PROXIMATE, MINERAL AND PHYTOCHEMICAL COMPOSITION OF SOME SELECTED FEED INGREDIENTS IN SEMI-ARID REGION OF NORTH EASTERN NIGERIA

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ABSTRACT

Seeds of Cucumbar sativus L, Acacia nilotica, L, Glycine max L, Parkia globosa, Hibiscus subdariffa L, Mangifera indica, Moringa oleifera, Citrullus lanatus, Adonsonia digitata and Mesocarp of Hypalina theibecca indigenous to semi-arid zone of North Eastern Nigeria were analyzed for proximate composition, minerals and phytochemical properties to assess their potentials as alternative sources of protein, energy and other nutrients for non-ruminant animals. The Samples were purchased from Garin Alkali in Bursari local market in Yobe State. The samples were air dried and milled to pass through 1mm sieve screen and stored in a cleaned well labeled polythene bag prior to laboratory analyses. Triplicate of representative samples of the feed ingredients were used for analyses. The proximate compositions of the samples were determined using conventional standard analytical methods of Association of Analytical chemists. Mineral contents were determined using Flame Atomic absorption Spectrophotometer Photometer while the Iron contents were determined calorimetrically. All data collected were subjected to analyses of variance using statistical analytics software (SAS). The results of the proximate composition analysis showed considerable variations between samples in Crude Protein (CP), Crude Fiber (CF), Dry Matter (DM) and Ether Extract (EE), Nitrogen free extracts (NFE), Carbohydrates (CHO) and ash. The CP, DM, CF, EE, ash, NFE and CHO values of the samples under investigation ranged from 7.51 to 35.22, 77 to 94.00, 0.05 to 25.00, 2 to 26, 3.00 to 14.00, 10.27 to 70.46 and 30 to 74.48% respectively. The highest level of CP 35.22% was recorded in Glycine max seed while the lowest value of CP 7.51% was recorded in Mangifera indica seed. Minerals such as Sodium (Na), Potassium (K), Magnesium (Mg),Chromium (Cr), Zinc(zn), Copper(cu),Manganese(Mn) and Iron (Fe) ranged from 0.64 to 3.20, 0.06 to 0.77, 2.04 to 9.04, 0.29 to 0.89,0.88 to 2.72, 0.16 to 2.59, 0.83 to 4.96, 0.19 to 1.15 and 0.52 to 2.26 ppm respectively. Highest concentration of important minerals such as Calcium (2.72 ppm), Sodium (3.20 ppm), iron (2.26 ppm), Zinc (2.59 ppm) and Magnesium (9.06 ppm) were obtained in Acacia nilotica, Acacia nilotica and Moringa oleifera, Hibiscus subdariffa and Parkia globosa. Phytochemical screening revealed the presence of alkaloids, tannins, Phenols and Flavonoids. The highest values of total phenol 417 mg/GAE/100g, tannin 4.54 mg/GAE/100g, Flavonoid 2.21RE/100g and Alkaloid 11.00 % was recorded in Acacia nilotica, Glycine max, Citrullus lanatus and Hypalina theibecca. The study revealed that Acacia nilotica, Hibiscus subdariffa, Parkia globosa and Glycine max are rich in calcium and sodium, iron and Magnesium and zinc. Similarly the crude protein and carbohydrate values of Acacia nilotica, Hypalina theibecca, Citrullus lanatus and Adonsonia digitata are comparable to most cereal grains and can be used when processed.

Key Words: Proximate, Minerals, Phytochemicals and Feed ingredients.

Introduction

The production of conventional feed ingredients such maize and soya beans may no longer be able to keep pace with the demands (Diarra *et al*., 2011). Consequently, determination of other suitable alternative plants to serve as sources of protein, energy and other nutrients for non-ruminant animals are timely. The utilization of non-conventional feed resources is justified by serious feed deficits, rising cost of production, continuing low animal productivity, and inability of the components of the animal industries to meet national targets, especially of animal protein (Iyayi, 2017). Babiker *et al*. (2009) observed that tables of chemical composition of feed ingredients are in fixed figures without considering the variability in nutrients which may happen due to intrinsic (variety) and external factors such as soil type, climatic conditions, geographical locations, storage and season of growing. Several authors have also reported that energy value in feed ingredients is not constant and that may happens due to the conditions of harvesting (Zijlstra *et al*., 1999), post-harvest storage (Kim *et al*., 2003) or growing location (George and McCracken, 2003). Feed analyses are essential for ensuring accurate information on the composition of feed ingredients and determining the level of desirable and undesirable substances, enabling the production of safe, balanced diets for livestock. The study

was conducted to investigate the Proximate, Mineral and Phytochemical composition of some selected feed ingredients in semi-arid area of Yobe state, Nigeria.

