ISSN 2664-4010 (Print) & ISSN 2664-6730 (Online)
South Asian Research Journal of Agriculture and Fisheries
Abbreviated Key Title: South Asian Res J Agri Fish

| Volume-3 | Issue-6 | Nov-Dec -2021 | **DOI: 10.36346/sarjaf.2021.v03i06.001**

Review Article

Bioprospecting Potential of Bambara Ground Nut (*Vigna subterranea* [L.] Verdc.) for Access and Benefit Sharing

Melak Agajie[1*]

[1]Ethiopian Biodiversity Institute, Assosa Biodiversity Center, researcher in crop and Horticulture case team

***Corresponding Author**
Melak Agajie

Article History
Received: 06.09.2021
Accepted: 11.10.2021
Published: 14.11.2021

Abstract: Ethiopia is one of the top biodiversity-rich countries in the world. The country is endowed with greater diversity of plant, animal and microbial genetic resources. However, like any other developing countries, Ethiopia lacks technical expertise and adequate financial resource to explore and use the genetic resources and associated traditional knowledge significantly. The grain of Bambara groundnut is regarded as a source of a complete and balanced diet. Therefore, the information given would encourage researchers and companies to work on the genetic resources of Bambara groundnut (*Vigna subterranea* [L.] Verdc.) for medicinal uses, flavoring preservative agents and food production.

Keywords: Orphan crop, Bambara ground nut, cleistogamous flowers.

INTRODUCTION

Ethiopia is one of the top biodiversity-rich countries in the world. The country is endowed with greater diversity of plant, animal and microbial genetic resources [2]. The various agroecological conditions and availability of diverse floral resources makes the country one of the best suitable places for the existence of large and unique biodiversity both in plants and animals. Bambara groundnut (*Vigna subterranea* [L.] Verdc.) is a nutritionally rich grain legume crop indigenous to Africa. It is tolerant to drought stress and has become adapted to grow under low input and marginal agricultural production systems in Africa and Asia.

However, like any other developing countries, Ethiopia lacks technical expertise and adequate financial resource to explore and use the genetic resources and associated traditional knowledge significantly.

Therefore, the only option for Ethiopia is to collaborate with the developed nations or domestic investors and interested one in pharmaceutical, cosmetics, medicinal and oil production industries and other companies alike to explore the genetic resources jointly and strategically.

Ethiopia has issued a proclamation on access to genetic resources and community knowledge, and community rights (Proclamation No 482/2006 and Regulation 169/2009). The Proclamation includes ownership, user rights, conditions for access, benefit sharing, types of benefits, authorities and responsibilities between users and providers are the main frameworks. These procedures can be achieved in the Access and Benefit Sharing Directorate of the Ethiopian Biodiversity Institute. Based on these frameworks, the country has been mandated in implementing access and benefit sharing thematic on the Convention of Biological Diversity (CBD).

Therefore, the objective of this information is to motivate and encourage any bioprospecting company or an interested individual to work on the genetic resources of Bambara groundnut (Vigna subterranea [L.] Verdc.) for medicinal uses, flavoring & preservative agents, food production and related research activities.

Description of the crop plant

The current crop production systems in tropical and subtropical regions are dependent on the cultivation and use of a very limited number of commodity crop species. Most of the native or African “orphan” crop species such as

Bambara groundnut (Vigna subterranea [L.] Verdc.), groundnut (Arachis hypogaea L.) and cowpea (Vigna unguiculata L.) have unique benefits in food, nutritional, and health security for humankind [1]. Furthermore, neglected crop plant species have a long agricultural history, are valuable components of the smallholder farming systems, and are considered as future food security crops. These species have intrinsic eating quality attributes and resilience to the biotic and abiotic stresses associated with climate change. They have adapted and co-evolved under the prevailing farming and environmental conditions, pest and disease pressure, and low input farming systems in Africa. However, orphan crop species have received limited research and development attention by researchers and policy makers and, hence, their economic value, production methods, product development, and commercialization have not yet been fully explored [3].

