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BAMBARA NUT (VIGNA SUBTERRAENEA (L.) VERDC) AND ITS NUTRACEUTICAL AND FUNCTIONAL PROPERTIES: A REVIEW

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Abstract

The aim of this paper was to review literature on the nutraceutical and functional properties of Bambara nut in food systems/products. Bambara nut is a very important legume which is widely consumed in Africa as a staple food and contains high protein which makes it a complete food. A superior alternative to sources of animal protein is the Bambara nut, which has been called the most significant protein among plant proteins. Bambara nut has been classified as a functional food and its use in traditional medicine has been emphasized, hence it has nutraceutical benefits. Some authors have produced specialty malts from Bambara nut which is beneficial as ingredient at both household and industrial level. The usefulness of Bambara nut seems not to have been harnessed. The legume has desirable functional properties which are beneficial to the food

industry. From the literature, some functional properties of Bambara nut include foam capacity, water and oil binding capacity, emulsifying stability. Incorporation of Bambara nut flour into human foods have great prospects, but these prospects have to be further investigated since Bambara nut is underutilized and under-researched. It has also been reported that Bambara flour exhibited superior properties (foaming and fat absorption) compared with its protein isolate counterpart.

Keywords: Proteins, legume, flour, emulsion, foaming, binding, medicine

Introduction

Among all the legumes in existence, *Phaseolus vulgaris*, L. which is the common bean has the highest economic value (Silva *et al.,* 2014). Legumes are plant sources of food proteins and are consumed as the major sources of proteins in some regions of the world (Duranti, 2006). Bambara nut (*Vigna subterranean*) is a legume which is used both in human and animal feeding especially by monogastric animals (Okonkwo *et al*., 2022) as a source of protein which has its origin in West Africa *(*Unigwe, 2018*)*. According to research, the third-most significant legume is Bambara nut after peanut also called groundnut (*Arachis hypogaea* L.) (Ogundele, 2017).

Nwadi *et al*. (2020) referred to Bambara nut as complete food owing to the high protein content. Yahaya *et al*. (2022) have classified Bambara nut as the most important among the plant proteins and a better replacement for animal protein sources. Okafor *et al*. (2022) (Table 1) and Udeh *et al*. (2020) (Table 2) have classified Bambara nut as a nutraceutical and functional food. Jideani and Jideani (2021) have emphasized its use in traditional medicine. Specialty malts (Adetokunboh *et al*., 2022) and amylase-rich malts (Adetokunboh *et al*., 2022) have been produced from Bambara nut and are useful as functional food ingredients.

Table 1. The traditional medicine utilization of Bambara nut (BGN) for various health enhancement in different African countries

Local name	Type of BGN	Traditional Medicinal use	Country
Njugo' beans gugoboon in Afrikaans gugori uhosal fndlubu in kdebele; nduhu in senda	fmmature seeds and mature seeds	N).To check nausea and vomiting and morning sickness during pregnancy. 2). Treatment of some malignancies and inflammatory disorders	pouth Africa
Aboboi akyii	Black seeds	To alleviate swollen jaw diseases	dhana
Aboboi akyii	jilled seeds	To treat skin rashes and sick children	dhana
Aboboi akyii	Cream colored Bdk seeds mixed with guinea fowl meat	treating diarrhea	dhana
	peeds of the mature black landrace	Treatment for impotence and in traditional medicine.	Botswana
kjugu mawe	tater boiled Bdk	rse for treatment	Kenya

	and maize and	of diarrhoea.	
Njugu mawe	Pound BGN leaves and Lantana trifolia L	To wash livestock as a Preventative against ticks. Also use as a pesticide on vegetables	
Njugu mawe	BGN leaves pound with Mexican marigold and L. trifolia,	Serve as insecticide	
Njugu mawe	leaves are pounded with traditional salt (‘mbala’),	Use in treatment of cattle infected with ‘tuoolao’ (a type of mouth disease)	
Njugu mawe	Roasted BGN seeds	Use for treatment of polymenorrhea.	Luo tribe in Kenya
Njugu mawe	roasted seeds	Use for treatment of polymenorrhea.	Luo tribe in Kenya
Njugu mawe	Crushed seeds mixed with water	Use for treatment of cataracts.	Luo tribe in Kenya
Njugu mawe	BGN seed flour diluted in water or water from cooked BGN seeds	Remedy for internal bruising; speed up the resorption of people suffering hematomas	Luo tribe in Kenya
Okpa otuanya in Igbo (Nigeria), Epi roro in Yoruba and Guijiya	Cruised seeds mixed with water and cooked seeds	To treat venereal diseases and protein malnutrition related disorder	Nigeria

