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PROXIMATE AND MINERAL POTENTIALS OF *PANICUM MAXIMUM* (Jacq.) AS A SUBSTITUTE TO MAIZE AND SORGHUM IN LIVESTOCK FEED

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ABSTRACT

There is a continued pressure to source for an alternative feed for livestock in Nigeria. This study was aimed to compare the proximate and mineral compositions of *P. maximum* seeds with maize and sorghum seeds with a view to finding out if *P. maximum* seeds could serve as a substitute for maize and sorghum in feeding livestock. The laboratory analyses were conducted at the Institute of Agricultural Research and Training, Ibadan. Proximate and mineral contents were determined using AOAC and spectrophotometric methods, respectively. Means were separated using Duncan's multiple range test at p = 0.05. The results revealed that *P. maximum* seeds had highest carbohydrate content (86.65 g/100 g ± 1.52) and lowest moisture content (6.78 g/100 g ± 0.75) with appreciable mineral contents compared to maize and sorghum seeds. Although maize and sorghum seeds had higher mineral content than *P. maximum* seeds, the high carbohydrate content of *P. maximum* seeds, which provides higher energy to livestock, and low moisture content will be more advantageous to store for a long time. Therefore, this study suggests the use of *P. maximum* seeds, with the addition of nutrient and protein supplements, as a substitute to maize and sorghum in livestock feed.

Key words: Proximate content; mineral content; *Panicum maximum*; livestock
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INTRODUCTION

There is continued pressure from people to source for alternative feed for livestock and other animals to prevent food insecurity resulting from competition between animals and humans (Cramer *et al*., 2017). The feeding value of any grain for livestock involves factors such as availability, accessibility, nutrient availability and chemical composition (Dynes and Schlink, 2002). Any grain that does not provide adequate nutrients for growth and development is not a good quality grain (Adesogan *et al*., 2006).

Panicum maximum (Jacq.) also known as guinea grass in Nigeria is indigenous to Africa (Batistoti, 2012). It is a member of the Poaceae family with about 450 species (Kellogg, 2015). *P. maximum* grows naturally in many parts of Nigeria because it can tolerate fire and shade. It grows in sugar cane fields due to its ability to thrive under shaded conditions (Bamikole *et al.,* 2001). It is a tall perennial plant with stems up to 3.5 m in height. The leaf blade is about 35 mm wide while the flowers are produced in a well-developed panicle of 60-70 cm long. The bisexual flower has 3-4 stamens, while the fruits develop from a two-flowered spikelet. The seeds are numerous on the spikelet and it has short creeping rhizomes (Doss *et al.*, 2011).

Sorghum bicolor (L.) Moench popularly referred to as guinea corn is usually grown in Nigeria for human and animal consumption. It is largely produced in the northern part of Nigeria. Because of its drought-tolerance, it is an excellent choice as livestock feed (Getachew *et al*., 2016**).** Sorghum is the fifth most important cereal crop in Nigeria after rice, wheat, corn and barley (FAO, 2010). Rao *et al*. (2006) reported that Nigeria is ranked as the third largest producer of Sorghum in the world. It is the main cereal food for over 750 million

people living in semi-arid tropical regions of Africa, Asia and Latin America (CCCF, 2011). Sorghum used to be grown mainly for human consumption but later became food for feeding livestock (Getachew *et al*., 2016**).**

Maize (*Zea mays* L.) is the most important grain after wheat and rice in Nigeria, providing food and fuel for humans and feed for livestock (FAO, 2010). Its grain has great nutritional values and can be used as raw material in manufacturing industries for the production of starch, oil and protein, alcoholic beverages and fuel (Afzal, 2009).

