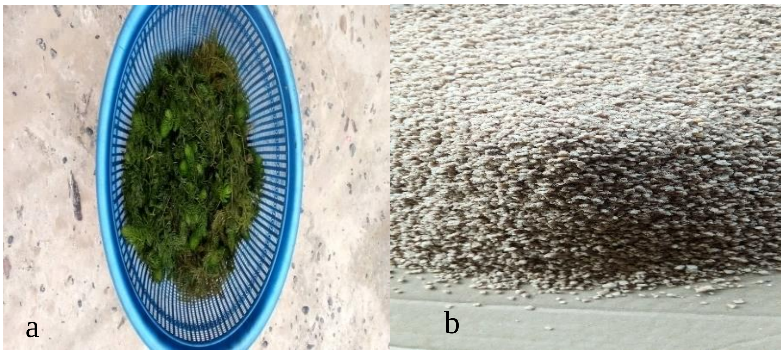

Figure 1: a; *Ceratophyllum demersum* (coontail), b; Formulated feed (broiler starter)

Table 1: Proximate Composition of *C. demersum*

Composition	Percentage (%)
Crude Protein	15.08
Either extract	2.40
Crude Fibre	17.6
Nitrogen free extract	39.5
Ash	14.2
Moisture	1.50
Anti-nutritional Factors	
Alkaloids	1.50
Tannin	11.52
Saponin	21.84
Flavonoids	1.46

Table 2: Composition of experimental broiler starter and finisher diets

	Starter diets				Finisher diets			
Feed ingredient (kg)	**T1 (0%)**	**T2 (32.43%)**	**T3 (67.57%)**	**T4 (100%)**	**T1 (0%)**	**T2 (32.43%)**	**T3 67.57%)**	**T4 (100%)**
Maize	50.00	50.00	50.00	50.00	55.00	55.00	55.00	55.00
Soybean meal	18.00	18.00	18.00	18.00	14.50	14.50	14.50	14.50
GNC	14.15	14.15	14.15	14.15	10.00	10.00	10.00	10.00
CM	------	3.47	7.23	10.70	-------	4.77	9.53	14.30
Wheat offal	10.70	7.23	3.47	-------	14.30	9.53	4.77	-------
Fish meal	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Common salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.35	0.35	0.35	0.35	0.40	0.40	0.40	0.40
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Calculated	100	100	100	100	100	100	100	100
Composition								
Crude protein (%)	22.56	22.42	22.40	22.50	19.89	19.60	19.54	19.44
Metabolizable energy (Kcal/Kg)	2753.40	2794.71	2794.74	2744.75	2953.50	2964.71	2964.74	2954.75

*Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000 mg); K3 (1,500 mg); B1 (1,600 mg); B2 (4,000 mg); B6 (1,500 mg); B12 (10 mg); Niacin (20,000 mg); Pantothenic acid (5,000 mg); Folic acid (500 mg); Biotin H2 (750 mg); Choline chloride (175,000 mg); Cobalt (200 mg); Copper (3,000 mg); Iodine (1,000 mg); Iron (20,000 mg); Manganese (40,000 mg); Selenium (200 mg); Zinc (30,000 mg); and Antioxidant (1,250 mg) per 2.5 kg

The percentage composition of the experimental meals for the starter and the finisher phases and the diets were prepared according to NRC to be iso-energetic and iso-nitrogenous (Li *et al.*, 2021),

Data collection

Data were collected on the performance characteristics of birds; feed conversion ratio (FCR) and weight gain, feed consumption, and body weight weekly per replicate (Akpodiete *et al.,* 2023).

Blood indices

Three (3) birds were randomly chosen from each treatment. Blood samples were collected from the brachial vein (wing vein) using 7ml syringes with well-labeled two empty bottles (plain and EDTH). The first set of samples was taken in labeled sterile universal bottles containing ethylene diamine tetra-acetic acid, and others in heparin bottles without anti-coagulant. The samples in ethylene diamine tetra-acetic acid-containing bottles were used to analyze for full blood count (red blood cells, hemoglobin, packed cell volume, platelets, lymphocytes, and white blood cells) with the help of an automatic hematology analyzer (Portable Auto Blood Analyzer YSTE680). Serum biochemistry parameters were obtained after the blood samples had been allowed to stand for one to two hours at room temperature and centrifuged for ten minutes at 2000. rpm to separate the cell from the serum according to Sanubi et al., (2023).

Statistical Analysis

Data generated were processed and analyzed using the analysis of variance (ANOVA) and significant means were separated using the Duncan Multiple Range Test as outlined by Steel and Torne (1990).