Juga bean	Mature seeds	Recommended for treatment of polymenorrhea.	Zambia
Njugu mawe	Seed flour diluted in water/cooking water	Remedy for internal bruising; speed up the resorption of people suffering hematomas	Luo tribe in Kenya
Njugu mawe	Boiled or cruised or cooked seeds	Treatment of anaemia in children and peri partum women within 1 month of delivery	Cô te d'Ivoire,
Njugu mawe	Juice obtained from boiling BGN seeds and maize	Treatment of diarrhea	Cô te d'Ivoire,
Njogo bean	BGN flour and flour from fruit of Puvpalia lappacea (L.) (Amaranthaceae)	Use as hemostatic drink, to treat menorrhagia during pregnancy, and rectal bleeding.	Cô te d'Ivoire,
Njogo bean	A decoction of seeds with leaves of Terminalia laxiflora (L.) (Combretaceae)	used as a drink to treat gonorrhea	Cô te d'Ivoire,
Njogo bean	Black BGN seeds mixed with unidentified plant	used forthe treatment of ulcers	Cô te d'Ivoire,
Njogo bean	Cooked Protein rich cream coloured seeds	Helps to overcome Kwashiorkor, the common protein deficiency disease in young children	Central Africa

Source:Okafor *et al.* (2022)

Table 2 Summary of the nutraceuticals in Bambara nut (BGN) and their functions.

Nutraceuticals	Functions
Alkaloid compounds (e.g.-9 Octadecenamide, (Z)-ethanol 1 methoxy- benzoate, -1 Monolinoleoylglycerol trimethylsilyl and ether butylated hydroxytoluene)	Antimicrobial and antioxidants activity
Flavonoid compounds (e.g. rutin and myricetin). Tannin compounds (e.g. chlorogenic acid and ellagic acid)	Anti-inflammatory activity, oestrogenic activity, enzyme inhibition, antimicrobial activity antiallergic activity, antioxidant activity, vascular activity and cytotoxic antitumour activity
Sphingolipids	Involved in protein sorting, apoptosis and calcium regulation
Fatty acids	Anti-inflammatory, antimicrobial and cytotoxic Activities
t-Ferulic acid	Exhibits a wide variety of biological activities such as antioxidant, anti inflammatory,antimicrobial, antiallergic, hepatoprotective, anticarcinogenic, antithrombotic, increase sperm viability, antiviral and vasodilatory actions, metal chelation, modulation of enzyme activity, activation of transcriptional factors, gene expression and signal transduction
p-Coumaric acid	High free radical scavenging, anti inflammatory, antineoplastic, and antimicrobial activities
Catechin and Epicatechin	involved in antioxidant activities
Salicylic acid	Performs anti-inflammatory functions through suppression of transcription of genes for cyclooxygenase

Source: Udeh *et al.* (2020)

Bambara nut is commonly consumed in different parts of Africa and has different names based on the locality. In Nigeria, it is known as *okpa* among *the Igbos, epiroro a*mong the Yorubas and *gurjiya* among the Hausas. In Ghana, it is known as *aboboi* while in Malawi it is known as *nzama.* In South Africa, it is known as *jugo* beans. Mubaiwa *et al*. (2018) reported that Bambara nut is indigenous to Sub Saharan Africa, has enormous nutritional and agricultural potential, but has been scientifically ignored. *Ene-Obong et al.* (2013) reported that Bambara nut is consumed on daily basis in the North Central and South East geo-political zones of Nigeria by above 70 % of the population. Bambara nut is comprised mostly of protein and carbohydrate and it supplies the plant protein needed in Nsukka municipality of Nigeria. The longer cooking time of two hours of Bambara nut grain is a disadvantage which could limit its use (Ogundele, 2017). Other disadvantages include its content of anti-nutritional factors and difficulty in dehulling (Hillocks, 2012). The beany flavour of the flour is a disadvantage. Kudre and Benjakul (2013) reported that the beany flavour of Bambara nut was as a result of lipid oxidation and reported that the flavour of flour from Bambara nut could be improved through defatting using chloroform/methanol. Extrusion cooking which is basically a high-

temperature short time process is an appropriate method to tackle these problems. A composite flour made of Bambara nuts, unripe plantains, and turmeric has been used to make snacks *(*Adegunwa, 2017). Attaugwu et al. (2016) and Uvere et al. (2010) have produced weaning foods from Bambara nut and maize composite flour blends. Omeire et al. (2015) produced noodles from cassava, defatted Bambara nut and wheat flour blends. These authors all noted that the addition of Bambara nut increased the protein content of the products. According to studies, Bambara nuts offer a wealth of unrealized potential. Bambara nut has high protein and carbohydrate content. The nature of its protein and carbohydrate qualifies it as suitable for use as an emulsifier. Bambara nut flour produced more stable emulsions than Bambara nut starch. Bambara nut flour has foaming, water and oil binding capacity; therefore, its incorporation into foods has high prospects. The aim of this paper was to review the literature on the functional properties of Bambara nuts in food systems/products.