One of the challenges facing Nigeria is food insecurity; the level of supply of plant produce cannot meet the demands of the populace, yet many of the staples consumed by the humans such as maize, cowpea, millet, guinea corn and rice are also used as feed mill consumed by birds and other livestock. Studies have been carried out on *P. maximum* in Nigeria with focus on the nutritive value of the leaves as forage to feed cattle (Ezenwa, 1995; Olanite, 2003; Olanite *et al*., 2006) and the chemical composition of the leaf (Ademosun, 1973). There is paucity of scientific information on the proximate and mineral contents of *P. maximum* seeds. Therefore, there is the need for the determination of the proximate and mineral compositions of the seeds of *P. maximum*, which have been observed to be consumed by birds, with a view to recommending them as a substitute for livestock feed. This could reduce the competition between man, birds and other animals on grains like maize, sorghum, millet. The objective of this study was to compare the proximate and mineral content of the seeds of *Panicum maximum* with those of sorghum and maize with a view to finding out if the seeds could serve as a substitute for maize and sorghum in feeding the livestock.

MATERIALS AND METHODS

Collection of seeds and preparation of samples

The *P. maximum* seeds were collected from the parent plants along Ibadan-Abeokuta road at Odeda in Ogun state while maize and guinea corn seeds were bought from Osiele market. The collected seeds had their identities confirmed at the Herbarium of the Department of Pure and Applied Botany in the Federal University of Agriculture, Abeokuta, Nigeria. The laboratory analyses were carried out at the Institute of Agricultural Research and Training (IAR & T) Ibadan, Oyo state, Nigeria. Collected seeds were ground and treated with concentrated chlorine solution separately. These samples were oven-dried at a temperature of 60^{o}C for 24 hr and stored in air-tight container. Each sample (100 g) was weighed and extracted with methanol for the analyses.

Determination of proximate composition

The moisture, dry matter, fat, ash and crude fibre contents were determined using thermal drying method described by AOAC (1990) while crude protein was estimated by determining the total organic nitrogen using the macro-Kjeldhal method and multiplying the value by 6.35 (Koyuncu *et al.*, 2014). Carbohydrate content was determined by the method of AOAC (1990) as described by Aina *et al.* (2012) which is 100 - (% moisture + % dry matter + % fat + % ash + % crude fibre+ % crude protein).

Determination of mineral composition

The mineral composition was determined using Atomic Absorption Spectrophotometer (Okalebo *et al.*, 2002). The minerals determined were sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), copper (Cu) and manganese (Mn) while iron (Fe) and phosphorus (P) were determined using calorimetric procedures described by Mohammed *et al.* (2011).

Data Analysis

Descriptive statistics (mean, standard error with Duncan's multiple range test at 5% probability level) were carried out using Statistical Analysis Systems (SAS) software package version 9.2 (SAS, 2010).

RESULTS

Proximate Analysis

The results of proximate analysis showed that *P. maximum* seeds had the lowest moisture content (6.78 g/100g ± 0.73) which was significantly ($p<0.05$) lower than that of sorghum (11.86 g/100 g ± 1.04) and maize (7.16 g/100 g ± 0.84) as shown in Table 1. The dry matter content (93.22 g/100 g ± 1.82) of *P. maximum* seeds was higher than that of sorghum (88.14 g/100 g ± 1.79) and maize (81.81 g/100 g ± 1.04) (Table 1).

Panicum maximum seeds had the least fat content (1.16 g/100 g± 0.19) compared with sorghum (3.63g/100 g ± 1.05) and maize (2.40 g/100 g ± 0.70). *Panicum maximum* seeds also had the least ash content (0.51 g / 100 g ± 0.09) compared with maize (2.40 g / 100 g ± 0.57) and sorghum (1.93 g/100 g ± 0.27). *Panicum maximum* seeds had the least crude fibre content (1.42 g / 100 g ± 0.29) which was significantly lower ($p < 0.05$) than that of sorghum (6.88 g / 100 g ± 0.45) and maize (2.40 g / 100 g ± 0.38) (Table 1).

The seeds of *P. maximum* had the least crude protein content (3.48 g/100 g ± 0.08) compared with sorghum (10.73 g/100 g ± 0.20) or maize (8.75 g / 100 g ± 0.19). *Panicum maximum* seeds had the highest carbohydrate content (86.65 g/100 g ± 1.52) which was significantly higher ($p < 0.05$) than that of maize (77.46 g/100 g ± 1.76) and sorghum (64.97 g/100 g ± 0.71) (Table 1).

