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Nutrients, Phytochemicals Composition of Moinmoin Made From Different Varieties of Leguminous Plants

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Abstract
Objective:
The nutrients, phytochemicals composition of moinmoin made from different varieties of leguminous plants were quantitatively investigated
Methods:
Samples were subjected to chemical and instrumental analysis for proximate, minerals and phytochemical composition. Chemical analysis was carried out according to AOAC methods. While atomic absorption spectrophotometer (AAS) was used for mineral determination.
Results:
The result of the nutrients composition revealed that moinmoin made from Mucuna pruriens and packaged in banana leave have higher protein content (34.46 %), and fat content (7.72%) compared to samples from cowpea moinmoin and bambaranut. Although there was increase in values of Na, Ca and Mg in moinmoin made from Mucuna pruriens wrapped with banana leave but moinmoin made from cowpea sample CMML have higher values than other bambaranut and was significantly different ($p<0.05$). Phytate, oxalate and alkaloid were significantly higher in moinmoin Mucuna pruriens wrapped with banana leaves and was significantly different ($p<0.05$) compared to moinmoin made from cowpea and bambaranut except from saponin which is higher in moinmoin made from bambaranut. Moinmoin made from cowpea was higher and significantly different ($p<0.05$) from other samples in terms of tannin content.
Conclusion:
Mucuna moinmoin was very high in protein, this could be utilized in fighting against food insecurity and malnutrition currently posing a big threat to poor Nigeria children. Proper selection and processing methods needs to be develop to ensure that nutrients are preserved in food.

Keywords: *Leguminous Plants, Nutrients, Phytochemicals, Moinmoin, Alkaloid, Phytate*

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I. Introduction

Food legumes constitute a major source of nutrients such as proteins, lipids, carbohydrates, and other important substances such as fibre, minerals and vitamins (Deshpande, 1992) which are necessary for human and animal health. Similarly, they contain anti-nutritional components such as saponin, tannins, Phytate, lectin/haemagglutanin, oxalates, polyphenol, among others, which hinder the body from digesting the nutrients in pulses. These toxins cause food poisoning to human beings and animals (Osifo, 1974). According to Olusanya (2008) and Geil and Anderson (1994), legumes contain some toxic components such as anti-trypsin factors which impair the digestion of proteins and hence prevent its efficient utilization. Phytate, oxalates and cyanides cause various physiological disorders like increase in relative weight of pancreas and liver, and also diarrhea (Arija et al., 2006). Fortunately, many of these toxic components are destroyed by heat provided by different food processing methods (Olusanya, 2008).

Mucuna pruriens belong to the underutilized species that has great prospect for improving food security, by reducing malnutrition and alleviating poverty especially in developing countries. Mucuna is consumed by the people of south eastern Nigeria as a legume of last resort during famine or scarcity of other legumes. It is also used sparingly for thickening sauces and soups in that region (Onweluzo *et al.*, 1994). Mucuna has been reported to contain approximately 30% crude protein and appreciable amounts of amino acids (Ezeagu *et al.*, 2003). In addition, it has been described as one of the best green manure, cover crops and has the capacity to suppress weeds (Carsky *et al.*, 1998; Ukachukwu *et al.*, 2002). One serious limitation to the attainment of this potential is the fact that Mucuna is said to contain anti-nutritive factors such as trypsin inhibitors, Phytate, tannins etc, in addition, it contains L-dopa (3,4-dihydroxy-L-phenyl alanine). L-dopa has been reported to cause such toxic effects as vomiting, nausea, anorexia, diahorrea, aggression, hallucinations and severe depressions when inadequately processed beans are consumed (Duke, 1981; Afolabi *et al*., 1995; Lorenzetti *et al.,* 1998).

Bambara groundnut (*Vigna subterranea* L. Verdc) is a seed crop of African origin. It is cultivated principally by farmers as a famine culture crop because of its agronomic values and the ability to produce in soils considered insufficiently fertile for cultivation of other more favoured species such as common beans and groundnuts (*Arachis hypogaea*) (Anchirinah *et al.*, 2001; Kay, 1979). Bambara is grown extensively in Nigeria (Oguntunde, 1985; Enwere, 1998) but it is one of the lesser utilised legume in Nigeria. Nigeria produced over 100,000 metric tonnes, closely followed by Niger with 30,000 metric tonnes and Ghana with 20,000 metric tonnes (Asiedu, 1989).

