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Phytochemical Analyses of Leaves of Some Browse Plants in Etche, Rivers State

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Abstract:
Mutton is a healthy source of animal protein with abundant nutritional benefits. It is thus essential to provide nutrient-rich browses for rearing and breeding goats. The quality of meat obtained is dependent on the type of browses fed to goats. Two (2) plants; Macaranga barteri and Microdesmiscasearііfolia, were identified as the browse of choice by goats in Ozuzu community of Etche Local Government Area in Rivers State.The leaves were analysed for qualitative and quantitative determination of the phytochemicals.Alkaloids (Wagner's test), anthraquinone glycosides (Bontrager's test), phytosterols (AOAC method), flavonoids (AOAC method), terpenoids (Salkowski's test), saponins (AOAC method), and tannins (AOAC method), were determined according to the specified methods with slight modification. The anti-nutrients were determined using AOAC method.The mineral composition of the plant leaves was determined using the Association of Analytical Chemists (AOAC) method via a Buck Scientific Atomic Absorption spectrophotometer (210VP model). The proximate composition was determined using the AOAC gravimetric methods.Qualitative analysis revealed the presence of alkaloids, anthraquinone glycosides, phytosterols, flavonoids, terpenoids and tannins in both leaves. The proximate analysis revealed percentage values for Crude protein (15.51 ± 0.23 %), Moisture content (70.46 ± 0.83 %), Ash content (10.94 ± 0.17 %), Crude fibre (75.33 ± 1.22 %), and Fat content (5.28 ± 0.18 %). Anti-Nutrient assay revealed: Tannins (85.05 ± 0.19 mg/100g), HCN (0.28 ± 0.18 mg/kg), Phytate (9.80 ± 0.54 g/kg), Flavonoid (8.32 ± 0.14 %), and Alkaloid (9.42 ± 0.63 %), while Mineral Composition assay revealed: Zn (2.65 ± 0.01 mg/kg), Fe (308.50 ± 0.01 mg/kg), K (5796.25 ± 0.06 mg/kg), Mn (97.40 ± 0.10 mg/kg), Na (33.35 ± 0.01 mg/kg), Ca (6763.35 ± 0.01 mg/kg). Levels of tannin, alkaloids, phytates, flavonoids and hydrogen cyanide in the leaves were below threshold values for toxicity. Calcium and Magnesium, exceeded the required daily allowance affirming the potential of the leaves as good nutritional sources for goats.The proximate analysis revealed sufficient levels of protein, crude fibre and ash content which are significant in determining the nutritional quality of browse plants.

***Key Word**: Anti-nutrients Composition, Browse plants, Goats, Mineral Composition, Mutton, Proximate Composition.*

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I. Introduction

Goat rearing, in rural communities within Southern Nigeria, fulfils important economic and social functions. While rural rearers are interested in making sales and using goats for traditional ceremonies, the elites consume mutton (goat meat) as a source of animal protein, owing to the fact that it is acclaimed to be lower in saturated fat, cholesterol, and calories compared to beef, pork, lamb and chicken[1]. Mutton is rich in vitamins, especially Vitamin B_{12} which helps to lower stress and depression[2]. It is also rich in Calcium and Potassium. However, the quality of meat produced is dependent on the browse available for consumption. Traditionally, these animals are fed plant leaves and kitchen wastes brought to them by the owner or are left to freely browse plants within their surroundings which could be laced with high levels of phytochemicals such as tannins, alkaloids, steroids, flavonoids, and saponins, phytates, and hydrogen glycosides which have anti-nutrient tendencies[1]. The consequence of exposure to such browse could be poor absorption of essential nutrients which could lead to malnourished goats or in some extreme cases, death. Man becomes the end recipient, as the quality of mutton becomes compromised. Hence, the need to study the proximate, nutrient and anti-nutrients available in leaves of selected plants browsed by goats in order to advice the farmer accordingly on the right choice of browse.

II. Material and Methods

Sample Collection

The leaves of *Macaranga barteri* and *Microdesmiscasear iifolia* were sampled from a farm in Ozuzu community in Etche Local Government Area of Rivers State, Nigeria (longitude 5º 8' 51" N and latitude 6º 59' 46"E).

