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NUTRITIONAL/CHEMICAL CONSTITUENTS, GROWTH PERFORMANCE AND ANTHROPOMETRIC ANALYSIS OF *Adansonia digitata* LEAVE-BASED DIET IN FEMALE RATS

Oyegoke Rukayat Abiodun[1, *], Abdulwahab Aminat Abebi [1], Musa Fasilat Jumoke[1], Osifade Jahswill Toluwanimi[1], Nafiu Mikhail Olugbemiro[1], and Moronfolu Ibrahim Adeola[2].

[1]Department of Biochemistry, Faculty of Life Sciences, University of Ilorin, P. M. B. 1515. Ilorin, Nigeria
[2]Department of Chemical Sciences, College of Natural and Applied Sciences, Summit University, Offa, Kwara State, Nigeria.

*Corresponding Author email: oyegoke.ra@unilorin.edu.ng

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ABSTRACT:

The nutritional benefits of most of our extinction underutilized edible plants cannot be underrated. However, there is the need to quantity their nutrients and estimate the amount our body requires to function effectively. Therefore, the nutritional constituents and assessments of *Adansonia digitata (A. digitata)* leave-based diet were evaluated in rats. Fifty rats were grouped into five and were fed on a basal diet, 25%, 50%, 75%, and 100%- inclusion, respectively. The constituents, Feed Conversion Ratio (FCR), Body Weight Gain (BWG), Feed intake (FI), Body Mass Index (BMI), Abdominal, Arm Circumferences, and animal length were estimated using standard methods. Proximate revealed high *fiber* and carbohydrate contents. Calcium, Vitamin C/E, saponin, and tannins were the most abundant. No notable difference ($p < 0.05$) was observed in the BWG and FI when 25% and 50% inclusion were compared with the control. For the BMI, all groups showed significant differences when initial values were compared with the final. At the same time, for the abdominal circumference (AC), Arm Circumference (ArC), and naso-anal length, there was no notable difference between 75% and 100%. Overall, the results indicate that the leaves possess good nutritional constituents and can be incorporated into our diet at 25% and 50% inclusions to achieve excellent nutrition and body metabolism.

KEYWORDS: *Adansonia Digitata* Leaf-Based Diet, Nutritional, Proximate, Vitamins, Growth Performance

1. INTRODUCTION

Nutrition, according to Jung and Co (2018), is the process of ingesting, absorbing, and utilizing the nutrients required for the body's growth, development, and upkeep. The components of foods that provide nourishment to the body are called nutrients (Owais *et al*., 2024). Nutrients provide nourishment to support growth and maintain life (Jung *et al*., 2018). Edible medicinal plants are plants that contain both nutritional and therapeutic benefits. These plants are often rich in essential nutrients and bioactive compounds that can promote health and prevent diseases (Masum and Osw, 2016). They include garlic, ginger, turmeric, aloe vera, and baobab, etc. *Adansonia digitata* (*A. digitata*) is a plant found majorly in West, East, and Southern Africa, especially in countries like Nigeria, Sierra Leone, Burkina Faso, Kenya, Uganda, Malawi, and Zimbabwe (Yazzie *et al*., 1994). Different components of the plants, including the bark fiber, are used for food and medicine (Sidebe and Williams, 2002). Its leaves provide a variety of essential nutrients that aid in promoting overall health and well-being. Baobab, indigenous to Africa, is a versatile tree known for its nutrient-rich parts (Hamad *et al*., 2024). The pulp of the fruit is exceptionally high in vitamin C. At the same time, the seeds offer significant protein, digestible carbohydrates, and oils, along with lysine, thiamine, calcium, and iron. A. digitata leaves are even more nutritious than the fruit pulp. They contain high vitamins A, C, and E levels, which have antioxidant and anti-inflammatory properties. The leaves of *A. digitata* contain essential nutrients like minerals, including iron, magnesium, and calcium, vitamins C, E, and K, protein, and dietary fiber, which can help address nutrient deficiencies, especially in regions with prevalent malnutrition. Their incorporation into diets can enhance overall health and well-being, providing a natural remedy for various health issues (Chadare *et al.*, 2009; Yusha'u *et al.*, 2010). They are a staple food in many African populations and can be consumed fresh or dried (Yazzie, 1994). However, due to various climatic conditions, geographical locations, and topography of the soil, the nutrients found in these plants differ in quantity and quality from one region to the other (Sani *et al*., 2022; Stadlmayr *et al*., 2020). Aside from this, there is a need to know the effect of these nutrients on the various growth parameters of the body system so that it will be ascertained that they are well-digested, absorbed, and utilized efficiently. In the same vein, much research has been done on the leaves of *A.digitata* for evaluation of some growth performance characteristics, mostly on poultry animals and majorly from northern Nigeria because it is majorly grown there (Wudil *et al*., 2020). Therefore, the a need to evaluate the growth performances of *A. digitata* leaves from South-Western Nigeria, inclusive of

