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Evaluation of the nutritive values of the leaves of three common trees in Landmark University as potential feed resources in poultry

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Abstract*—** The nutritional value of the leaves of three popular tree species in Landmark University Omu Aran, North Central of Nigeria were investigated with the aim of incorporating them into poultry feed. The leaves are those of *Moringa oleifera*, *Parkia biglobosa* and *Anacardium occidentalis*. The accepted techniques for analysis of the Association of Official Analytical Chemists (AOAC) was employed in this study. The result showed that all of the leaves had substantial levels of crude protein (10.27–24.75%), nitrogen free extract (40.92–76.33%), and ash (8.33–13.22%), but low levels of ether extract (2.01–3.15%). The ten minerals and nine amino acids analysed for were present in all the leaves. Phytate, alkaloid and tannin were lowest in *Parkia biglobosa* with the respective values of 4.0, 0.2 and 5.6 mg/g; *Moringa oleifera* has the lowest saponin (0.95 mg/g) and cyanide (0.94 mg/g) while the lowest value of oxalate (27.0 mg/g) was observed in *Anacardium occidentalis* leaves**.** Highest values for phytate (2.15 mg/g), alkaloid (4.02 mg/g), oxalate (0.38 mg/g) and tannin (1.83 mg/g) were observed in *Moringa oleifera;** highest values for saponin (6.13 mg/g) and cyanide (1.38 mg/g) were observed in *Anacardium occidentalis* and *Parkia biglobosa* respectively. The study's findings demonstrated that the leaves of these trees generally high nutrient levels, making them possible acceptable substitute ingredients for chicken feed.

Keywords*— *Agriculture, feed resources, proximate components, minerals, amino acids, anti-nutritive factors, poultry

I. INTRODUCTION

Poultry production plays a major role in bridging the protein gap in developing countries where average daily consumption is far below recommended standards [1]. However, the productivity of poultry in the tropics Nigeria inclusive has been impeded by scarcity and high prices of the conventional protein and energy sources [2]; hence the need to develop cheap and readily available alternative feeding materials to support poultry growth has become imperative.

Plant leaves are known to be abundant in vital lipids, proteins, and micronutrients and to have anti-microbial and anti-parasitic properties. They can be used to feed poultry, thereby increasing productivity [1]. Their inclusion in animal diets, however, is still minimal due to the heavy reliance on vitamin/mineral premixes, which are widely used sources of micronutrients [3].

Parkia biglobosa is an evergreen deciduous tree of the Fabaceae family. It grows in a variety of African habitats and is mostly cultivated for its pods, which contain both a pleasant pulp and valuable seeds. The crushing and fermentation of these seeds is a significant economic activity where the tree is grown. The locust bean tree's numerous parts are also utilized medicinally.

Moringa oleifera, a tree that can withstand drought and was first found in Northwestern India, south of the Himalayas, but has now expanded to the tropical belt. This tree's edible leaves, fruits, blossoms, and immature pods are found in many tropical and subtropical nations' traditional diets. The plant produces a lot of biomass, develops quickly, and exhibits outstanding biochemical features. Moringa is referred to as the "Miracle Tree" because its various parts can be used as food supplements, to treat water and to treat bacterial or fungal skin

problems with an extract. . In an experiment using layer chickens, [6] observed that this tree's leaf has hypocholesterolemic qualities, so its addition in laying chickens feed may help lower egg cholesterol levels.

The *Anacardium occidentale* or cashew tree is a perennial tropical tree is a native of Northeastern Brazil that is now grown extensively in Vietnam, Nigeria and India. Cashew nut tree is a multipurpose species. The seeds command high economic value.

Parkia biglobosa, *Moringa olifera* and *Anacardium occidentale* leaves for this study are some of the commonest tropical plants that are of great value to human. Very little study have been done on the inclusion of these leaves as feed resources in poultry. This study intends to provide possible alternative feed ingredients in the feed of poultry that will reduce the competition between man and animal for food and ensure a reduction in the existing high cost of feed ingredients for poultry by exploring the potential inherent in the leaves of these trees.

II. MATERIALS AND METHODS

A. Location of Study

The investigation was done in Landmark University Teaching and Research Farm, and the Animal Science laboratory, Landmark University, Omu Aran, Latitude 8° 8'' N and Longitude 5° 6'' E (wnytrip.com) located at the guinea savannah zone of Nigeria.