Preparation of Plant Leaf Material

The leaves were washed under running tap water, then air-dried for two weeks. They were ground into fine powder and stored in an air-tight container. The methanolic extraction of the ground leaves of each plant was carried out and allowed to stand for 48 hours, then filtered using a Whatman No.1 filter paper.

Qualitative phytochemical assay

The qualitative phytochemical assay of different phytochemicals such as: Alkaloids (Wagner's test), anthraquinone glycosides (Bontrager's test), phytosterols (AOAC method), flavonoids (AOAC method), terpenoids (Salkowski's test), saponins (AOAC method), and tannins (AOAC method), were determined according to the specified methods with slight modification.

Mineral Composition Assay

The mineral composition of the plant leaves was determined using the Association of Analytical Chemists, AOAC method[3] via a Buck Scientific Atomic Absorption spectrophotometer (210VP model). The minerals analysed for include; Zinc (Zn), Iron (Fe), Potassium (K), Manganese (Mn), Sodium (Na), and Calcium (Ca). The concentration of the elements was determined from their calibration curves and percentage metal content calculated using Equations 1 and 2 as follows:

$$\%\ Metal\ Content = \frac{Concentration\ \ (ppm)\times Volume\ \ of\ \ metal\ \ solution}{10^4\times Sample\ \ weig\,ht} \quad \textbf{(1)}$$

$$Metal\ \left(\frac{mg}{100\,g}sample\right) = \%\ Metal\ content\ \times 1000 \quad \textbf{(2)}$$

Anti-Nutrient Composition

The quantitative composition of the percentage crude phytochemical anti-nutrients in the leaf extracts such as; alkaloids, flavonoids, tannins, phytates, and hydrogen cyanides content was determined according to methods described by [4,5,6], FolinCeocalteu[7] and the Association of Analytical Chemists, AOAC, all with slight modification.

Proximate Composition

The proximate composition of the percentage crude phytochemical nutrients in the leaves such as; moisture content, crude protein, crude fibre, fat, carbohydrate content and ash content were determined using the AOAC gravimetric methods.

III. Result

The preliminary qualitative assay for the methanolic leaf extracts is as presented in Table 1. It revealed presence of the following phytochemicals: alkaloids, anthraquinone glycosides, phytosterols, flavonoids, terpenoids, and tannins in the leaves of these browse plants; *Microdesmiscasear iifolia*and *Macaranga barteri*, while saponins were found to be absent.

Table 1 Qualitative phytochemical assay of the studied plants

SAMPLE	Alkaloid	Anthraquinone Glycoside	Phytosterol	Flavonoid	Terpenoid	Saponin	Tannin
Microdesmiscase ariifolia	+	+	+	+	+	-	+
Macaranga barteri	+	+	+	+	+	-	+

***Absent: -, Present: +**

The mineral composition of the studied leaves is presented in Table 2. Zn; 2.65 ± 0.01mg/kg, Fe; 308.50 ± 0.01mg/kg, K; 5796.25 ± 0.06mg/kg, Mn; 97.40 ± 0.10mg/kg, Na; 33.35 ± 0.01mg/kg and Ca; 6763.35 ± 0.01mg/kg were revealed to be present.

Table 2: Mineral Composition of the studied leaves

MINERAL ELEMENTS	SAMPLE MINERAL COMPOSITION (mg/kg)	RDA (mg/kg)
Zn	2.65 ± 0.01	30
Fe	308.50 ± 0.01	350
K	5796.25 ± 0.06	2200
Mn	97.40 ± 0.10	30
Na	33.35 ± 0.01	700
Ca	6763.35 ± 0.01	2600

Values are expressed as Mean ± Standard Error (SEM) (n = 2)

The anti-nutrient composition of the studied leaves is presented in Table 3. Tannin;85.05 ± 0.19mg/kg, HCN; 0.28 ± 0.18mg/kg, phytate;9.80 ± 0.54mg/kg, flavonoid;8.32 ± 0.14% and alkaloid;9.42 ± 0.63% were identified in their respective compositions.