[*] Corresponding author.

anthropometric data on the Wistar rats due to their physiological similarities with humans. The study's goal was to determine the proximate analysis, minerals, vitamin constituents, and secondary metabolites in A. digitata leaves grown in South-Western Nigeria and also determine the growth performance characteristics and the anthropometric index of female Wistar rats fed on an *A. digitata* leaves-based diet.

2. MATERIALS AND METHODS

Plant Material Collection and Authentication:

A. digitata leaves were obtained at Ayedade farm in Ogbomosho, Oyo State, southwest of Nigeria. The Herbarium Unit of the Department of Plant Biology at the University of Ilorin conducted the identification and authentication, assigning a voucher specimen number (UILH/0011/951/2024). After that, the leaves were washed and allowed to dry at room temperature until they reached a consistent weight before being ground.

Feed Components:

Soybeans, sucrose, yellow corn, and maize husk were obtained from the Oja Oba market in Ilorin, Kwara State. Sunola produced the soyabean oil, and Kewalram Nigeria Limited, Nigeria, refined the soybeans. Vitamin and mineral mix, cellulose, and methionine were purchased at the Aromokeye store in Ilorin, Kwara State, Nigeria.

Experimental Animals:

Fifty (50) female Wistar rats were obtained from the Animal Housing Unit at the Department of Biochemistry, University of Ilorin, each with an average of 100.15 ± 14.24. Before the experiment started, they were housed in a well-ventilated section of the animal house.

Nutritional /Chemical Analysis of *A. Digitata* Leaves.

Proximate Analysis of *A. Digitata* Leaves.

To identify the leaves' proximate elements, methods detailed by the Association of Official Analytical Chemists (A.O.A.C.) (2010) were em ployed.

Determination of Carbohydrate Content in *A. Digitata* Leaves:

The method of estimation by difference was used to calculate carbohydrate content of *A. digitata* leaves and the formulated diet.

Carbohydrate = 100 – (% moisture + % ash + % protein + % lipids + % fiber).

Assessment of *A. Digitata* Leaves' Mineral Content:

The mineral content of *A. digitata* leaves was ascertained by wet oxidation or perchloric acid digestion (AOAC, 1990).

Determination of Vitamin Content of *A.Digitata* Leaves:

The Association of Official Analytical Chemists' official procedures were used to identify the vitamins present in *A. digitata* leaves (AOAC, 1990).

Determination of Secondary Metabolites Constituents of *A. Digitata* Leaves:

The secondary metabolites in *A. digitata* leaves were determined using standard analytical tests for both qualitative and quantitative analyses.

Qualitative Secondary Metabolites: *A. digitata* leaves weighing 10 g were extracted in 200 ml of distilled water and left at room temperature for 48 hours. Following this, the determination of alkaloids (Harborne, 1998), saponins (Wall *et al*., 1954), anthraquinones, steroids, and phlobatannins (Trease and Evans, 1989), cardiac glycosides, cardenolides, and dienolides (Sofowora, 1993), triterpenes and tannins (Odebiyi and Sofowora, 1978), flavonoids and phenolics (Milutinović *et al*., 2018) were all conducted on the aqueous extract.