It is predominantly self-fertilizing crop with cleistogamous flowers. It is cultivated extensively by smallscale farmers in the drier regions of SSA under the traditionally low-input and marginal agricultural production systems.

Fig-1: Crop stand, underground part and pod of Vigna subterranea

Bambara groundnut is cultivated in altitudes ranging from 1100 m to 1600 m above sea level with mean temperatures between 20 and 28 ^{o}C [4]. The crop is relatively drought tolerant and requires limited agricultural inputs for production. It thrives with limited rainfall and under poor soil fertility conditions where many crop species would fail to be produced [5]. It requires from 110 to 150 days for growth and physiological maturity, depending on the genotype and environment. Bambara groundnut prefers well-drained soils. Sandy or loamy soils with a pH ranging from 5.0 to 6.5 are ideal for its establishment, for high pod yields, and for ease of harvest. Unshelled yields of 500–800 kg/ha were reported under poor soil conditions with reduced nutrients and without the use of inorganic fertilizers. This is attributed to its ability to fix atmospheric nitrogen through a symbiotic association with Rhizobium bacteria [6].

Bambara groundnut is grown as a cover crop to protect the topsoil from erosion and to suppress weed infestations, making it significant for crop rotation with major cereal crops [4]. Bambara groundnut consists of a highly established tap root system and a highly branching stem bearing numerous horizontal branches where the leaves arise. The leaf consists of an extensive petiole with a green or purple base. It has irregularly developing flowers that arise from an elongated peduncle beneath the soil. The leaves with erect petioles are alternate and trifoliate. The peduncles are auxiliary, extending from the stem nodes and containing one to three flowers per peduncle (usually two). Pale yellow flowers appear on the freely branching stalks and, after fertilization; the stems extend towards the soil along with the growing seed with them. The harvestable yield of Bambara groundnut is a matured unshelled pod developed underground. The pod is harvested after the plants are dug out of the soil. In plants with a bunched growth type, the pod remains attached to the root crown and is manually harvested. The growth cycle lasts between 90 and 170 days, while pod maturity takes about 120–150 days under ideal conditions. The flowers bloom 40–60 days after sowing and the pods matures 30 days after pollination. The seeds reach maturity after 55 days and continuous production of seeds occurs after every 30 days [7].

Bambara groundnut pods are formed underground spanning some 4 cm deep in the soil. Some Bambara groundnut genotypes bear a single seed per pod, while others can produce two to three seeds. The pods are formed in a clump and are yellow or dark red in colour. The grain colour is diverse and includes cream, yellow, brown, red, purple and black colours [7].

The International Institute of Tropical Agriculture (IITA) maintains the majority of Bambara groundnut germplasm accessions collected from various SSA countries [8]. In SSA, the crop is still cultivated using genetically unimproved landrace varieties. There is need for a concerted research effort on germplasm assembly, evaluation, product profiling, and variety design and development. The Bambara groundnut genome has not been fully explored, which is a key to utilizing the available genetic variation for breeding and cultivar development.

The main yield limiting factors include a lack of improved cultivars with high yield and resistance to insect pests and diseases. In most SSA countries, the crop is cultivated using unimproved varieties or landraces that were developed through mass selection from wild relatives.

Distribution of the crop plant

The origin of the Bambara groundnut is West Africa and the region of cultivation is Sub-Saharan Africa's warm tropics Bambara nut grows well anywhere groundnut (peanut) grows, and so is vastly present from Kwara state and throughout the northern parts of Nigeria.

It is believed to have originated from the Timbuktu areas in central Mali, West Africa [1]. However, the primary centre of genetic diversity of Bambara groundnut is the north-eastern region of Nigeria and northern Cameroon (Figure 1). Also, a secondary centre of diversity exists outside Africa and includes Sri-Lanka, Malaysia, the Philippines, and India [9]. Bambara ground nut is predominantly cultivated in the western part of Ethiopia, in the three zones of Benishangul gumuz regional state. Production is practiced by local/indigenous communities of the region using landrace seeds at hand.