B. Procurement of materials

The test leaves from the trees were gotten from the Teaching and Research Farm of Landmark University, found in the environment. The leaves were harvested fresh from the trees. The harvested leaves were taken to the drying location in plastic bags, where they were dried for a week (1 week) at room temperature in the shade in a closed, airy space before being ground.

C. Nutritive and anti-nutritive assessment

The Association of Official Analytical Chemists' approved procedures were followed for the proximate analyses of the samples. [7], whereas the [8] method was used to quantify the detergent fibers, and the [9] formula was used to determine metabolizable energy (ME):

ME (Kcal/Kg) = (CP x 36) + (EE x 81.8) + (NFE v 35.5)

Where: CP = crude protein, EE = ether extract and NFE = nitrogen free extract.

Quantitative evaluation of anti-nutritive components was performed in triplicate, utilizing the technique of Association of Official Analytical Chemists (AOAC, 2006). For amino-acid evaluation, amino-acid analyzer machine (Pertem^{R} S433model) was used to determine the level of arginine, valine, leucine, methionine, isoleucine, lysine, cysteine and tryptophan. The minerals were analysed with an automatic Atomic Absorption Spectrophotometer (Jenway Model 6305).

Data generated were analyzed using the Analysis of Variance (ANOVA) and reported as means of determinations made in triplicate. With the use of the Statistical Analysis System software 10], the significant differences between the samples were determined using the Duncan multiple test at a 5 percent level of significance.

III. .RESULTS ANDNDISCUSSION

A. Proximate evaluation

Table 1 displays the proximate composition. The Crude protein (CP) values recorded for the three leaves were comparable to CP of some of the conventional and non-conventional feed resources like maize (7.0 -10%), sorghum (8 -14%), millet (13.2), wheat offal (10-15.4%), rice bran (6.8-13.1%), citrus pulp (6.1%) [11]. The CP of 24.75% observed forMoringa leaf (MLM) in this study is lower than 27.2% by [12] but higher than 18.92% observed by [13]; the CP for parkia leaf (PBLM) and cashew leaf (CLM) in this study were lower than respective values of 18.40% [14] and. 17.12% [15]. These differences may be due to the age, season and the time the leaves were harvested [16] and the variety/strain differences [17]. [18] added that any plant item that contains protein at a rate of roughly 12% of its caloric value is regarded as a good source of protein. MLM and PBLM in this study have been able to meet this requirement. The amounts of CP in the leaves used in this study have special nutritional relevance since they may satisfy the protein needs of animals and strengthen their immune systems.

The crude fiber (CF) obtained for MLM and CLM in this study were lower than 9.3% observed by [13] and 7.4% observed by [15] respectively. This lower CF may enhance the digestibility of the leaves. However, for PBLM; the observed CF value is similar to 4.66% reported by [14]. The CF in this study for all the leaves are within the range reported for edible Nigerian vegetables [19]. Although high fiber content negatively affect the digestibility of the feed by animal, yet the presence of enough fiber is necessary for the digestive system to function normally. Heart disease, rectum and colon cancer, varicose veins, phlebitis, obesity, appendicitis, diabetes, and even constipation have all been linked to low fiber diets. Therefore, there is need to strike a balance on the right level of CF.

The amount of ash in the feed ingredients is a reflection of the mineral content in those ingredients. [20]. The levels (8.33-13.22%) obtained in this study are fairly high and may suggest high level of minerals in the leaves. In addition, these values agree to the values reported by [13], [14], and [15] for MLM, PBLM and CLM respectively. The values here are more than the 4.73, 1.56, and 9.06% reported for wheat bran, corn and sotol pineapple respectively by [21].

The observed ether extract (EE) values reported here, were lower than 17.1% and 8.11% observed by [12] and [14] for MLM and PBLM respectively, but higher than the 2.74 and 1.22% reported by [13] and [15] for MLM and CLM respectively. The amount of fat in diet affects the available energy. The presence of fat-soluble vitamins (A, D, E and K) in a feed depend on the fat composition of the ingredients; thus, from this angle, these three leaf meals have adequate

composition of fat inherent in them and can be used as feed ingredients.