Quantitative Secondary Metabolites: The determination of saponins (Obadoni and Ochuko, 2001), flavonoids (Boham and Kocipai, 1974), terpenoids and glycosides (Sofowora, 1993), and steroids (Wall *et al*., 1954) were carried out on the *A. digitata* leaves.

Animal Grouping:

The rats (50) were acclimatized for one week before being divided into five groups as outlined below:
Group A – Rats feed on basal control diet
Group B - Rats feed on 25% inclusion of *A. digitata* leaves
Group C - Rats feed on 50% inclusion of *A. digitata* leaves
Group D - Rats feed on 75% inclusion of *A. digitata* leaves
Group E - Rats feed on 100% inclusion of *A. digitata* leaves
The animals were fed their designated diets for six weeks prior to being sacrificed.

Composition f Diets (G):

The procedure described by the American Institute of Nutrition (1977) was adopted for the feed formulation.

Table 1: Composition of Experimental Diet

Ingredients	Treatments (*A. digitata* leave-based diet)				
	Group A (Control / Basal diet)	Group B (25%)	Group C (50%)	Group D (75%)	Group E (100%)
Corn starch	506	379.50	253	126.50	-
A. digitata leaves	-	126.50	253	126.50	506
Cellulose	40	40	40	40	40
Sucrose	100	100	100	100	100
Soybean	250	250	250	250	250

Soybean oil	50	50	50	50	50
Vitamin/Mineral mix	50	50	50	50	50
D-methione	4	4	4	4	4
Total	1000	1000	1000	1000	1000

Unit of diet composed – g/ kg.

Feed Analysis:

Determ ination of Feed Intake (Fi):

To obtain the quantity of feed consumed by each group per day feeds given to different animals per group were measured, and the remains the next day were measured to determine how much was consumed according to the formula.

FI (g) = Total feed given– Feed remaining.

Determination of Body Weight Gain (BWG): The body Weight of each animal in various groups was taken weekly, and the average was calculated and recorded.

BWG (g)= Final Weight- Initial Weight.

Determination of Feed Conversion Ratio (FCR), expressed as grams of feed per gram of weight gain, was determined by dividing the FI by the BWG (Mwale *et al*., 2008). Mathematically as;

FCR = FI (G) / BWG (Go

Anthropometric Analysis

Determination of Body Mass Index (BMI) was calculated as the ratio of the animal's weight (g) to the square of its length (cm^2) (Bernardis and Patterson, 1968).

BMI = Rats Weight (g) / Length (cm^2).

Determination Abdominal Circumference (AC): This was measured using a tape rule around the rat's abdomen in centimeters (Novelli *et al*., 2007).

Determination of Arm Circumference (ArC): This was measured using a tape rule to measure around the rat's arm (Novelli *et al*., 2007).

Determination of Length of Animal (Naso-anal length): The length of the body was recorded from the snout to the pelvic-caudal junction at the base of the tail (Novelli *et al*., 2007). Every measurement was taken with a non-elastic tape measure.

Statistical Analysis:

All results were reported as the average of five replicates ± (SEM). One-way analysis of variance (ANOVA) was used to analyze the data statistically, and Duncan's multiple range test was used for post hoc comparisons, utilizing SPSS version 20. Results were deemed significant at $p < 0.05$.

3. RESULTS AND DISCUSSION

Nutritional/ Chemical Constituents of *A. Digitata* Leaves:

Proximate Composition of *A. Digitata* Leaves:

Table 2 presents the proximate composition of *A. digitata* leaves. The leaves contain high fiber and carbohydrate content and a moderate amount of moisture, ash, protein, and lipid. According to Ashikkumar *et al*. (2007), proximate analysis of food provides estimates of its carbohydrate, lipid, crude protein, and fat content. The fiber content was far higher than those obtained in the same species grown in northern Nigeria, as documented by previous research (Belewu *et al.,* 2008; Wudil *et al.,* 2020), although it compares favorably with Yahauri spices reported by Oyegoke *et al.* (2024). This high fiber content is beneficial because fiber plays an essential role in regulating intestinal transit by absorbing trace elements (Abolaji *et al*., 2007) and increases dietary bulk and therefore prevents constipation (Abolaji *et al*., 2007; Olowokudejo *et al*., 2008). Fiber, therefore, helps to bring down the levels of cholesterol and the risk of cardiovascular disease and diabetes (Mgbemena *et al*., 2022). The high carbohydrate content means *A. digitata* serves as a credible source of energy as a carbohydrate, especially glucose, which is an energy source for muscle cells, brain cells, and blood cells (Ejelonu *et al.,* 2011), which are important for the maintenance of cellular function and biochemical reactions. While the protein content of *A. digitata* leaves is moderately available, it remains greater than that of certain leafy vegetables, such as *Ficus capensis* leaves cultivated in southeastern Nigeria (Achi, 2017). Mgbemena and Amako (2020) state that proteins are necessary for hormones, enzymes, and blood plasma production in the body. According to past studies, fresh green leafy vegetables contain low levels of protein, located as enzymes rather than storage pools, as in grains and nuts (Ifon and Bashir, 1989; Wills *et al*., 1998; Oboh and Masodje, 2009). The lipid content of this leaf is lesser than that of some leafy vegetables commonly consumed in Nigeria, as recorded in the literature (Sena *et al*., 1998). It is well-documented that most leafy vegetables are generally poor sources of lipids (Ifon and Bassir, 1980; Ejoh *et al*., 1996). This is very advantageous as its low-fat intake lowers the risk of aging, cancer, and cardiovascular diseases (Kris-Etherton *et al*., 2002). The moderate ash level of this leaf compared favorably with that of those grown in the south-savanna region of Nigeria (Wudil *et al*., 2020). The leaves ash content indicates the proportion of mineral elements they contain. This implies that a high ash content will mean a high mineral content and, therefore, higher nutritional quality (Fagbohun, 2012). The moderate moisture content of the leaves can give it a two-way definition. According to research, the moisture contents of most leaves, especially vegetables, range between 6 -15% (Rishi *et al*., 2012), and our leaves fall within this range in a moderately available range. This signifies that the growth and development of microorganisms will be inhibited at this percentage, thereby extending their shelf life (Dike, 2010). In the same way, the moderate moisture content of these leaves may promote a moderate activation of co-enzymes and water-soluble enzymes essential to their metabolic activities (Iheanacho and Udebuani, 2009).

Table 2: Proximate Composition of the Leaves of *A. digitata*

Parameters	Moisture	Ash	Crude Fiber	Lipid	Protein	Carbohydrate
Composition (100%)	8.63 ± 0.15	11.41 ± 0.54	38.24 ± 0.42	5.54 ± 0.34	7.27 ± 0.20	29.06 ± 0.09

Values are means of five determinations ± SEM.

Mineral Content of *A. Digitata* Leaves:

The mineral content of the leaves of *A. digitata* is presented in Table 3. Five minerals were detected, out of which three are macro minerals – Calcium, Iron, and Magnesium and two microminerals – Copper and Zinc. Calcium was the most abundant among the macro minerals. Minerals, both macro and trace elements, are vital components of our food. Their functions include regulating water balance in the body, influencing nerve and muscle function, and building and maintaining bones (Kim and Choi, 2013). In *A. digitata* leaves, calcium is the most abundant, and it plays a crucial role in bone formation, density, and strength (Heaney, 2001). Therefore, *A. digitata* leaves can supply the body with abundant calcium to play these roles.

Table 3: Mineral content of the leaves of *A. digitata*

Mineral	Cu	Zn	Ca	Fe	Mg
Composition (mg/100g)	0.22 ± 0.00	1.08 ±0.04	20.08 ± 0.00	6.11 ± 0.04	7.19 ± 0.00

Values are means of five determinations ± SEM.

Iron is essential for the production of hemoglobin and myoglobin, which transport oxygen in the muscles and blood. Additionally, it supports the activity of antioxidant enzymes like peroxidase and catalase, which safeguard cells against oxidative damage. The moderate iron content in *A. digitata* leaves contributes to their role in preventing oxidative stress and maintaining overall cellular health (Makena *et al*., 2021).