Results and Discussion

Coontail (*Ceratophyllun demersum*) meal's (CM) proximate composition Table 1, revealed 15.08% crude protein, 17.6% fiber, 14.2% ash, 2.4% ether extract, and 39.5% Nitrogen-free extract. The parameters of the proximate study of CM were similar to the findings of Balkhasher *et al.*, (2021) and Kiziloğlu *et al.,* (2023), which in their different studies recorded similar values. However, despite its minimal significance as an energy source and interference with digestive processes, the crude fiber in poultry diets is frequently linked to improved energy availability. Moderate fiber intake may help gastrointestinal growth, which would improve productive capacity (De Vries, 2015). Also, the typical ash percentage of forage for animal nutrition ranges from 9 – 18% Dry Matter, the 14.12% value proved to be sufficient (Afonso *et al.*, 2021).

The results on the growth performance Table 3, showed that the initial live weight and feed conversion ratio of birds on different experimental diets were not significantly ($p>0.05$) affected among the treatments. The final live weight, weight gain, and feed intake were (2310.22g, 1022.46g, and 1400.05g) significantly ($p<0.05$) different among treatments. The final live weight and weight gain were higher ($p<0.05$) in T4, where Coontail replaced wheat offal at 100% in comparison with other treatments at the starter phase. During the finisher phase, the birds showed no significant ($p>0.05$) difference among the treatments. The final live weight, weight gain, and feed conversion ratio (FCR) of the birds were all significantly ($p<0.05$) affected by the experimental diets. Final live weight was higher ($p<0.05$) on T3, weight gain and FCR showed higher values ($p<0.05$) for birds in T4. The observed decrease in the final live weight could be a result of the high amount of fiber (17.6%) in CM which is in agreement with Balkhasher *et al*., (2021) who discovered that the declining growth of Nile tilapia fish and Kiziloğlu *et al.*, 2023, that fed on Coontail meal to common carp. They observed that the high content of fiber at higher inclusion levels prevents the fish and carp from developing by reducing their metabolism processes.

Table 3: Growth performance of broilers chicken fed diets containing grade level of CM at 21 days

Parameters	1 0%	2 32.43%	3 67.57%	4 100%	SEM±	P-value
Initial weight (g)	40	40	40	40	0.00	0.00
Final weight (g)	1036.50^{b}	1028.43^{c}	1062.46^{a}	1040.39^{b}	0.81	0.04
Weight gain (g)	996.50^{c}	988.43^{c}	1022.46^{a}	1000.39^{b}	0.61	0.02
Feed intake (g)	1400.05^{a}	1345.15^{b}	1350.35^{b}	1340.24^{b}	0.08	0.03
Feed conversion ratio	1.32^{c}	1.36^{b}	1.40^{a}	1.34^{c}	0.05	0.01

abc mean is the same row with different superscripts that are significantly different ($P< 0.05$), SEM = Standard Error of mean.

Table 4: Growth performance of broilers chicken fed diets containing grade level of CM at 42 days

Parameters	1 0%	2 32.43s%	3 67.57%	4 100%	SEM±	P-value
Initial weight (g)	1036.50^{b}	1028.43^{c}	1062.46^{a}	1040.39^{b}	0.81	0.04
Final live weight (g)	2284. 27^{b}	2280.23^{b}	2310.22^{a}	2294.39^{b}	1.36	0.02
Weight gain (g)	1247.77^{c}	1251.80^{b}	1269.83^{a}	1231.93^{b}	0.08	0.03
Feed intake (g)	2216.50	2208.43	2220.39	2242.46	0.07	0.02
Feed conversion ratio	1.78^{b}	1.76^{c}	1.82^{a}	1.75^{c}	0.05	0.04

Table 5 Haematological Characteristics of broilers fed experimental diets

Parameters	T1	T2	T3	T4	SEM	P-value
WBC (x103/L)	3.09^c	3.10^c	3.13^b	3.14^a	0.04	0.03
RBC (x10^6/L)	2.32^c	3.37^b	2.39^c	4.88^a	0.01	0.03
PCV (%)	30^c	33^b	35^a	34^b	1.46	0.02
Hb(g/dl)	11.29	11.36	11.30	11.50	0.06	1.52
MCH (pg)	20.97^b	23.25^a	19.53^c	21.52^a	0.36	0.04
MCV (%)	73.38^a	63.42^b	72.46^a	73.87^a	1.78	0.02
MCHC (%)	24.43^c	26.67^b	27.43^b	28.63^a	0.92	0.04

a,b,c; means in the same row with different superscripts are significantly different (p<0.05) *CM= Coontail, NS= Not significant, * = significant difference