In Nigeria, the freshly harvested pods are cooked, shelled and eaten as vegetable snack, while dry seeds are either roasted and eaten as a snack (Kay, 1979; Alobo, 1999) or milled into flour and used in preparation of moinmoin (Olapade *et al*, 2005) analogy called '*okpa*' among the Igbo tribe of Nigeria (Enwere,1998). For most food uses, the seed coats of legumes including Bambara are removed to reduce the anti-physiological factors and fibre content, and this result in better appearance, texture, cooking quality, palatability and digestibility of the products (Akinjayeju and Enude, 2002). Dehulling can be accomplished manually or mechanically depending on the type of legume and/or quantity involved (Ehiwe and Reichert, 1987). Dehulling has been a limitation factor in the preparation of flour from Bambara that could produce acceptable moinmoin substitute most especially with respect to the texture and flavour.

Moinmoin is one popular dishes traditionally prepared in Nigeria using different edible legume most especially cowpea. *Moinmoin* is a gelled product made from steaming wet-milled beans. These products are enjoyed by majority of Nigerians especially with the combination of cereal based dishes. In southwest part of Nigeria, the use of traditional packaging materials such as *Thaumatococcus danielli* commonly known as *moinmoin* leaves is a custom. In southeast Nigeria banana leaves and are more preferred as a traditional packaging material to packaged legume made into pudding such as *moinmoin*, *okpa* and *pukka* made from fresh or dried maize (Asogwa and Onweluzo, 2010). Removal of the antinutrients would be necessary for effective utilization of proteins, carbohydrates and minerals in human nutrition. This study reports on the proximate, mineral, phytochemical composition of moinmoin made from three varieties of edible legumes in Nigeria.

II. Methodology

Collection and preparation of materials

Ten (10) milk cups of matured seeds of cowpea and Bambara nut were purchased from umuahia central market, Abia State while velvet beans or lion bean was gotten from the department of crop production, federal college of agriculture, Akure, Ondo State. The seeds were hand picked to remove impurities.

Preparation of moinmoin from Bambara nut and cowpea

Fresh pastes were prepared from both cowpea and Bambara (figure 2) and reconstituted flours. Flours 200g were each hydrated with 300ml of water (60^{oC}) and allow standing for 1h. 200g paste each was blended with red pepper 20g, fresh onion 20g, 10g salt, 1g mono-sodium-glutamate seasoning and 50ml warm palm oil(60^{oC}) was added to each and blended separately in a Shasio food blender at speed 2 for 10. The mixture of bambara nut paste was dispensed into standard moinmoin aluminium cup while that of cowpea was wrapped in *Thaumatococcus danielli* leaves an d steamed for 45min at ambient pressure follow the method described by Olapade and Adetuyi, (2007). Thereafter the samples were dried in a hot air oven at 50^{oC} and stored at -4oC for analysis.

Preparation of Mucuna *moinmoin (*beans pudding).

The methods described by Onweluzo and Eilitta (2003) were used to prepare the products. For Mucuna *moinmoin* (MMM), 5cups of whole beans were soaked in excess water for 24h, washed and dehulled. The dehulled seeds were ground with 30g fresh pepper, 200g onions and 60g crayfish. Thereafter, the paste was poured into a mortar, mixed and 8 bouillion cubes and 50ml of palmoil were added. The mixture was stirred with the addition of 500ml of water, divided into five batches and wrapped with banana leave and steamed for the of 2hr. Thereafter the samples were dried in a hot air oven at 50^{oC} and stored at -4oC for analysis.