The values of proximate components from this study were favorably compared to those from [22] who reported mean values of 19.4% (CP), 13.62% (CF), 7.07% (ash), 1.84% (EE) and 35.68% (NFE) in their examination of the nutritional comnponents of three Nigerian leafy vegetables

Acid detergent fiber (ADF) is a gauge of the forage's fiber content. Digestibility and nutritional availability decline when ADF rises. A measurement of the amount of plant cell walls in the hay is neutral detergent fiber (NDF). NDF quantifies hemicellulose, cellulose, and lignin, which indicate the forage's fibrous mass. [23]. An ADF of 25 to 45 percent and an NDF of 35 to 55 percent are thought to be indicative of high quality forages (as fed). It is also known that lower grade forages have an ADF of 35 to 45 percent and an NDF of 55 to 70 percent (as fed). NDF levels in pasture above 65% may restrict feed consumption. Interesting to note, however, is that none of the leaves in the current study reach that threshold level. The NDF (34.21-41.76%) and ADF (20.12-23.46%) in this study are within the high standard level mention above and 17-61% advised for forages used in large animal rations [24]. This is suggesting that the intake of the tested tree leaves by livestock will not be hindered.

TABLE 1 THE PROXIMATE COMPOSITION OF THE THREE LEAF MEALS

Parameters	***MLM***	***PBLM***	***CLM***	***SEM***
Dry matter	93.00^{a}	85.07^{b}	88.30^{b}	0.95
Protein CP	24.75^{a}	12.33^{b}	10.27^{c}	1.97
Ash	13.22^{a}	10.27^{b}	8.33^{c}	0.73
CF	3.77^{b}	11.91^{a}	1.36^{c}	1.47
EE	3.15^{a}	2.40^{b}	2.01^{c}	0.14
NFE	46.77^{c}	48.14^{b}	76.33^{a}	4.97
NDF	41.76^{a}	38.12^{b}	34.21^{c}	1.14
ADF	23.46^{a}	20.12^{b}	20.42^{b}	0.03
ME (Kcal/kg)	2809.01^{b}	2349.17^{c}	3243.86^{a}	0.75

Note: abcd = means along the same row but with different superscripts are significantly different ($p<0.05$).
MLM: Moringa Leaf Meal; PBLM: *Parkia biglobosa* Leaf Meal; CLM: Cashew Leaf Meal; CF: Crude fiber; EE: ether extract; NFE: nitrogen free extract; NDF: neutral detergent fiber; ADF: acid detergent fiber; ME. Metabolizable energy;

B. The ant-nutritive value of the MLM, PBLM and CLM

Table 2 displays the leaves' antinutritional value. There were significant variation in the antinutritive properties of the leaves ($P < 0.05$). The moringa leaf had the highest values of phytate, alkaloid and oxalate. As opposed to that, the highest level of saponin was found in cashew leaves, and the lowest level was found in moringa leaves. However, statistically speaking ($P > 0.05$), the oxalate levels in moringa and parkia leaves were comparable. The study's measurements of cyanide varied from 0.01 to 1.38 percent. The highest value was found in parkia (1.38%), next comes cashew (1.18%), the lowest value, however was found in moringa leaf.

The tannin content of parkia is higher than 0.21mg/g reported by [14]. This may also be due to the species, age and processing technique used. Moringa had the highest amount of phytate 2.15mg/g, phytate bound with phosphorus in the body thereby hindering the absorption of phosphorus for the animals.

TABLE 2 **ANTI-NUTRITIVE COMPONENTS OF THE LEAVES**

Parameters (mg/g)	***MLM***	***PBLM***	***CLM***	***SEM***
Phytate	2.15^{a}	0.04^{c}	1.32^{b}	0.24
Saponin	0.95^{c}	3.36^{b}	6.13^{a}	0.62
Alkaloid	4.03^{a}	0.02^{c}	2.04^{b}	0.47
Oxalate	0.38^{a}	0.34^{a}	0.27^{b}	0.04
Tannin	1.83^{a}	0.56^{b}	0.75^{c}	0.24
Cyanide	0.94^{c}	1.38^{a}	1.18^{b}	0.17

abcd = means along the same row but with different superscripts are significantly different ($p<0.05$).
MLM: Moringa leaf meal; PBLM: Parkia biglobosa leaf meal; CLM: cashew leaf meal

C. Amino Acid Evaluation

As chemical substances that combine to make proteins, amino acids have an impact on both the quantity and type of protein. In an animal's body, each amino acid has a particular purpose. Red blood cell production, as well as the production of hormones, immunoglobins, enzymes, development and tissue repair all depend on amino acids. Additionally, they help produce glucose and provide as a fallback when other precursors are not available. .

