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Proximate Composition of Morning Glory (*Ipomea indica*) Leaf Meal

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Authors' contributions

This work was carried out in collaboration among all authors. Author AMS handled the design, protocol of the study and wrote the first draft of the paper. Author ASD performed the statistical analysis. Author MD managed the literature research. All authors read and approved the final manuscript.

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ABSTRACT

Biochemical studies with a view to evaluate the organic and inorganic nutrients in air-dried *Ipomea* leaf meal commonly known as morning glory (*Ipomea indica*) was carried out. Samples were replicated four times and the values recorded for each nutrient according to the replicates analyzed. The results of mean percentages for organic nutrients revealed that the samples contained 6.83±0.33% moisture, 6.83±0.17% ash, 17.89±0.45% protein, 1.67±0.17% lipid, 1.84±0.34% fiber and 81.84±0.38% nitrogen free extract (NFE). The inorganic content on the other hand was 0.68±0.04% magnesium, 1.11±0.08% sodium, 3.33±0.56% potassium, 1.68±0.03 calcium and 0.53±0.01% phosphorous. This indicated that air-dried leaf meal from *Ipomea indica* has nutritional qualities that could provide farmers with organic and inorganic nutrients for enhanced livestock nutrition. Therefore, air-dried leaf meal from *Ipomea indica* is recommended for feeding livestock in the study area.

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1. INTRODUCTION

The growing demand and high cost of conventional livestock feed ingredients in the tropics have created the need for viable alternatives, particularly the natural feed resources that are native to the region [1,2]. The search for alternative feed resources has reawakened research interests in the use of tropical plants as sources of nutrients for livestock nutrition [3,4].

Plants make a collection of an abundant biomass in farmlands, bush fallows and forests in Nigeria. These are commonly used by small-scale livestock farmers for feeding animals [5]. Leaf meals from tropical trees, shrubs and legumes have demonstrated higher levels of crude protein and minerals with lower levels of crude fiber and anti-nutritional contents than tropical grasses [6]. Although the quantities of anti-nutritional factors in tropical plants limit their optimal utilization by livestock, they were however reported to contain 15.30 to 33.30% crude protein and 2.7 to 15.60% fiber [7]. Among the 5000 species of trees, shrubs and legumes reported as suitable for feeding livestock in Africa, only 80% have real fodder value while 5% were recorded as good [8].

Ipomea is a tropical legume that has over 500 species among the family *convolvolceae*. It is a climbing woody herbaceous plant that has heart shape leaves and funnel shape flowers. It has vigorous, rapidly growing perennial vines climbing up to 12 m on trees or spreading across the ground and thrives well in moist areas along streams, road sides and cultivated lands as weed in tropical areas including Nigeria [7]. The leaves of Ipomea contain adequate quantities of the most essential amino acids that are comparable to conventional feed materials used for feeding livestock. They are also an excellent source of bio-elements such as calcium, magnesium, iron, zinc and copper [9].

Identifying additional feed sources such as Ipomea leaves in Nigeria is necessary in view of the current food crises, this could go a long way to improve the production and productivity of livestock and uplift the quality of life of farmers in the country. Unfortunately, the potentials of Ipomea leaves as source of animal feed has not been fully exploited in the study area due to lack of information on the nutritional value of the plant leaves, therefore the need to evaluate their nutritive importance scientifically.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Zuru Local Government Area of Kebbi State. Zuru is located within latitude $11^0$35' and $11^0$55' North and longitude $4^0$45' and $5^0$25' East of the equator [10]. Zuru Local Government Area is geographically found in the South Eastern part of Kebbi State [11]. The weather of the area is marked by a single rainy season which last for five to six months and a dry season that last for four to five months, with an average annual rainfall of 1025 mm/annum. The climatic condition of the area is characterized by a hot and wet season as in the tropics and a harmattan period occurring around November to January. The soil type is sandy-loam and fertile which makes it suitable for plants growth [10].