Fig-2: Map of Benishangul Gumuz regional state of Ethiopia

Chemical composition of the crop plant

The grain of Bambara groundnut is regarded as a source of a complete and balanced diet. It contains carbohydrates (51–71%), crude protein (18–24%), oil (4–12%), fibre (3–12%), and ash (3–12%) [18]. Furthermore, it has essential and non-essential amino acids at 32.72% and 67.28%, respectively, per 100 g of grain [10]. Lysine is the major essential amino acid (10.3%) present in the grain. Due to higher protein and amino acid contents, Bambara groundnut is an ideal food to complement most cereal-based diets in Sub Saharan Africa [11]. The total energy gains from Bambara groundnut grain consumption are the highest compared with other legumes such as cowpeas, pigeon peas (Cajanus cajan L.) and lentils (Lens culinaris L.) [12].

Bambara groundnut grain is consumed fresh or roasted and served as snack when young and immature. During maturity, the grain develops a hard seed coat; hence it has to be boiled prior to processing and consumption. In Benin, the grains are processed into flour to make bread, cakes and dumplings. In eastern African countries, the crushed grains are

used to prepare soup. Moreover, Bambara groundnut flour is processed to make bread in Zambia [13]. In South Africa and Swaziland, the grains are utilized to add flavour in boiled cowpea grain [14]. It is also processed to produce milk similar to soybeans. The derived milk is used as a weaning food in several African countries. Bambara groundnut milk has a lighter colour compared with soybean milk [15].

The biomass (the stem, leaves, and haulm) has been extensively used for livestock feed. Additionally, the seed cake is used for livestock feed, while the grains are fed to swain and poultry.

Young and succulent leaves contain essential mineral elements, including nitrogen and phosphorus, which are useful for animal health [16]. In Nigeria, tilapia fish are fed with Bambara groundnut leaf protein [17].

MEDICINAL USES

Bambara groundnut has been used to prepare traditional medicines. Reportedly, white grains are boiled with guinea fowl meat to treat diarrhea, while ground black grains are mixed with water to treat sick children. Also, Bambara groundnut flour is used to cure skin rashes, and grains are often chewed to relieve a swelling jaw [9].

CONCLUSION

The various agroecological conditions and availability of diverse floral resources makes Ethiopia one of the best suitable places for the existence of large and unique biodiversity both in plants and animals genetic resouces. Bambara groundnut (*Vigna subterranea* [L.] Verdc.) Is a nutritionally rich grain legume crop indigenous to Africa? It is tolerant to drought stress and has become adapted to grow under low input and marginal agricultural production systems in Africa and Asia. It is predominantly self-fertilizing crop with cleistogamous flowers. The grain of Bambara groundnut is regarded as a source of a complete and balanced diet. It contains carbohydrates (51–71%), crude protein (18–24%), oil (4–12%), fibre (3–12%), and ash (3–12%). Bambara groundnut has also been used to prepare traditional medicines.