Materials and Methods

Sample collection and preparation

The selected feed ingredients are *Cucumbar sativus L* seed, *Acacia nilotica*,L seed, *Glycine max L* seed, *Parkia globosa seed, Hypalina theibecca, (*mesocarp), *Hibiscus subdariffa L.*seed, *Mangifera indica* seed, *Moringa oleifera* seed, *Citrullus lanatus seed* and *Adonsonia digitata* seed. Samples were purchased from Garin Alkali in Bursari local market in Yobe State. The samples were identified and authenticated at the Agronomy and Forestry and Wildlife Departments, Federal University Gashua. The samples were air dried and milled to pass through 1mm sieve screen and stored in a cleaned well labeled polythene bag prior to laboratory analyses.

Sampling and Laboratory analysis

Triplicate of representative samples of the feed ingredients were obtained and placed in clean plastic containers properly labeled and tightly sealed. Samples were analyzed in the Department of Animal Science, Land Mark University Omu-Aran Kwara State, Nigeria.

Proximate analysis

Proximate chemical compositions for all samples were determined according to Official Methods of Analysis (A.O.A.C., 1990). Nitrogen free extract (NFE) was obtained by difference.

Mineral analysis

The Minerals were determined according to procedure described by (Martin Prevel, 1984) using flame atomic absorption spectrophotometer and photometer, Iron contents was determined calorimetrically.

Phytochemical

Total Flavonoid determination

The total flavonoid contents were determined using the Aluminum colorimetric methods (Chang *et al*., 2002, Stankovic, 2011) with some modification using Rutin as the standard.

Tannin determination

The tannin content was analyzed using the method reported by Ejikeme *et al*. (2014). One gram of the sample extracts was macerated with 50 ml of Methanol and filtered. 0.3ml of 0.1N Ferric Chloride, 0.1N HCl and 0.3ml of 0.0008m of Potassium Ferricyanide was added and the absorbance was read at 720nm.

Alkaloid determination

0.5g of the test samples was weighed and 20ml of 20% Acetic acid was added to it in 100ml beaker. The beakers were covered and allowed to stand for 4 hours. They were later filtered and placed in water bath to reduce the weight to one quarter. Concentrated Ammonium hydroxide was added drop-wisely until precipitation was complete. It was then collected by filtration and weighed. The total phenol content was analyzed using Folin-Ciocalteu method as reported by Agbenorhevi and Marshall (2012).Triplicate absorbance readings were taken for each sample. The results for the samples were expressed as concentration of gallic acid equivalent (mg GAE/100 g) using the equation obtained from the standard calibration curve.

Statistical analysis.

All measurements were replicated three times and expressed as mean ± SEM. Data collected were subjected to one way analysis of variance (ANOVA) and significant means were compared using Duncan multiple Range Test (DMRT).