The magnesium content of the leaves is higher than that of some other leafy vegetables. Therefore, its roles cannot be underemphasized. It is involved in over 300 enzymatic reactions in the body, including those that regulate blood glucose levels. Proper magnesium intake can improve insulin sensitivity, which is necessary for maintaining a healthy body weight and preventing BWG (de Sousa Melo *et al*., 2022).

Copper is an essential trace mineral that contributes to the antioxidant defense system by acting as a cofactor for superoxide dismutase (SOD), an enzyme that safeguards cells against reactive oxygen species (ROS)-induced damage. Even in small amounts, the copper in *A. digitata* leaves enhances their antioxidant potential, contributing to overall health and disease prevention (Du *et al*., 2010; Olayinka *et al*., 2024).

Zinc is a crucial component of numerous enzymes and proteins that protect against oxidative stress and support the immune system. Therefore, the zinc content in these leaves boosts their antioxidant properties, helping to mitigate oxidative damage and maintain immune function (Prasad, 2020).

From the above, deductions can be made that the mineral composition of *A. digitata* leaves underscores their potential benefits.

Vitamin Content of *A. Digitata* Leaves:

Table 4 presents the results of the vitamin content determination of *A. digitata* leaves. Six vitamins were detected, with vitamins C and E being the most abundant.

These are compounds that are vital for various physiological functions in the body (Habbib *et al*., 2014). Vitamin A and B complexes assayed in this research (B_1, B_2, and B_3) are found in minute quantities in *A. digitata* leaves. However, the quantity is enough to elicit their physiological activities since they are only needed in small amounts. Vitamin A is involved in maintaining immune function, good vision, and healthy skin. (Harrison, 2012). Vitamin B_1 plays a crucial role in carbohydrate metabolism, helping convert carbohydrates into energy. Efficient metabolism of carbohydrates is essential for energy balance and weight management (Gropper *et al*., 2018). The vitamins B_2 and B_3 are crucial for oxidative phosphorylation and the creation of coenzymes (Adesina, 2006). Vitamin C is an antioxidant that helps neutralize free radicals, protecting cells from oxidative damage (Carr and Maggini, 2017). It also regenerates other antioxidants within the body, such as vitamin E. The high vitamin C content in *A. digitata* leaves enhances their antioxidant capacity, contributing to overall well-being and helping prevent chronic diseases (Carr and Maggini, 2017). As a lipid-soluble antioxidant, vitamin E guards against oxidative damage to cell membranes (Burton and Traber, 1990). It performs a crucial role in preventing the oxidation of body lipids. The significant amount of vitamin E in the leaves supports their antioxidant potential, helping to reduce oxidative stress and inflammation (Burton and Traber, 1990).

Vitamin K is essential for blood clotting and maintaining bone health (Shea and Booth, 2016). It also has antioxidant properties that help protect cells from oxidative damage. The presence of vitamin K in *A. digitata* leaves adds to their overall antioxidant potential (Shea and Booth, 2016).

Secondary Metabolites Constituents of *A. Digitata* Leaves:

Table 5 displays the plant secondary metabolite constituents of the leaves. Steroids, cardiac glycosides, triterpenes, flavonoids, and saponins were detected in the leaves, while alkaloids, tannins, and phenolics were not detected. Saponins and flavonoids were the most abundant in the leaves. Plants' medicinal value is attributed to their bioactive phytochemical compounds, which produce specific physiological effects (Akinmoladun *et al*., 2007). *A. digitata* leaves contain high concentrations of saponins. This antioxidant acts by counteracting free radicals, lowering oxidative stress, and exhibiting antimicrobial properties, allowing it to be effective against bacteria, fungi, and viruses. It also possesses the potential to lower cholesterol levels due to its hypercholesteric effect (Nnam, 2011); glycosides have antibacterial and antiviral properties and anti-inflammatory effects, as well as useful in treating various diseases (Harborne, 1986). Flavonoid has anti-inflammatory and antioxidant characteristics, enhance endothelial function, and reduce blood pressure (Beecher, 2003). This suggests that the plant can act as a radical scavenger and exhibit a variety of metabolic and signaling enzymes, thus preventing chronic disease. Triterpenes have anti-cancer and anti-inflammatory characteristics and are useful in protecting the liver from damage (Yadav *et al*., 2010). Steroids act by regulating various physiological functions and reducing inflammation (Kaur *et al*., 2018), all of which are important for the proper maintenance of health.