Table 3: Anti-Nutrient Composition of the studied leaves

SAMPLE	Tannin (mg/kg)	HCN (mg/kg)	Phytate (mg/kg)	Flavonoid (%)	Alkaloid (%)
Browse Plants	85.05 ± 0.19	0.28 ± 0.18	9.80 ± 0.54	8.32 ± 0.14	9.42 ± 0.63

*Values are expressed as Mean ± Standard Error (SEM) (n = 2)

Proximate composition of the studied leaves is presented in Table 4. Moisture content;70.46 ± 0.83%, ash; 10.94 ± 0.17%, fat content;5.28 ± 0.18%, crude protein;15.51 ± 0.23%, crude fibre; 75.33 ± 1.22%, and carbohydrate; 22.50 ± 0.92%, were present in their respective compositions.

Table 4: Proximate Composition of the studied leaves

SAMPLE	Moisture Content (%)	Ash (%)	Fat Content (%)	Crude Protein (%)	Crude Fibre (%)	Carbohydrate (%)
Browse Plants	70.46 ± 0.83	10.94 ± 0.17	5.28 ± 0.18	15.51 ± 0.23	75.33 ± 1.22	22.50 ± 0.92

Values are expressed as Mean ± Standard Error (SEM) (n = 2)

IV. Discussion

The mineral composition in the extract of the studied leaves is presented in Table 2. The value for Calcium (Ca) was found to be; 6763.35 ± 0.01 mg/kg. This value is above the recommended daily allowance (RDA) of calcium, which is 2600 mg/kg, thus confirming the browse plants studied as rich sources of calcium for goats. This value is also higher than the calcium content in *Microdesmispuberula* which is 1635.00 mg/kg, and the calcium content in banana peels used in ruminant feeds which is 591.00 mg/kg[8,9]. Calcium (Ca) is important to goats for the development of the nervous system together with muscular and heart functions as well as development of bones and teeth[10]. Calcium concentration in the range of 1200.00 mg/kg and 2600.00 mg/kg is needed for maintenance of lactating and growing ruminants[11].

Potassium (K) is important in the formation of hormones and functional muscles and also in the maintenance of alkaline-acid balance in the blood of ruminants (goats)[1]. The value for K was found to be; 5796.25 ± 0.06 mg/kg. This value is above the recommended daily allowance (RDA), 2200mg/kg for Potassium in goats and compares favourably with values of other browse plants in literature[8]. This infers that these leaves are rich nutritional sources of potassium. The value for Mn was found to be 97.40 ± 0.00 mg/kg. This value is higher than the RDA value. This value suggests that the browse plants investigated are good sources of Mn. Zinc (Zn) is relevant to animals in building a strong immune system, for protein formation and epithelial tissue formation[10]. Iron (Fe), is a relevant component of haemoglobin, it is useful to animals in the transportation of oxygen to their cells[12]. The value for Iron (Fe) was found to be; 308.50 ± 0.01 mg/kg. Even though the value is

slightly below the RDA value for Fe; 350.00 mg/kg. It can be said that the browse plants under consideration are moderate sources of iron.

The anti-nutrient composition in the extract of the studied leaves is presented in Table 3. The tannin concentration was found to be 85.05 ± 0.19 mg/kg, which is below the lethal dose of tannins; 2260 mg/kg, in literature[13]. This implies that the leaves of these browse plants are tannin-safe[14,15]. Ruminants are more susceptible to toxic effects of cyanides than monogastric animals. The lethal dosage of cyanide is 2 mg/kg[14]. In this study, the hydrogen cyanide (HCN) value of 0.28 ± 0.18 mg/kg was recorded, this value is far below the lethal dose, thus making it safe for consumption by goats[16]. Phytic acid chelates multivalent metal ions such as Zinc, Calcium and Iron, making it a strong inhibitor of iron-mediated free radical generation. Diets high in phytate content reduce the bioavailability of these minerals and this action has adverse effects on protein and starch digestion. High phytate values usually imply that the plant is unsafe for consumption because, it inhibits mineral absorption at high amounts[8]. In this study, a phytate value of 9.80 ± 0.54 g/kg was obtained, this value is less than the values obtained for other browse plants which lies within the range of; 13.80 - 25.20 mg/g[17].