Table1. Proximate composition of some selected feed ingredients

	Nutrients (%)						
Sample code	**DM**	**CP**	**CF**	**EE**	**Ash**	**NFE**	**CHO**
CS	86.00^{c}	9.02^{e}	7.14^{g}	21.00^{cd}	7.00^{c}	41.84^{e}	48.98^{f}
AN	85.00^{c}	13.21^{c}	4.34^{i}	20.00^{de}	4.00^{e}	61.45^{c}	65.78^{d}
GM	94.00^{a}	35.22^{a}	20.00^{b}	23.00^{bc}	5.00^{d}	10.27^{j}	30.27^{j}
PG	90.00^{b}	28.18^{b}	12.50^{d}	26.00^{a}	5.00^{d}	18.65^{h}	31.32^{i}
HT	92.00^{ab}	7.69^{f}	11.11^{e}	2.00^{h}	8.00^{b}	63.22^{b}	74.31^{a}
HS	91.00^{b}	11.38^{d}	17.94^{c}	19.00^{e}	14.00^{a}	15.27^{i}	33.22^{g}
ML	92.00^{ab}	7.51^{f}	0.05^{j}	10.00^{g}	4.00^{e}	70.46^{a}	70.48^{b}
MO	77.00^{d}	12.12^{cd}	10.00^{f}	25.00^{ab}	7.00^{d}	22.87^{g}	32.87^{h}
CL	87.00^{c}	8.83^{ef}	5.55^{h}	15.00^{f}	3.00^{f}	61.45^{c}	60.17^{d}
AD	87.00^{c}	11.38^{d}	25.00^{a}	9.00^{g}	7.00^{c}	34.63^{f}	59.62^{e}
SEM	1.33	0.66	0.48	0.80	0.33	0.002	0.002

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L.AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera* CL=*Citrullus lanatus*.L, AD= *Adonsonia digitata* DM= Dry matter, CP= Crude protein, CF= Crude fibre, EE= ether extract, NFE= Nitrogen free extract. All test performed are in triplicates and mean values were used.

Table 2: Mineral Composition of some selected feed ingredients.

	Minerals(ppm)								
Sample Code	**Na**	**K**	**Mg**	**Cr**	**Ca**	**Zn**	**Cu**	**Mn**	**Fe**
CS	0.64^{b}	0.12^{d}	8.00^{b}	0.88^{a}	1.52^{d}	0.35^{b}	3.31^{c}	0.76^{b}	1.22^{d}
AN	3.20^{a}	0.15^{c}	2.80^{e}	0.29^{c}	2.72^{a}	0.20^{e}	4.13^{b}	0.38^{c}	1.83^{b}
GM	0.64^{b}	0.15^{c}	4.72^{d}	0.29^{c}	1.68^{c}	0.20^{e}	4.96^{a}	0.38^{c}	1.23^{d}
PG	0.64$_{b}$	0.77^{a}	5.04^{c}	0.58^{b}	2.00^{b}	2.59^{a}	4.96^{a}	1.15^{a}	1.04^{e}
HT	0.64^{b}	0.18^{b}	2.72^{e}	0.29^{c}	0.88^{f}	0.22^{d}	3.31^{c}	ND	1.13^{de}
HS	0.64^{b}	0.13^{d}	9.04^{a}	0.89^{a}	0.88^{f}	0.23^{d}	4.13^{c}	ND	2.26^{a}
ML	0.64^{b}	0.06^{f}	2.04^{f}	0.58^{b}	1.04^{c}	0.16^{f}	ND	0.38^{c}	1.56^{c}
MO	3.20^{a}	0.09^{e}	4.96^{cd}	0.58^{b}	1.04^{c}	0.27^{c}	0.83^{e}	ND	ND
CL	0.64^{b}	0.07^{f}	3.12^{e}	0.58^{b}	1.04^{c}	0.22^{d}	1.65^{d}	0.19^{d}	1.83^{b}
AD	0.64^{b}	0.07^{f}	4.72^{cd}	0.58^{b}	0.88^{f}	0.17^{f}	1.65^{d}	ND	0.52^{f}
SEM	0.03	0.53	0.33	0.01	0.01	0.003	0.09	0.03	0.05

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L. AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera* CL= *Citrullus lanatus*.L, AD= *Adonsonia digitata* Na= Sodium, K=Potassium, Mg=Magnesium, Cr= Chromium, Ca= Calcium, Zn= Zinc, Cu= Copper, Mn= Manganese, Fe= Iron, All test performed are in triplicates and mean values were used"