Functional properties of Bambara nut

Many researchers have reported Bambara nut as having desirable functional properties which will be beneficial to the food industry. Some of these functional properties include emulsion, foaming, water and oil binding capacities. Ibrahin and Ogunwusi (2016*)*

reported that the high content and quality of protein and carbohydrate in Bambara nut makes it suitable for use as an emulsifier. Fasinu *et al*. (2015) reported that Bambara nut could be used as a potential emulsifier in the food and pharmaceutical industry. Ibrahin and Ogunwusi (2016) and Fasinu et al. (2015) investigated physicochemical changes of some emulsions stabilized using Bambara nut and concluded that emulsion stability increased with the speed of homogenization, decreased with acidity (vinegar) but increased with alkalinity (sodium chloride). Stability values were higher in emulsions stabilized using Bambara nut flour than that stabilized using Bambara nut starch; therefore, Bambara nut flour produced more stable emulsions than Bambara nut starch. Arise *et al*. (2017) isolated storage proteins from Bambara nut and reported that the foaming capacity and emulsion activity of Bambara nut protein were pH dependent. Maximum percentage of foaming capacity was observed at pH 3.0 while emulsion activity increased with an increase in pH. Hence, food foams and emulsions could be formulated with Bambara nut proteins as an excellent ingredient. Aremu *et al*. (2008) studied some functional properties of Bambara nut flour in the presence of some salts such as sodium chloride, sodium nitrate and sodium nitrite and reported that foaming stability, gelation concentration, water absorption and oil

emulsion capacity were dependent on the type and concentration of salt used. *Boateng et al. (2013) investigated some functional properties of Bambara nut* (foam capacity, water and oil binding capacity, emulsifying stability) and reported that incorporation of Bambara nut flour into human foods have great prospects; but cautioned that these prospects have to be further investigated since Bambara nut is underutilized and under-researched (Udeh *et al*., 2020; Tan *et al*., 2020; Khan *et al*., 2021). Sefa-Dedeh and Yiadom-Farkye (1988) reported that Bambara flour exhibited superior properties (foaming and fat absorption) compared with its protein isolate counterpart. Awolu *et al*. (2017) produced composite flour from blends of cocoyam, Bambara nut and wheat and reported that the composite flour blend had acceptable nutritional and functional properties. They concluded that the composite flour blend was suitable for use in food products. Alakali *et al*. (2010) formulated beef patties using flour from Bambara nut seed and reported that the inclusion of Bambara nut seed flour resulted in reduced shrinkage, increased moisture, percentage cooking yield and fat retention. From these studies, it would appear that the flour would be more beneficial in food systems than the protein isolates. Okpa is a typical delicacy produced from Bambara nut flour which is a typical delicacy very popular in the south Eastern part of Nigeria. It

would appear that the high water and oil absorption capacities as well as the emulsifying capacity of the Bambara nut flour are responsible for the desirable texture and overall quality of okpa produced from the flour. However, *Kiin-Kabari et al. (2015)* produced composite flour from blends of wheat and plantain enriched with Bambara nut protein concentrate. An increase in Bambara nut protein isolates increased pasting temperature, foam, emulsion, oil and water absorption capacities. *Oujifard et al. (2012)* investigated the impact of protein isolate from Bambara nut on gel properties of surimi and reported that gel properties of surimi could be improved by using protein isolate from Bambara nut at appropriate level (for example at 0.25 g/100 g). These studies also indicate that the protein isolates from Bambara nut could perform well in some food systems. The Bambara nut starch has some benefits in food systems or products. Odeniyi *et al*. (2017) reported that native starch from Bambara nut had a high tendency of retrogradation but this could be reduced by pregelatinization and carboxymethylation; concluding that starch from Bambara nut was stable and could be used in pharmaceutical formulations. This, by extension, can also be applicable to food products. In other applications, starches (pregelatinized and carboxymethylated) from Bambara nut have been used for pharmaceutical purposes

such as to improve ibuprofen tablet formulations (Omoteso *et al*., 2018). The pregelatinized starch presented a longer disintegration time.

Conclusion

Bambara nut has been reported by many researchers as an underutilized legume. Bambara nut has desirable potentials including functional, medicinal and nutritional. Many researchers have attempted to exploit these potentials. More research is required on Bambara nuts since this underutilized legume has the potential for more lucrative and diversified uses.

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