Table 4: Vitamin content of the leaves of *A. digitata*

Vitamins	A	B_1	B_2	B_3	C	E	K
Composition (g/100g)	0.01 ± 0.01	2.60±0.06	0.001±0.00	0.43±0.02	23.03 ± 1.55	19.93 ± 0.00	0.38 ± 0.05

Values are means of three determinations ± SEM.

Table 5: Secondary plant metabolites of *A. digitata* leaves

Secondary plant metabolites	Alkaloids	Tannins	Saponins	Glycosides	Phenolics	Flavonoids	Triterpenes	Steroids
Concentration (%)	Nd	Nd	137.17 ± 0.76	34.62 ± 0.18	Nd	62.51 ± 1.01	33.30 ± 0.32	36.15 ± 0.28

Values are means of three determinations ± SEM. Nd - Not Detected

Growth Performance Characteristics of Rats Fed on *A. Digitata* Leave-Based Diet :

The result of the above is presented in Table 6. The FI of rats fed on *A. digitata* leave-based diet at 25% and 50% inclusion compared favorably ($p>0.05$) with each other and the group fed on the basal control group. In comparison, a notable contrast ($p<0.05$) was discerned when these three sets were juxtaposed with the groups fed with 75% and 100% inclusion of the leave-based diet. The FI can be defined as a measure of acceptability, palatability, and consumption by an animal (Masafu, 2006). Also, feed quality could determine the amount of feed an animal will consume because an animal will eat more to meet its nutrient requirement (Ikyume *et al*., 2020). From the result obtained in this study, it can be inferred that the feed was accepted till 50% inclusion of *A. digitata* leaves as the FI was significantly high till this percentage. The reduction in FI at 75% and 100% might be due to the non-acceptability and unpalatability of the feed at high doses, and this might be due to the fact that leaves contain some antinutrients, i.e., saponins and triterpenes, coupled with the fact that saponins were the secondary metabolites with the highest concentration. Excess consumption of these bioactive chemicals can interfere with the absorption of nutrients in the body, the palatability, and the FI (Bayon *et al.,* 2016).

The outcomes of the weight gain of rats fed on *A. digitata* leaves inclusion followed the same trend as that of the FI, showing a favorable comparison in rats fed on 25% and 50% inclusion as well as the control diet. In comparison, the reverse was observed in those feds on 75 and 100% diets. This shows that the FI was directly proportional to the weight gain, indicating that *A. digitata* leaves have a high bioavailability index since their high consumption results in an increase in weight gain. In the same vein, the consistent and dose-related loss of weight in rats fed with *A. digitata* leaves at 75% and 100% inclusion meal-based diet might be attributed to the abundance of fiber that aids the digestion and excretion of excess nutrients and reduction in appetite. This might also be of advantage as it might help control body weight. This is similar to the result reported by Salifu *et al*. (2016).

The FCR of rats fed at 25% and 50% compared favourably with each other ($p > 0.05$) and were substantially reduced ($p < 0.05$) than that of the control and those fed on the other two inclusions. A very high FCR was recorded for the 75% and 100% inclusions. The decrease in FCR computed for the 25% and 50% inclusions, which were even lower than the control, suggests that the *A. digitata* leaf meal-based diet was able to support animal growth by being utilized efficiently. According to Doma (1998), a lower FCR indicates a more efficient diet in monogastric animals. The higher antinutrient concentration at 75% and 100% inclusion might also be the cause of the poor FCR observed (Ayo-Ajasa *et al*., 2015). In addition, Adewusi and Matthew (1994) found that increasing fiber content in rat diets resulted in lower FI, conversion rate, and true digestibility.