REFERENCES

1. Alhassan, G. A., & Egbe, M. O. (2013). Participatory rural appraisal of Bambara groundnut (Vigna subterranea (L.) Verdc.) Production in Southern Guinea Savanna of Nigeria. *Agricultural Science*, *1*(2), 18-31.
2. Ethiopian Biodiversity Institute (EBI). (2014). Government of the Federal Democratic Republic of Ethiopia, Fifth National Report to the Convention on Biological Diversity, *Addis Ababa, Ethiopia*, 1-72.
3. Oerke, E. C., Dehne, H. W., Schönbeck, F., & Weber, A. (2012). *Crop production and crop protection: estimated losses in major food and cash crops*. Elsevier.
4. Azam-Ali, S. N., Sesay, A., Karikari, S. K., Massawe, F. J., Aguilar-Manjarrez, J., Bannayan, M., & Hampson, K. J. (2001). Assessing the potential of an underutilized crop–a case study using bambara groundnut. *Experimental Agriculture*, *37*(4), 433-472.
5. Dansi, A., Vodouhè, R., Azokpota, P., Yedomonhan, H., Assogba, P., Adjatin, A., & Akpagana, K. (2012). Diversity of the neglected and underutilized crop species of importance in Benin. *The scientific world journal*, *2012*.
6. Singh, A. L., & Basu, M. S. (2006). Bambara Groundnut: Its Physiology and Introduction in India. In *Advances in plant physiology* (pp. 235-249). IK International Publishing House Pvt Ltd.
7. Shrestha, J., Kunwar, C. B., & Bhandari, B. (2018). Response of mass selection in maize (Zea mays L.). *Our Nature*, *16*(1), 35-42.
8. Effa, E. B., & Uko, A. E. (2017). Food security potentials of Bambara groundnut (Vigna subterranea (L.) Verdc.). *Int. J. Dev. Sustain*, *6*, 1919-1930.
9. Akpalu, M. M., Atubilla, I. A., & Oppong-Sekyere, D. (2013). Assessing the level of cultivation and utilization of bambara groundnut (Vigna subterranea (L.) Verdc.) in the Sumbrungu community of Bolgatanga, Upper East Region, Ghana. *International Journal of Plant, Animal and Environmental Sciences*, *3*(3), 68-75.
10. Gonné, S., Félix-Alain, W., & Benoît, K. B. (2013). Assessment of twenty bambara groundnut (Vigna subterranea (L.) Verdcourt) landraces using quantitative morphological traits. *International Journal of Plant Research*, *3*(3), 39-45.
11. Alake, O. C., & Ayo-Vaughan, M. A. (2017). Genotypic variation and correlations between yield system traits and yield components in African landraces of bambara groundnut. *South African Journal of Plant and Soil*, *34*(2), 125-137.
12. Berchie, J. N., Adu-Dapaah, H. K., Dankyi, A. A., Plahar, W. A., Nelson-Quartey, F., Haleegoah, J., ... & Addo, J. K. (2010). Practices and constraints in Bambara groundnuts production, marketing and consumption in the Brong Ahafo and Upper-East Regions of Ghana.
13. Cook, D. (2017). *Small scale farmer's utilization and perceptions of Bambara groundnut production in South Africa: a case study in a semi-arid region of Limpopo* (Master's thesis, University of Cape Town).

14. Mubaiwa, J., Fogliano, V., Chidewe, C., & Linnemann, A. R. (2017). Hard-to-cook phenomenon in bambara groundnut (Vigna subterranea (L.) Verdc.) Processing: Options to improve its role in providing food security. *Food Reviews International*, *33*(2), 167-194.
15. Yao, D. N., Kouassi, K. N., Erba, D., Scazzina, F., Pellegrini, N., & Casiraghi, M. C. (2015). Nutritive evaluation of the bambara groundnut Ci12 landrace [Vigna subterranea (L.) Verdc.(Fabaceae)] produced in Côte d'Ivoire. *International Journal of Molecular Sciences*, *16*(9), 21428-21441.
16. Keller, G. B. (2004). *African nightshade, eggplant, spiderflower et al.-production and consumption of traditional vegetables in Tanzania from the farmers point of view* (No. BOOK). Institute of Agronomy of the Tropics and Subtropics.
17. Mazahib, A. M., Nuha, M. O., Salawa, I. S., & Babiker, E. E. (2013). Some nutritional attributes of bambara groundnut as influenced by domestic processing. *International Food Research Journal*, *20*(3), 1165.
18. Mayes, S., Ho, W. K., Chai, H. H., Song, B., Chang, Y., & Massawe, F. (2019). Bambara Groundnut (Vigna Subterranea (L) Verdc)—A climate smart crop for food and nutrition security. In *Genomic Designing of Climate-Smart Pulse Crops* (pp. 397-424). Springer, Cham.

Citation: Melak Agajie (2021). Bioprospecting Potential of Bambara Ground Nut (*Vigna subterranea* [L.] Verdc.) for Access and Benefit Sharing. *South Asian Res J Agri Fish*, *3*(6), 88-92.