Mineral composition of *Panicum maximum*, guinea corn and maize seeds

The results of mineral composition showed that there was no significant difference ($p > 0.05$) between the sodium content of sorghum (2.89 mg/100 g ± 0.01) and *P. maximum* (2.02 mg/100 g ± 0.01); the maize seeds had the highest sodium content (35.50 mg /100 g ± 1.40). *Panicum maximum* seeds had the least potassium content (67.78 mg/100 g ± 1.22) when compared with sorghum seeds (316.46 mg /100 g ± 2.50) and maize (258.12 mg/100 g ± 2.10). Sorghum had the highest calcium content (12.86 mg /100 g ± 1.90) which was significantly different ($p < 0.05$) from that of maize (3.32 mg/100 g ± 0.75) and *P. maximum* (3.23 mg/100 g± 0.39) (Table 2).

The seeds of *P. maximum* had the least magnesium content (41.38 mg/100 g ± 0.67) which was significantly lower ($p < 0.05$) than that of sorghum (161.74 mg /100 g ± 2.00) and maize (127.09 mg/100 g ± 1.90). *Panicum maximum* seeds had the least Iron content (0.82 mg/100 g ± 0.03) compared with sorghum (3.12 mg /100 g ± 0.87) and maize (2.71 mg/100 g ± 0.52) (Table 2).

The seeds of *P. maximum* had the least zinc content (0.99 mg/100 g ± 0.08) compared with that of maize (2.21 mg /100 g ± 0.19) and sorghum (1.59 mg/100 g ± 0.20). There was no significant difference ($p > 0.05$) between the copper content in *P. maximum* (0.09 mg/100 g ± 0.01) and maize (0.06 mg/100 g ± 0.01) and sorghum (0.18 mg /100 g ± 0.01) (Table 2)

Panicum maximum seeds had the least manganese content (0.12 mg/100 g ± 0.01) when compared with that of maize (0.34 mg /100 g ± 0.02) and sorghum (0.27 mg/100 g ± 0.01). Also, *P. maximum* seeds had the least phosphorus content (98.67 mg/100 g ± 1.02) compared with that of sorghum (218.40 mg /100 g ± 2.65) and maize (110.51 mg/100 g ± 1.35) (Table 2).

Table 1: Proximate composition of *P. maximum, Sorghum bicolor* and maize seeds

Seeds	Moisture Content (g/100 g)	Dry matter content (g/100 g)	Fat content (g/100 g)	Ash content (g/100 g)	Crude fibre content (g/100 g)	Crude protein content (g/100 g)	Carbohydrate content (g/100 g)
P. maximum	6.78 ± 0.73[b]	93.22 ± 1.82[a]	1.16 ± 0.19[c]	0.51 ± 0.09[c]	1.42 ± 0.29[b]	3.48 ± 0.08[c]	86.65 ± 1.52[a]
Sorghum	11.86 ± 1.04[a]	88.14 ± 1.79[b]	3.63 ± 1.05[a]	1.93 ± 0.27[b]	6.88 ± 0.45[a]	10.73 ± 0.20[a]	64.97 ± 0.71[c]
Maize	7.16 ± 0.84[b]	81.81 ± 1.04[b]	2.40 ± 0.70[b]	2.40 ± 0.57[a]	2.40 ± 0.38[b]	8.75 ± 0.19[b]	77.46 ± 1.76[b]

Mean values (± standard error) followed by different superscripts within the same column are significantly different at 5% level of probability using Duncan‘s Multiple Range Test (DMRT)