2.2 Samples Collection

Fresh Ipomea leaf samples were obtained from the university garden located in Zuru town. Four replicates of the leaf samples were collected during the rainy season (between August and September 2020). During this period, the plant is readily available and in active growth.

2.3 Processing of the Samples

The leaves were washed and spread indoors for air-drying in seven days. The air-dried leaves were pulverized to produce leaf meals (powder) which ware stored in plastic containers before the laboratory analysis.

2.4 Analytical Procedure

Four samples were taken for laboratory analysis. These were analyzed for both the organic (moisture, ash, protein, lipid, fiber and Nitrogen Free Extract) and inorganic (magnesium, sodium, potassium, calcium and phosphorous) nutrients according to the methods described by Association of Official Analytical Chemist (AOAC) [12].

2.4.1 Determination of organic nutrients

2.4.1.1 Moisture

The leaf meal samples (5 g each) were dried in an oven at 105°C for 6 hours and cooled in the desiccator and weighed again. This process was repeated to obtain a constant weight. The percentage moisture content was determined as follows:

%Moisture = Weight loss due to drying/weight of sample x 100

2.4.1.2 Crude fat

The samples (5 g each), were weighed into a thimble and placed in a soxhlet apparatus. A 500ml round bottom flask was attached to the base of the extractor which was clamped to a retort stand. 300 mL petroleum ether was also added into the thimble. The set up was placed on a heating mantle with the top of the extractor connected to the reflux condenser. The source of heat was switched on and water source supplied to enable the solvent (in the flask) boil and extract lipid from the sample. The extraction was completed in 12 hours and the solvent was recovered using rotary evaporator. The extracted lipid in the flask was placed in an oven at 70°C for 30 minuts to remove all the solvent residues completely and cooled in a desiccator. The percentage of lipid was calculated as follows:

Weight of lipid= Weight of flask and sample after extraction – Weight of flask before extraction

2.4.1.3 Crude protein

The crude protein content of the samples was determined using microkjeldahl method. The digested samples were diluted and made alkaline with NaOH and distilled water. The liberated ammonia gas was trapped in a conical flask containing boric acid solution. The conical flask was positioned to allow stem of the condenser dipped into the boric acid solution. After collecting 50cm³of the distillate, the receiver was lowered and the tip of the condenser was washed with distilled water, the ammonia solution in the distillate was titrated against 0.1 M Hcl. A blank determination was carried out using the same amount of the reagents in the absence of the sample.

%Nitrogen Content= Titre value x M x 0.0014 x Df x Cf / Weight of sample

Where:

M = Molarity of Hcl = 0.01 M
Df = Dilution factor = 50
Cf = Correction factor = 10
% Crude protein = % Nitrogen x 6.25
% Nitrogen was converted to percentage crude protein by multiplying the value of nitrogen with 6.25, the conversion factor. Most proteins contain 16% Nitrogen, hence, the conversion factor is 6.25 (100/16 = 6.25).

2.4.1.4 Crude fiber

To determine the crude fiber, 100 ml of 0.25 M H_2SO_4 was added to 2 g each of the leaf meal samples and boiled for 30 minutes after which the hot mixture was filtered. The residue was washed free of acid with plenty of warm water. The residue was then transferred into round bottom flasks to which 100 ml of 0.25 M of NaOH was added and boiled again for 30 minutes. The mixture was then filtered and the residue washed free of alkali with warm water. The residue was then transferred to a dried, weighed silica dish and dried to a constant weight at 105°C for 90 minutes, cooled in a desiccator and weighed. The weighed samples were burnt off and reweighed. The percentage crude fiber content was calculated as follows:

Initial weight of residue - Final weight of residue x 100

2.4.1.5 Ash content

The leaf meal sample (5 g) was added into a previously dried, cooled and weighed crucible. The crucible (containing the sample) was transferred into a muffle furnace and ignited at 550°C to obtain a white ash The ash was moistened with distilled water, dried in a steam bath and then on hot–plate and ashed again at 550°C to a constant weight. The percentage ash content was calculated as follows:

% Ash Content=Weight of ash x 100/ Weight of sample

2.4.1.6 Carbohydrate

The carbohydrate content was determined by difference that is:

% Carbohydrates= 100 - (%Mo + % As + % Cf + % Cp)

Where; %Mo= Percentage moisture content
%As= Percentage ash content

%Cf= Percentage crude fat
%Cp= Percentage crude protein

2.4.2 Determination of mineral composition

The mineral composition of the fish samples were determined according to the methods reported by Association of Official Analytical Chemist (AOAC) [12]. The leaf meal samples (2.0 g each) were weighed into a silica crucible and subjected to dry ashing in a muffle furnace at 550°C. The ash obtained was dissolved in 5 ml HNO_3/HCl/H_2O (1:2:3) and heated gently using heating mantle to obtain until brown fumes disappeared, Distil water (5 ml) was added to the remaining content in the crucible and heated. The solution was filtered using whatman No4 filter paper and made up to 100 ml. Working standard solutions were prepared by diluting the stock solution. Mg, Ca, and P in the leaf samples were analyzed using atomic absorption spectrophotometer, (Model 215 VGP BUCK Scientific) equipped with flame and graphite furnace. The Na and K content was determined using flame photometer.

2.5 Data Collection and Statistical Analysis

The nutrients analyzed in the laboratory were categorized as organic and inorganic nutrients in g/kg for organic nutrients and mg/100 g of dry weight for the inorganic nutrients. These were analyzed for descriptive statistics using Statistic Package for Social Students (SPSS) 20th version. The results were expressed as percentages of mean and standard error of means as described by Aliyu et al. [13].

3. RESULTS AND DISCUSSION

The results for organic and inorganic composition of air-dried Ipomea (*Ipomea indica*) Leaf Meal are shown in Tables 1 and 2.

There was higher moisture and ash content from air dried leaves of *Ipomea indica* in the present study compared to 2.10% and 1.50% for the leaves of *Ipomea batatas* as reported by Unigwe et al. [14] and 3.11% and 1.9% for *Ipomea involucrate* as reported by Opene et al. [15], Except for the leaves of *Ipomea aquatica* where the moisture content (7.50%) was higher than the present study but lower (3%) in ash content reported by Umar et al. [9]. In contrast, Unigwe et al. [14] reported lower (4.07%) moisture with higher (11.05) ash content from *Ipomea batatas.* Variation in the values for moisture and ash content between this result and the previous reports could be attributed to the method of processing the leaf material and the drying period to which the leaves were subjected. Higher moisture content could favor microbial activities under high temperature and result to deterioration of the leaf meals intended for future use. The moisture content of leaf meal in the present study indicates the keeping quality of the meals for longer time without deterioration, therefore giving it a better shelf life.

The crude protein and lipid content in the present study were higher than 3% and 0.4% for crude protein and lipid found in *Ipomea aquatica* as reported by Nagendra et al. [16]. Another study by Umar et al. [9], reported that the fresh leaves of *Ipomea aquatica* contained 6.3% crude protein and 11.00% lipid. The crude protein content of the leaves is lower than the findings of this study unlike the lipid content which was much higher than what was obtained in the present study study were lower than 24.21% and 3.88% reported for the crude protein and lipid content of Ipomeabatatas by Unigweetal. [14]. Variation in the content of the crude protein and lipid between the present and the previous findings could be attributed to the age of the leaf materials used in addition to the processing methods. The protein content of the leaves could have reduced due to age while the lipid content due to drying. The protein content of the leaf meal in the present study is an indication of nutritional potentials and palatability due to the lipid content.