Chemical Analysis

The its moisture content, ash, crude fiber, crude protein and fat content were determined using the Association of Official Analytical Chemists, A.O.A.C(2005) methods. The total carbohydrate content was determined by difference. Carbohydrate = 100% - (%Crude fiber + %Crude protein + %Ash + %Fat + %Moisture)

Mineral content determination

Ash was dissolved in 10% HCl, heated, cooled, filtered and made up to the mark in 100 mL standard flask with distilled water. The mineral contents of the samples were analyzed for with the aid of atomic absorption spectrophotometer (Buck Scientific Instrument). According to the Association of Official Analytical Chemists, A.O.A.C(2005) methods.

Phytochemical Evaluation

The sample were quantitatively screened according to the procedure enumerated by A.O.A.C (2005) method for Phytate, Day and Underwood (1986) for oxalate, Saponin and Alkaloid were determined by method described by Sofowora, (1993) and Maxwell *et al* (1995).

Statistical Analysis

All chemical analysis was determined in triplicate. The results were analyzed using Steel and Torrie (13) procedure.

III. Results And Discussion

Proximate composition of *Moinmoin* made from different varieties of leguminous plants

The Table 1 below show the proximate composition "*moinmoin*". made from different varieties of leguminous plants. *Moinmoin made from cowpea* cooked with vegetable oil wrapped in leave (CMML) has the lowest moisture content (7.20%), followed by MMBL (7.78%) and was not significantly different ($p<0.05$) from sample CMML. Samples BMAC have the highest moisture and fibre content 9.11% and 6.67% respectively. Sample MMBL has the highest value for protein (34.46%), fat (7.72%) and ash (6.02%) content and it was significantly different ($p<0.05$) from other sample. Sample CMML has the highest 56.72% and was significantly different ($p<0.05$) from other sample.

Table 1. Proximate composition of *Moinmoin* made from different varieties of leguminous plants

Components (%)	CMML	MMBL	BMAC
Moisture (%)	7.200 ± 0.20^{a}	7.785 ± 0.045^{a}	9.11 ± 0.58^{b}
Ash (%)	5.020 ± 0.01^{a}	6.02 ± 0.340^{b}	4.54 ± 0.70^{a}
Fat (%)	6.770 ± 0.93^{a}	7.72 ± 0.780^{b}	6.67 ± 0.60^{a}
Fibre (%)	1.030 ± 0.03^{a}	3.25 ± 0.110^{b}	6.88 ± 2.20^{c}
Protein (%)	23.25 ± 0.71^{b}	34.46 ± 0.31^{c}	18.85 ± 0.03^{a}
Carbohydrate (%)	56.72 ± 1.33^{c}	40.76±2.05a	53.95 ± 0.08^{b}

Means with the same superscripts along the column are not significantly different (p=0.05)
CMML- cowpea moinmoin wrapped with leave
MMBL-moinmoin wrapped with banana leave
BMAC- bambaranut moinmoin cooked inside tin cup

Minerals composition of *Moinmoin* made from different varieties of leguminous plants

The Table 2 below shows the Minerals composition of *Moinmoin* made from different varieties of leguminous plants. Sample CMML has the highest content of calcium (274mg/100g) followed by BMAC and MMBL with 150mg/100g and 125mg/100g respectively. Sample CMML was significantly different ($p<0.05$) from other sample, also sample CMML have the highest magnesium, sodium and potassium content as compared to others in the table with 697mg/100g, 629mg/100g, and 854mg/100g respectively. Sample BMAC has the highest iron content but was not significantly different from sample CMML. Sample MMBL has the highest zinc content and was significant different from other samples.

Table 2: Minerals composition of *Moinmoin* made from different varieties of leguminous plants

Minerals (mg/100g)	MMBL	BMAC	CMML
Calcium (Ca)	125 ± 3.90^{a}	150 ± 3.90^{b}	274.5 ± 1.32^{c}
Magnesium(Mg)	89.56 ± 0.43^{a}	254 ± 0.43^{b}	697.0 ± 1.22^{c}
Sodium (Na)	256.6 ± 5.070^{a}	497 ± 5.070^{b}	629.0 ± 3.10^{c}
Iron (Fe)	7.90 ± 0.26^{a}	18.30 ± 0.26^{b}	17.00 ± 1.20^{b}
Zinc (Zn)	45.2 ± 0.28^{a}	3.47 ± 0.28^{c}	9.450 ± 0.50^{b}
Potassium (K)	495 ± 13.90^{a}	670 ± 13.90^{b}	854.0 ± 4.50^{c}