Table 6 Serological Characteristics of Birds Fed Experimental Diets

Parameters	T1	T2	T3	T4	SEM	P-value
Total protein (mg/d1)	7.69^b	6.21^c	8.40^b	9.20^a	0.01	0.03
Albumin(mg/dl)	5.29^b	3.55^{ab}	6.23^{ab}	7.37^a	1.44	0.02
Glucose(mmo1/d1)	6.20^a	4.94^b	5.12^b	5.60^a	0.14	0.01
Cholestero1(mmo1/dl)	4.90^a	3.33^{ab}	3.83^a	2.90^c	0.12	0.03
Urea (mmol/d1)	2.18	2.27	2.31	2.15	0.38	0.02
Globulin (g/l)	2.40^b	2.66^a	2.35^b	1.88^c	0.20	0.01

a,b,c; means in the same row with different superscripts are significantly different (p<0.05) *CM= Coontail, NS= Not significant, * = significant difference

Haematological Characteristics

Blood indices have been used in evaluating the nutritional qualities of diets Ogbuewu *et al*., (2017). They are also valuable indicators of the capability of mammalian bone marrow to synthesize red blood cells (Srole and Ganz 2021).

The level of erythrocytes (RBC) in chickens influences the health of the birds as a whole. The mere fact that the PCV, haemoglobin, and RBC counts of the birds fed the test item increased numerically, suggests that the blood's oxygen-carrying capability is within the required range (Henrikson 2017). According to Aikpitanyi *et al.* (2020), haemoglobin, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration is significant blood parameters whose values were used to evaluate the presence and severity of anemia. A decrease in the levels of haemoglobin, MCV, and MCH in the birds is a further indication that they have not been exposed to stress factors, Dawood *et al*., (2020). Also, it has been observed that the MCHC values recorded were within the standard level in birds. These results were similar to an earlier report by Aikpitanyi *et al.* (2020) that fed Ginger and Black Pepper as Feed Additives on the Growth and Carcass qualities of Broiler Chickens. It has been documented that iron and other trace element deficiency could be the cause of a low mean corpuscular hemoglobin concentration (MCHC) value Aikpitanyi *et al.* (2020). In the present study, only the treatment group had an MCHC value of approximately 28.63g/dl, which is within the recommended range of 26.00-35g/dl Devrim *et al.,* (2010).

Serological Characteristics

The serum profile is a biochemical process that identifies the organism's current state and any changes that have occurred as a result of internal and external influences (Ejiofor *et al.,* 2021).

Table 6 represents the findings of the blood serum of broiler chickens fed graded levels of Coontail meal. The blood serum of broiler chickens fed various levels of coontail meal showed significant (P<0.05) variations among treatments. The liver is the primary site of serum protein synthesis, and serum proteins have a number of critical roles in the body, including maintaining blood volume through the colloidal osmotic effect, balancing blood *pH,* transporting hormones and medications, taking part in cell coagulation and the body's defense against foreign invaders, and catalyzing chemical reactions (enzymes) and regulating metabolism (hormones) Fails and Magee (2018). According to Fails and Magee (2018), albumin's primary functions include carrying multiple molecules and maintaining blood pressure. For both sexes of the birds, the albumin assessments from this investigation fell within the range of 3.55 - 7.30mg/dl as reported by Fails and Magee (2018). The 2.51–4.48 mmol/l range of cholesterol parameters reported by Abdulazeez *et al.,* (2016) that fed broiler chickens with graded levels of baobab (Adansonia digitate L) seed meal contradicts the 2.90–4.90 mmol/l range of cholesterol from this study. There is a significant ($p<0.05$) variation in the levels of the globulins seen in this study, however, T4 had the lowest level (1.88 g/dl), and T2 had the highest (2.66 g/dl). These values fall within the recommended range of 2.1 – 4.3 g/dl. In a separate study, Tothova *et al.*, (2019) ascertained changes in globulins in broiler chickens as a result of age, diets, and ecological factors during the fattening period (finisher phase).

Conclusion

The study reported that broiler chickens that received T3 (67.57%) coontail meal performed better on the final weight, weight gain and feed conversion ratio compared to the other test diets and the control diet in both phases. On the blood indices of birds fed coontail revealed no advert effect on the overall performance of the birds. Consequently, it is recommended that this aquatic plant could be used as a substitute to wheat offal in broiler diets since it grows throughout the year.

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