The leaves' amino acid composition is as presented in Table 3. The highest values for arginine, cysteine, isoleucine, lysine and threonine were obtained in cashew leaf, while the lowest values for these amino acids with the exception of lysine were recorded in moringa leaf. The highest values for leucine and tryptophan were recorded in moringa leaf, while the parkia leaf had the highest values for methionine and valine. The lowest values for these four amino acids were observed in cashew leaf with the exception of tryptophan where the lowest value was obtained in parkia leaf. Methionine and cysteine are potent antioxidants that aid in the body's ability to detoxify toxic substances and defend against radiation. It was observed that similarities ($p > 0.05$) occurred between CLM and MLM in their arginine content.

In this study, the methionine level of cashew leaves was comparable to the [25] recommended standard for broiler chickens. The amount of lysine found in parkia leaves in the current study is less than the 0.85 percent level established by [25]. Therefore, if parkia leaf meal is used in broiler feed, a premix must be included as a supplement. .

TABLE 3 THE AMINO ACID PROFILE OF THE THREE LEAF MEALS

Parameters (%)	***MLM***	***PBLM***	***CLM***	***SEM***
Arginine	2.39^{b}	1.78^{a}	2.14^{c}	2.65^{a}
Cysteine	1.29^{ab}	0.03^{c}	1.20^{b}	1.37^{a}
Isoleucine	1.54^{b}	1.08^{d}	1.31^{c}	1.79^{a}
Leucine	2.20^{a}	1.47^{b}	1.04^{c}	0.36^{d}
Lysine	1.20^{b}	1.19^{b}	0.61^{c}	1.85^{a}
Methionine	0.63^{a}	0.36^{c}	0.47^{b}	0.32^{c}
Threonine	1.62^{b}	1.08^{d}	1.36^{c}	1.79^{a}
Tryptophan	0.15^{b}	0.18^{a}	0.02^{d}	0.04^{c}
Valine	2.08^{a}	0.95^{c}	1.25^{b}	0.80^{d}

abcd = means along the same row but with different superscripts are significantly different ($p<0.05$).

MLM: Moringa leaf meal; PBLM: Parkia biglobosa leaf meal; CLM: cashew leaf meal

D. The Minerals Evaluation

In this study, the some macro and micro minerals were examined. The mineral analysis of the leaves is shown in Table 4. MLM has the highest values of potassium (K), calcium (Ca), magnesium (Mg), phosphorus (P), copper (Cu) and Iron (Fe), while CLM has the highest values for sodium (Na), manganese (Mn) and bromium (Br). The highest value for zinc (Zn) was observed in PLM. The lowest values for K, Ca, P and Zn were recorded in CLM, while lowest values for Na, Mn and Cu were recorded in PLM. Similar values for Mg and Fe were obtained in PLM and CLM. Similarity in value of Br was observed in MLM and PLM.

Ca serves as a component of bones and teeth and controls how nerves and muscles work. It plays a role in both milk clotting and the activation of prothrombin to thrombin conversion in blood coagulation. It is essential for the activation of enzymes [14].

From this study, it was observed that the leaves contain important minerals useful for monogastric nutrition.

TABLE 4 THE MINERALS PROFILE OF THE THREE LEAF MEALS

Parameters (mg/g)	***MLM***	***PBLM***	***CLM***	***SEM***
Potassium	57.67^{a}	40.33^{b}	16.33^{c}	5.13
Calcium	0.46^{a}	0.35^{b}	0.23^{c}	0.03
Sodium	1.67^{b}	1.00^{c}	3.00^{a}	0.27
Magnesium	0.03^{a}	0.02^{b}	0.02^{b}	0.001
Phosphorus	0.46^{a}	0.20^{c}	0.09^{d}	0.04
Zinc	0.05^{ab}	0.06^{a}	0.04^{ab}	0.04
Manganese	0.36^{b}	0.02^{c}	0.37^{a}	0.05
Copper	0.05^{a}	0.03^{b}	0.04^{a}	0.002
Iron	0.03^{a}	0.01^{b}	0.01^{b}	0.002
Bromium	0.07^{c}	0.07^{c}	0.09^{a}	0.002

a, b, c = Means (in same row) but with different letters in superscripts differ significantly ($p<0.05$)

MLM: Moringa leaf meal; PBLM: Parkia biglobosa leaf meal; CLM: cashew leaf meal

IV. CONCLUSION

The results in this study showed that the three leaves evaluated here have potentials to serve as replacement and or supplement as a protein source in monogastric feeds to a certain level thereby serves as alternatives to the expensive and scarce conventional feedstuffs.

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