Means with the same superscripts along the column are not significantly different (p=0.05)
CMML- cowpea moinmoin wrapped with leave
MMBL-moinmoin wrapped with banana leave
BMAC- bambaranut moinmoin cooked inside tin cup

phytochemical composition of *Moinmoin* made from different varieties of leguminous plants

The Table 3 below shows phytochemical composition of *Moinmoin* made from different varieties of leguminous plants. Sample MMBL had the highest Phytate content with 17.5/100g followed by CMML (7.64mg/100g) while samples BMAC had the lowest value for Phytate with 5.76mg/g The table also showed the alkaloid, oxalate, saponin and tannin content of the samples. Sample MMBL had highest content of alkaloid and oxalate, about 8.2% and 24.5mg/g respectively and they are significantly different ($p<0.05$) from others samples while BMAC had the highest percentage for saponin with 1.45%. Saponin were generally low in all samples but sample CMML shown the highest value 1.79mg/100g for tannin while there was no significant different between sample MMBL and BMAC in terms of tannin content.

Table 3: phytochemical composition of *Moinmoin* made from different varieties of leguminous plants

PHYTOCHEMICALS	MMBL	BMAC	CMML
Phytate (mg/g)	17.5 ± 791^{a}	5.768 ± 0.20^{c}	7.648 ± 0.20^{b}
Alkaloid (%)	8.20 ± 345^{a}	0.340 ± 0.14^{c}	6.00 ± 0.70^{b}
Oxalate (mg/g)	24.56 ± 036^{a}	$8.56\ \pm1.67^{b}$	22.87 ± 1.50^{c}
Saponin (%)	$0.560\ 0.43^{b}$	1.45 ± 0.193^{a}	0.038 ± 0.04^{c}
Tannin (mg/g)	$0.780\ 0.09^{a}$	0.790 ± 0.53^{a}	1.790 ± 0.53^{b}

Means with the same superscripts along the column are not significantly different (p=0.05)
CMML- cowpea moinmoin wrapped with leave
MMBL-moinmoin wrapped with banana leave
BMAC- bambaranut moinmoin cooked inside tin cup

IV. Discussion

Result in table 1 shows that there were significant different in some of the parameters evaluated. The crude protein of Mucuna "*moinmoin*", wrapped with banana leave (MMBL) and CMML) were higher (34.46% and 23.25%) than sample BMAC wrapped in aluminium cup. report had shown that Mucuna pruriens has high protein content. The result of protein presented in this study (34.46%) is higher but close to the result (31.5%) reported by Adeyeye et al, (2015). Phytate prevents precipitation of protein with Phytate, since Phytate is one of the phytochemical component of cowpea, banana and *Thaumatococcus* leaves. Study has shown that Bressani et al., (2003) that the presence of Phytate inhibits the solubility of protein but in this was not consistence with this study with study by Mustapha et al (2014) where moinmoin wrapped in nylon had the highest protein content. Therefore, the higher protein value in *moinmoin* wrapped in banana and *Thaumatococcus* leaves may be because leave is a natural material and could have impacted protein nutrient to the moinmoin compared to the sample wrapped in aluminium cup. the crude protein content of bambaranut flour reported by Adeyeye (2015) was lower than the value (18.85%) presented in this study and this may be as a result of the addition of crayfish during preparation. The table also show low fibre content in all the samples, these low fibre content may be as a result of dehulling effect of the cowpea which result in the removal of high fibre seed coats. This is in agreement with the findings of Ukachukwu *et al*., (2002) where there is low fibre content of Mucuna "*moinmoin*" after the bean was dehulled. The high value for fat in the samples wrapped in aluminum cup, (7.72%) was significant different ($p<0.05$) from other samples may be attributed to the fact that fat leaching into cooking water is very low compared to samples wrapped with leaves, since water can penetrate into the leaves. The table (2) below shows the Minerals composition of *Moinmoin* made from different varieties of leguminous plants. There was high appreciable amount of minerals in all the samples Sample CMML has the highest content of calcium (274mg/100g) followed by BMAC and MMBL with 150mg/100g and 125mg/100g respectively. Sample CMML was significantly different ($p<0.05$) from other sample, also sample CMML have the highest magnesium, sodium and potassium content as compared to others in the table with 697mg/100g, 629mg/100g, and 854mg/100g respectively. The high value for potassium, sodium and calcium in the samples may be as a result of high amount of these minerals in moinmoin. Moreso, high value for sodium could also be linked to the addition of sodium chloride (Table salt) and sodium monoglutamate (magi) during the preparation of the "*moinmoin*". Both sodium and potassium were high in the samples. Sodium and potassium are required to maintain osmotic balance of the body fluid, the pH of the body, regulate muscles and nerve irritability, control glucose absorption and enhance normal retention of protein during growth (NRC, 1989). Sample BMAC has the highest iron content but was not significantly different from sample CMML. Sample MMBL has the highest zinc content and was significant different from other samples. The high value for iron, calcium and zinc may be as a result of addition of mineral rich ingredient like fish, pepper and onion etc. This is in agreement with Asogwa *et al*., (2010) findings in their study, where the addition of mineral ingredients like onion, pepper and crayfish to Mucuna "*moinmoin*" increase the ash contents of the legumes pudding. The iron (Fe) content of bambara nut moinmoin 18.30mg/100g in the present study was comparatively lower than the 1.91-5.27 mg/100g reported by Adeyeye *et al.* (2015) for bambara groundnut bean flour. Fe requirement by humans is 10-15 mg for children, 18 mg for women and 12 mg for men (Fleck, 1976).