Table 3: Phytochemical properties of some selected feed ingredients

Sample Code	Total Phenol (MgGAE/100g extract)	Tannin (Mg RE/100g extract)	TotalFlavonoid (MgRE/100g extract)	Alkaloid (%)
CS	150.97^{c}	4.23^{ab}	0.24^{fg}	1.09^{i}
AN	417.84^{a}	1.24^{e}	0.27^{e}	7.61^{c}
GN	69.04^{ef}	4.54^{a}	0.08^{h}	2.20^{h}
PG	59.28^{f}	4.34^{a}	0.08^{h}	4.35^{e}
HT	238.24^{b}	3.60^{bc}	1.02^{c}	11.00^{a}
HS	98.72^{d}	4.37^{a}	0.44^{d}	1.09^{i}
MI	387.92^{a}	1.48^{e}	1.10^{b}	3.30^{f}
MO	97.36^{de}	3.08^{c}	0.22^{g}	5.26^{d}
CL	104.52^{d}	3.37^{c}	2.21^{a}	10.87^{b}
AD	58.05^{c}	2.23^{d}	0.25^{ef}	3.19^{g}
SEM	17.35	0.33	0.01	0.003

"^{abcdefgh} Means in the same column with different superscripts are significantly different (P<0.05)" CS= *Cucumis sativus* L. AN= *Acacia nilotica*,L GM= *Glycine max* PG- *Parkia globosa* HT= *Hypalina theibecca* HS= *Hibiscus subdariffa* MI= *Mangifera indica* MO= *Moringa oleifera,CL= Citrullus lanatus*.L, AD= *Adonsonia digitata* GAE= Gallic acid equivalent, RE=Rutin equivalent. All test performed are in triplicates and mean values were used"

Results and Discussion

Table 1 presents the result of the proximate chemical composition of some selected feed ingredients. The crude protein values of the samples under investigation ranged from 7.51 to 35.22 %. The highest level of CP was recorded in *Glycine max* seed while the lowest CP value of 7.51% was recorded in *Mangifera indica* seed. There were significant differences (P < 0.05) in CP, CF, EE, ash and NFE for the feed ingredients in this study. The DM, CP, EE, CF, ash and NFE values for *Mangifera indica* seed obtained in this study differed from the values earlier reported by other studies (Diarra *et al.*, 2011 and Fowonola, 2010).The highest value of NFE, EE, CF was recorded in *Mangifera indica*, *Parkia globosa* and *Glycine max* respectively. The DM, CP, CF, EE, ash and NFE values of 86, 9.02, 7.14, 21.00, 7.00 and 55.84 % obtained in this work for *Cucumis sativus* was not in agreement with values of 87.7, 24.5, 3.00, 0.07, 9.34 and 50.1% reported by Niyi *et al.* (2019). Similarly the values of 35.22, 20, 23 and 5% for CP, CF, EE and Ash for *Glycine max* was not in agreement with values of 39.08, 4.68, 21.08, and 3.40% reported by Diarra *et al.* (2011) and Fowonola (2010).The differences could be attributed to intrinsic (variety) and external factors such as soil type, climatic conditions, geographical locations, storage and season of growing. The mineral content of the various feed ingredients are presented in Table 2. The highest value of calcium, iron and magnesium was recorded in *Acacia nilotica* and *Hibiscus subdariffa.* The results showed significant difference (p<0.05) among the various feed ingredients investigated in this study. The present report showed that *Parkia globosa* had the highest concentration of Zinc. The highest values of total phenol 417mg/GAE/100g, tannin 4.54mg/GAE/100g, Flavonoid 2.21RE/100g and Alkaloid 11.00% was recorded in *Acacia nilotica, Glycine max, Citrullus lanatus* and *Hypalina theibecca* while the lowest values of 58.05 mg/GAE/100g, 1.24 mg/GAE/100g, 0.08 RE/100g and 1.09% were recorded in *Adonsonia digitata*, *Acacia nilotica, Parkia globosa and Glycine max,* and *Cucumis sativus* respectively as reflected in Table 3. The values of Flavonoid, Alkaloid, Tannin, and Phenol obtained in this study are at variance with values of 3.84 RE/100g, 1.64%, 0.46 mg/GAE/100g and 0.06 mg/GAE/100g reported by Okwu and Orji (2007).

Conclusion and recommendation

The study provided information on nutrient levels and phytochemical substances of some feed resources in semi-arid zone of Nigeria. This will serve as baseline upon which other studies can be done. It will also encourage the use of the less expensive and less competitive feed ingredients, thus, reducing the cost of feed, improve the profit margin of farmers. Further studies are recommended on processing of these feed ingredients to ensure effective utilization of these ingredients

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