The carbohydrate (NFE) and fiber contents of the leaf meal recorded from this study were higher than 4.3% and 0.9% reported by Nagendra et al. [16] for *Ipomea aquatica* leaf. The carbohydrate content of the leaves was also higher than 42.18% reported for *Ipomea aquatica* (49%), *Ipomea batatas* (55%) *Ipomea invulucrata* and 60% for *Ipomea tribola* respectively as reported by Umar et al. [9], Unigwe et al. [14], Opene et al. [15] and Sourav [17]. The higher fiber content (17.67% and 7.74%) reported for the leaves of *Ipomea batatas* and *aqutica* by Unigwe et al. [14] and Umar et al. [9] have contradicted the findings of the present study. Similarly, Essiett and Obioboho [3] reported higher values (20%, 22% and 27%) for fiber content from the leaves of *Ipomea tribola, batatas and involucrata* respectively. Variation in the values for carbohydrate and fiber content between the present study and the earlier reported ones could

Table 1. Organic composition of *Ipomea* leaf meal

Organic nutrients	Composition (% dry wt.)
Moisture	6.83±0.33
Ash	6.83±0.17
Protein	17.89±0.45
Lipid	1.67±0.17
Fiber	1.84±0.34
NFE	81.84±0.38

Values expressed as percentages of mean and standard error (Means ± SEM)
Wt= Weight, SEM= Standard error of means

Table 2. Inorganic composition of *Ipomea* leaf meal

Inorganic nutrients	Composition (% dry wt.)
Magnesium	0.68±0.04
Phosphorous	0.53±0.01
Calcium	1.68±0.03
Sodium	1.11 ±0.08
Potassium	3.33±0.56

Values expressed as percentages of means and standard error (Means ± SEM)
Wt= Weight, SEM= Standard error of means

be attributed to the age of the plant materials used. The carbohydrate content of the leaf meal for the present study indicates ability of the leaves to provide the soluble carbohydrate required during the process of digestion and the level of fiber content implies higher intake. This indicates the nutritional ability of the leaves for feeding purposes.

The magnesium content of *Ipomea* leaves recorded in the present study were higher than 0.26% and 0.3% reported for *Ipomea involucrata* and *aquatica* by Opene et al. [15] and Umar et al. [9]. The magnesium content of the leaves was however lower than 1.21 reported for *Ipomea aquatica* leaves Umar [9]. The sodium content of the leaves in this study was higher than 0.04% for *Ipomea involucrate* by Opene et al. [15] and 0.16% for *Ipomea aquatica* by Ibtisam et al. [18]. Similarly, the potassium content of the leaves recorded in the present study was higher than 0.07% reported for *Ipomea involucrata* by Opene et al. [15] and 0.44% for *Ipomea indica* by Csurhes [19]. However, Umar et al. [9] reported a potassium content of 5.46% from the leaves of *Ipomea aquatica*. This is in contrast with the findings of this study. Also, the calcium and phosphorous content recorded in the present study were lower than 0.42% and 0.11% reported for the leaves of *Ipomea aquatica* by Umar et al. [9]. Variation in the values for all the inorganic nutrients reported could be attributed to the climatic condition and soil type on which the plant grows and utilization of these nutrients by the plants. It has been reported that nutrient status of the soil affects availability and utilization of minerals by plants [14]. This could have limited availability of mineral nutrients in the plant leaves used for this study. However, the values obtained for all the inorganic nutrients were an indication of the feed value of Ipomea leaf meal. The availability of both organic and inorganic nutrients in the present study implies that leaves from *Ipomea indica* have good feed value and air-drying and pulverization can be used to process the leaves for livestock nutrition.

4. CONCLUSION

The findings of this study revealed that air dried leaf meal from *Ipomea indica* are good source of organic and inorganic nutrients, particularly the crude protein, nitrogen free extract, potassium calcium and sodium. These have also highlighted the efficacy of air-drying and pulverization in preserving the nutrients content of the leaves.

5. RECOMMENDATIONS

The study therefore, suggests the use of leaf meal from *Ipomea indica* as source of nutrients for feeding livestock. However, the leaves and other parts of the plant like vines should be

evaluated for nutritional and other purposes. The levels of anti-nutritional factors are also recommended for further studies.

COMPETING INTERESTS

Authors have declared that no competing interests exist

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