Table 2: Mineral composition of *P. maximum*, *Sorghum bicolor* and maize seed

Seeds	Sodium (mg/100 g)	Potassium (mg/100 g)	Calcium (mg/100 g)	Magnesium (mg/100 g)	Iron (mg/100 g)	Zinc (mg/100 g)	Copper (mg/100 g)	Manganese (mg/100 g)	Phosphorus (mg/100 g)
P. maximum	2.02±0.01^{b}	67.78± 1.22^{c}	3.23± 0.39^{b}	41.38± 0.67^{c}	0.82±0.03^{c}	0.99± 0.08^{c}	0.09± 0.01^{b}	0.12 ± 0.01^{c}	98.67 ± 1.02^{c}
Sorghum	2.89±0.01^{b}	316.46±2.50^{a}	12.86±1.90^{a}	161.74±2.00^{a}	3.12± 0.87^{a}	1.59±0.20^{a}	0.18± 0.01^{a}	0.27 ± 0.01^{b}	218.40± 2.65^{a}
Maize	35.50±1.40^{a}	258.12±2.10^{b}	3.32± 0.75^{b}	127.09±1.90^{b}	2.71± 0.52^{b}	2.21± 0.19^{b}	0.06± 1.01^{b}	0.34 ± 0.02^{a}	110.51± 1.35^{b}

Mean values (± standard error) followed by different superscripts within the same column are significantly different at 5% level of probability using Duncan‘s Multiple Range Test (DMRT)

DISCUSSION

Proximate and mineral composition analyses provided information on the basic chemical composition of the grains evaluated. *Panicum maximum* seeds had the lowest moisture content when compared with maize and sorghum seeds. This implies that *P. maximum* seeds can be stored for a long period without spoilage since water enhances microbial activity that leads to food spoilage. This result is in agreement with the work of Adeyeye and Ayejugo (1994) on chemical composition of *Cola accuminata* and *Garcinia kola* seeds and Oyelakin *et al.* (2018) on some wild and cultivated varieties of *Capsicum*.

The ash content was generally low in the seeds of the *P. maximum*, guinea corn and maize. It was lower in *P. maximum* seeds than in maize and sorghum seeds. The low ash content of *P. maximum* seeds suggests that it could be a low source of minerals, but it can be mixed with other grains with high mineral content to feed livestock. This is in line with the report of Maner (1999) on quality of ash content in maize.

Panicum maximum seeds had low crude fibre content when compared with maize seeds. The presence of crude fibre in *P. maximum* showed that it contains some level of insoluble fibres and it has been reported that insoluble fibres are essential for enhancing digestion and bowel movement (Oyelakin *et al.*, 2018).

The low protein content observed in *P. maximum* seeds could be enhanced by adding various protein supplements such as fish protein concentrate, soybean flour, cotton seed flour and egg protein so that they can serve as feed for livestock. Farmers have been reported to add protein supplements to maize and sorghum seeds which are low in protein content, before feeding them to livestock (Larbier and Leclercq, 1994; Bressani and Marenco, 2001).

Panicum maximum seeds had higher carbohydrate content than maize and sorghum seeds. Maize seeds have been reported to contain high energy among the grains used in feeding livestock (Fetuga *et al.*, 1979). This study has shown that *P. maximum* seeds have higher carbohydrate content than maize, which has been reported to have highest energy content among grains used in feeding livestock. This implies that *P. maximum* seeds can supply high energy when consumed by livestock. This corroborates the work of Ashifat *et al*. (2010) on the proximate evaluation of nutritional value of plants.

This study showed that *P. maximum* seeds contained appreciable amounts of sodium, potassium, calcium, magnesium, iron, zinc, copper, manganese and phosphorus, suggesting that the seeds are a good source of these macro- and micro- nutrients which could serve as health promoters. The study also showed that *P. maximum* seeds could serve as a substitute to feed livestock because they contain appreciable amount of minerals. Christine *et al*. (2014) had earlier reported the functions of some of these minerals to include the control of fluid balance in the body, nerve impulse transmission, component of bones and teeth, strength and hardness needed for effective nerve and muscle function, blood clotting, heart function and cell metabolism.

CONCLUSION

This study has shown that *P. maximum* seeds had low moisture content, high carbohydrate content and appreciable mineral contents and that it could serve as an alternative livestock feed in Nigeria. The low moisture content of *P. maximum* makes it to store for a longer period than maize and sorghum seeds. The study concludes that *P. maximum* seeds may serve as a substitute for maize and sorghum seeds which are traditionally used in feeding livestock.

It is hereby recommended that *P. maximum* seeds should be enhanced with nutrient and protein supplements and used to feed birds. This will reduce the level of competition between humans and livestock for maize and sorghum seeds, thereby mitigating food insecurity in Nigeria and other developing countries.

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