The Table 3 below shows phytochemical composition of *Moinmoin* made from different varieties of leguminous plants. Sample MMBL had the highest Phytate content with 17.5/100g followed by CMML (7.64mg/100g) while samples BMAC had the lowest value for Phytate with 5.76mg/g. similar result was observed in a study by Mustapha et al., (2014) where Phytate content were higher in sample of moinmoin wrapped with banana leave and *Thaumatococcus danielli* and was lower in moinmoin wrapped with aluminium cup. This higher value could be attributed to the fact that Phytate are naturally present in plants. In addition, Phytate in leaves such as *Thaumatococcus danielli* and banana leaves were leached into *moinmoin*, whereas the *moinmoin* packed in aluminium cup had lower values, this could be attributed to the fact that all the moinmoin sample were of soaking, dehulling and cooking of moinmoin as reported by Sanberg (1991), Sinha et al (2013). Alkaloids were found in all the samples in appreciable amount. This may be because alkaloids are naturally found in so many plant species. The effects of heat on alkaloid are minimal as compared to other phytochemicals. Alkaloids are useful in prolonging the action of several hormones and acting as stimulant as reported by Okwu (2004). In this study Sample MMBL had highest content of alkaloid and oxalate, about 8.2% and 24.5mg/g respectively and they are significantly different ($p<0.05$) from others samples. Saponin was also determined in each of the samples and it was low. This low amount in the samples may be due to the effect of processing as reported by Shi *et al* (2016), that processing method such as washing, soaking and blanching reduced portion of the saponin dissolved in water and lost in the soaking, washing and blanching of liquor. BMAC had the highest percentage for saponin with 1.45%. sample CMML shown the highest value 1.79mg/100g for tannin while there was no significant different between sample MMBL and BMAC in terms of tannin content.

V. Conclusion

Observation from this study revealed that banana leaves and *Thaumatococcus danielli* (ewe moinmoin as called by Yoruba tribe in Nigeria) had both positives and negatives effect on the phytochemicals and nutrients composition of "*moinmoin*" cooked with leaves and aluminum cup. Mucuna moinmoin was very high in protein this could be utilized in fighting against food insecurity and malnutrition currently posing a big threat to poor Nigeria children. Proper processing methods needs to be develop to ensure that nutrients are preserved in this food and local food handlers should work towards conserving the nutrients composition of foods through proper selection of right local or modern packaging materials which invariably has a great effect on the health of the consumers.

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