Table 6: Growth Performance Characteristics of Female Wistar Rats Fed on *A. digitata* Leaves-based Diet

	***A. digitata* Leaves-based Diet**				
Parameters	Control	25%	50%	75%	100%
IW(g)	123.26 ± 1.03^{a}	112.11 ± 0.91^{b}	98.74 ±0.68^{c}	90.21 ± 0.79^{d}	76.45 ± 1.02^{e}
FW(g)	142.18 ± 1.39^{a}	130.34 ± 0.91^{b}	118. .27 ± 1.05^{c}	97.16 ± 0.90 ^{d}	81.44 ± 0.80^{e}
BWG (g)	19.68 ± 0.36^{a}	18.17 ± 0.01^{ab}	20.14 ± 0.38^{a}	7.05 ± 0.11^{c}	5.01 ± 0.23^{d}
FI (g)	49.12 ± 0.78^{a}	43.41 ± 0.78^{ab}	46.64 ± 0.71^{a}	35.94 ± 0.72^{b}	38.35 ± 0.66^{c}
FCR	2.49 ± 0.81^{a}	2.39 ± 0.92^{b}	2.32 ± 0.53^{b}	5.10 ± 1.11^{c}	7.65 ± 0.23^{d}

IW (g); Initial weight, FW; Final weight, BWG (g); body weight gain, FI (g); Feed intake, FCR; Feed conversion ratio.

Anthropometric Indices of Rats Fed on *A. Digitata* Leave–Based Diet:

Table 7 shows the anthropometric index of female Wistar rats fed an *A. digitata* leaf-based diet.

Table 7: Anthropometric Index of Female Wistar Rats Fed with *A. digitata* Leave-based Diet (Before and After feeding Period)

Parameters	Groups (*A. digitata* leaves)				
	Control	25%	50%	75%	100%
BMI day 0 (g/cm^2)	0.33 ± 0.22^{a}	0.31 ± 0.03^{a}	0.30 ± 0.01^{a}	0.27 ± 0.02^{a}	0.25 ± 0.02^{a}
BMI day 42 (g/cm^2)	0.37 ± 0.03^{b}	0.34 ± 0.02^{b}	0.32 ±0.03^{b}	0.25 ±0.04^{b}	0.25 ± 0.02^{a}
AC day 0 (cm)	11.22 ± 0.98^{a}	10.78 ± 0.87^{a}	10.21 ± 0.78^{a}	10.56 ± 0.78^{a}	8.98 ± 1.01^{a}
AC day 42 (cm)	13.69 ± 1.01^{b}	12.23 ± 1.21^{b}	11.89 ± 1.11^{b}	10.92 ± 0.77^{a}	9.34 ± 0.78^{a}
ArC day 0 (cm)	1.65 ± 0.11^{a}	1.45 ± 0.41^{a}	1.32 ± 0.12^{a}	1.11 ± 0.12^{a}	1.11 ± 0.13^{a}
ArC day 42 (cm)	1.82 ± 0.12^{b}	1.57 ± 0.12^{b}	1.48 ± 0.16^{b}	1.19 ± 0.08^{a}	1.18 ± 0.09^{a}
NA length day 0 (cm)	19.23 ± 0.94^{a}	19.02 ± 0.78^{a}	18.23 ± 0.86^{a}	18.34 ± 0.54^{a}	17.35 ± 0.33^{a}
NA length day 42 (cm)	19.92 ± 0.34^{b}	19.89 ± 0.88^{b}	19.14 ± 0.78^{b}	19.11 ± 0.24^{b}	18.22 ± 0.45^{b}

Values are means of 5 replicates ± SEM. Values with superscripts along the same row different from the control for each parameter are significantly different ($p<0.05$). BMI; Body Mass Index, AC; Abdominal Circumference, ArC; Arm Circumference, NA Length; Naso-anal Length