Flavonoids are a group of polyphenolic compounds that chelate metals such as Iron and Zinc. They also reduce the absorption of these nutrients. They act to protect against Ultraviolet (UV) rays, attract pollinators and also serve as a defence against herbivory. However, the anti-nutrient effect of flavonoids is mainly concentration dependent. A study of goat weed by Dores et al. [18] reported a mean flavonoid content value of 5.33 % which was attributed to the flavour and the protective ability of the plant to herbivory. In this study, the value for flavonoids was found to be 8.32 ± 0.14 %. In comparison with literature values, this value is high and may suggest the presence of esters emitting pleasant scent from the leaves which attracts goats[19,18].

Chronic lethal dosage of alkaloids in goats has been reported to be 1.2 to 4.4 kg/kg which is significantly high compared to the value of 0.06 to 0.22 kg/kg (9.42 ± 0.63 %) obtained for alkaloids in the studied plant leaves. Ruminants are more resistant to the hepatic effects of plant alkaloids than monogastric animals because ruminal microflora degrades alkaloids thereby reducing the amount entering hepatic portal circulation. Alkaloid poisoning in ruminants is mostly due to chronic exposure[20]. High alkaloid values in these plants have inconsequential effect because alkaloid toxicity is impactful only on monogastric animals[21,22].

The proximate composition of the studied leaves is presented in Table 4. High moisture content promotes microbial contamination and chemical degradation[8]. Animal feed with low moisture content is desirable, because low moisture composition is a vital means of stability and less susceptibility to microbial pollution and easy storage form[9]. A moisture content value of 70.46 ± 0.83 % was recorded, which compares favourably with literature values of other browse plants of 61.95 to 72.07 % found in roots and tubers used as ruminant feeds[22,9].The importance of protein in goats cannot be over emphasized as proteins constitute the muscle, wool, skin and high proportions of animal body parts, it is also required in animal feeds for milk, and meat production. The crude protein value for the studied plants was found to be 15.51 ± 0.23 %, which is above the threshold (9.00 %) needed to meet the daily requirement for body maintenance of goats[9]. This suggests that the studied plants have the appropriate amount of protein required for goat maintenance. Ash is the inorganic residue left after water and organic matter have been removed by heating in the presence of oxidizing agents. Ash content gives an indication of the amount of minerals available within a food substance. High ash content depicts a substance rich in minerals, which are a necessary requirement for health and vitality. Browse plants rarely exceed an ash content level higher than 5 %. The ash content value was found to be 10.94 ± 0.17 %, which is significant when compared to literature values[8]. Thus, they can be regarded as a good nutritional source for goats.

Fats are major energy sources which provide essential lipid nutrients; they are needed for transportation of fat-soluble vitamins in the body. The crude fat value was found to be 5.28 ± 0.18 %, which is in the same range with other browse plants like 5.07 %; for Rheudelotti, and 6.51 % for *Microdesmispuberula* reported by Udo et al.[8] respectively. This suggests that these leaves could significantly contribute to the energy content of the feed and increase the storage life of the ruminant feed by reducing its chances of becoming rancid. Crude fibre gives a measure of quantities of indigestible cellulose and lignin present in a sample. These components, though they have insignificant food value, provide the nutrient bulk necessary for proper peristaltic action in the intestinal tract. A dietary fibre of 18-20 % is required for goats, however, a significant crude fibre value of 75.33 ± 1.22 %, was recorded. This experimental value was higher than that obtained from cassava leaf meal (15.6 %), guava leaves (16.1 %), seven browse plants (11.6 %) and, *Microdesmispuberula* (18.16 %) reported by Aduku[23], Okoli et al.[1] and Udo et al. [8] respectively. Increase in dietary fibre influences rumen fermentation, as adequate dietary fibre is essential in producing leaner carcasses in growing goats, and plays a role in prevention of milk fat depression in high producing lactating dairy goats in addition to enhancing nutrients digestion[24].

V. Conclusion

In this study, we deduced;*Microdesmiscasearіifolia* and *Macaranga barteri* leaves, as good nutritional sources of browse for goats. The proximate analysis revealed sufficient levels of protein, crude fibre and ash content which are very significant in determining the nutritional quality of a browse plant.Low levels of moisture content observed in the leaves suggest they cannot be easily degraded or contaminated by microbes. Levels of tannins, alkaloids, phytates, flavonoids and hydrogen cyanides were below threshold values for toxicity.

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