The rats in all the groups showed a substantial dissimilarity ($p < 0.05$) in BMI except those that fed on 100% inclusion of the leaves when the initial value (at Day 0) was compared with the final value after 42 days. For the abdominal circumference (AC) and Arm Circumference (ArC), there were notable changes ($p < 0.05$) in all the groups except for those that were fed 75% and 100% inclusions when the initial and final values were compared. However, for the naso-anal length, substantial dissimilarity ($p < 0.05$) was noted in all five groups (including the control) when both initial and final values were compared. Anthropometry measures body proportions and size by external means (e.g., weight, height, AC, skinfold thickness, and mid-arm muscle and calf circumferences), providing information on body composition based on one-compartment or two-compartment models and/or assessing health risks (Gibson, 2005). BMI is often used to classify weight as underweight, normal, overweight, or obese (Depress *et al.,* 2001; Chiolero *et al.,* 2008; Kolimechkov and Petrov, 2020), and it is the most widely used anthropometric data used in measuring growth performances in humans. The increase observed in this study at 25%, 50% *A. digitata* –leave-based diet, as well as the control, corroborates the result of the weight gain and hence improves the rats' growth performances. This finding is backed by the discovery of Izzuddin *et al.* (2020), who confirmed a positive correlation between BMI and linear growth across the life course from infancy to adolescence. Therefore, the decrease in BMI of rats fed at 75% and the non-significant difference observed in those feds at 100% suggests a very low growth rate, as the reduced weight gain evidence this. Measurement of AC, another type of anthropometric index (Morales-Rosello and Leon-Mendoza, 2005), has proven more effective in the diagnosis of growth disorders than BMI. In this study, it was used to assess growth performance characteristics as well as the risk of underlying pathological conditions such as hyperleptinemia, hypertension, dyslipidemia, non-insulin-dependent diabetes, glucose intolerance, atherosclerotic plaques, etc. (Carlos *et al*., 2007). Due to the challenges in accessing laboratory tests, which are often costly or not obtainable, it is especially hard to achieve (Carlos *et al*., 2007). The result obtained from this work reveals a meaningful increase in the AC in rats fed on 25% and 50% as well as the control group, and this followed a pattern as their increase in weight gain. This is in tandem with the previous study that linked a correlation between an increase in AC and weight gain. The non-significant difference observed in the other two groups supports a low BWG observed in the rats in those groups. The ArC has some potential virtues as a nutritional parameter (Owa and Adejuyigbe, 1997; Tang *et al*., 2013) because it is an easy and medium-term parameter. It can, therefore, work as a good proxy anthropometric measure for growth and nutrition. The increase in ArC observed in groups fed 25% and 50% - *A. digitata* leave-based diet, as well as the control in this study, is evidence that their nutrient requirements are met, and an increase in FI and weight gain supports this. The non-substantial dissimilarity observed in the ArC of rats fed 75% and 100% diets, which are corroborated with a reduction in weight gain and FI when compared with others, is an indication that there is a tendency that undernutrition might set in. Small ArC have been linked to many factors, including inactivity-related muscle loss, nutritional depletion, and systemic inflammation associated with some chronic pathology (Gosker *et al*., 2000). The notable elevation observed in the naso-anal length of all animal groups implies that there was an increase in growth rate in all groups. However, this was lower in rats fed on 75% and 100% -*A. digitata* leave-based diet.

CONCLUSION

This study concludes that *A. digitata* leaves possess essential nutrients needed by the body for proper functioning. These nutrients were well absorbed and digested, making them bioavailable to the body system. This was achieved effectively at 25% and 50% inclusion in the diet.

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Ethical Statement

This study was approved by the University of Ilorin (UILH/2024/021).

Author Contributions

O.R.A., and N.M.O., conceived and planned the experiments. A.A.A., and M.F.J., carried out the experiments. A.A.A., O.J.T., and M. I.A., took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis, and final manuscript.

Declaration Statement:

The authors state that all information in this article is accurate to the best of our knowledge, and we take full responsibility for its correctness.

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Conflict of Interest:

None declared.

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