



Isolation and Identification of Moulds from "Moi-Moi" a Locally Prepared Porridge from Bambara Groundnuts (*Vigna subterranea*)

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Authors' contributions

This work was carried out in collaboration between all authors. Authors EOE and OOG designed the study. Authors EOE and OVO carried out the practical work. Author EOE managed the literature searches and wrote both the protocol and the first draft of the manuscript. Author OVO edited the first manuscript draft. All authors read and approved the final manuscript.

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ABSTRACT

The preparation and fungal spoilage of "moi-moi" from Bambara groundnut were investigated. Its preparation followed the steaming of beans pudding. Pour plate technique was used to estimate the fungal population and isolates were identified using standard methods. The mean value of the total fungal population estimation on the "moi-moi" from Bambara groundnut, done 24 hours after preparation was 9.0×10^3 cfu/g. The value obtained for "moi-moi" kept without preservation for 48 hours was 11.4×10^4 cfu/g. *Aspergillus flavus*, *A. tamarii*, *Mucor* sp. and *Rhizopus* sp. were the fungi recovered. Good preservation is needed for "moi-moi" for prevention of fungal spoilage.

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1. INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L.) Verdc) is a legume existing mainly in Tropical Africa with the historical background of its origin being traced to North Africa [1]. The name “Bambara” was linked to a district name on the Upper Niger called Bambara. *Vigna subterranea* var. *spontanea* and *Vigna subterranea* var. *subterranea* are known varieties of this crop. Bambara groundnut has the ability to survive drought and can grow in soil less fit for cultivating other legumes [2]. It has greater tendency to withstand high temperature. It has great resistance against diseases and pests [3]. It can also play a role in improving soil fertility being a good nitrogen fixer [2]. With all these advantageous cultivating factors, the cultivation of Bambara groundnut has suffered a setback when compared to maize and rice cultivation due to its underutilization [4].

Information unveiling the potentials of Bambara groundnut is ongoing but has not really stimulated the interest of the people at greater extent as such is expected to impact high cultivation. Part of the avenues where bambara groundnut has been utilized is its transformation into flour as used as a composite in the production of bread and biscuits. Its high protein content has made it a good supplement. It is good at treating certain sexual transmitted diseases [5]. Bambara groundnut is made use as an ingredient of fish meal and fodder. The oil of Bambara groundnut also serves some medicinal effects. Bambara groundnut is known to be rich in protein as compared to other cereals. It contains a better percentage of carbohydrate, fat, ash and fibre [4]. This contributes to its high nutritional value. Man enjoys Bambara groundnut meal in form of milk, snack, bread and biscuit [4]. The boiled seeds with pepper and salt also give an enjoyable meal. Additional delicious meal that can be made with Bambara groundnut is “moi-moi” or “okpa” [6].

“Moi-moi” is a prepared food native to certain parts of Nigeria, noticeable among the “Yorubas” tribe. It is basically made from cowpea seed. The type made with the same process using maize grains among the “Yorubas” is called “abari”. “Moi-moi” can be fractioned into several short cup-like containers, polyethylene pack or leaf of *Thaumatococcus danielli* (African serendipity berry, sweet prayer plant, katemfe, okigbo). It is consumed along with food such as bread, pap

and “gari”. Some individuals can eat it with cooked rice (*Oryzae sativa*) grains too. It also has a traditional relevance as it is prepared and distributed during wedding among the “Yorubas”. A great financial income is made with the sales of “moi-moi” by some “Yorubas” serving as the main source of livelihood for the sellers.

Fungal spoilage of food commodities is associated with the activities of fungi on the food [7]. Fungi use the food as a substrate for growth under favourable conditions. Nearly all fungi are ubiquitous in nature. They produce spores that aid their constant dispersal. They easily invade an area and thrive if surrounding factors permit. They feed on the food nutrients by secreting digestive enzymes which in turn deteriorate the food. Some bring about food contamination by releasing secondary metabolites [8]. Species of *Aspergillus*, *Penicillium*, *Mucor* and *Rhizopus* are examples of fungi with a record of food spoilage [7].

As means of increasing the awareness of bambara groundnut; to expose its nutritional value, stimulate people’s interest toward its sales and consumption, and increase in cultivation; this work seeks to demonstrate the preparation of “moi-moi” using bambara groundnut as the basal ingredient and also to investigate mould growth on the cooked “moi-moi”.

2. MATERIALS AND METHODS

2.1 Materials

Bambara groundnut seeds used for this work were purchased from Bodija market, Ibadan, Oyo State and kept under normal atmospheric condition until they were used. Red pepper, vegetable oil, onions, cooking seasoning and salt were obtained from a local market in Esa-oke, Osun State, Nigeria.

2.2 Preparation of Bambara Groundnut “Moi-Moi”

The Bambara groundnut seeds were sorted to get rid of every particle. Three cups (peak milk tin) of the sorted seeds were washed with two runs of clean water. The washed seeds of Bambara groundnut were soaked in clean water covering the entire seed at ratio 1:2 (w/v) for 30 minutes. The soaked seeds were dehulled (removal of the shell) and sieved, and thoroughly washed with clean water. The clean-dehulled Bambara groundnut seeds were milled alongside

with water-rinsed red pepper and onion bulb. The milling was done by adequately transforming Bambara groundnut into an entire fine paste, vigorously stirred for 5 minutes after which 30 ml vegetable oil was introduced. The mixing proceeded for another 30 seconds for homogenization. Cooking seasoning and salt were added to taste and further stirring was done as 100 ml of water was added to reduce the thickness. At this point, the diluted paste was fractioned into a medium-sized nylon bag, tightly tied, steamed for 20 minutes and allowed to cool down.

2.3 Isolation and Characterization of Fungi

One gram of the “moi-moi” sample made from Bambara groundnut was totally dissolved in 9 ml of sterile distilled water and serially diluted in further sterile distilled water [9]. Pour plate technique was used to estimate the fungal population using Potato Dextrose Agar medium. The dilutions were plated out and incubated at 27°C for 3 days. Viable count of the colonies was taken and the colony forming unit was determined. Discrete colonies were picked at random from PDA plates and subcultured until pure cultures were obtained. The cultural characteristics considered were the colony growth pattern, mycelial and spore colour and growth rate. The fungal hyphae were stained with lactophenol cotton blue and microscopically examined [10].

3. RESULTS

The final appearance and taste of the moi-moi took a resemblance of the common moi-moi made using cowpea. The mean value of the fungal population on the “moi-moi” from bambara

groundnut, done 24 hours after preparation, was 9.0×10^3 cfu/g. The value obtained for “moi-moi” kept for 48 hours was 11.4×10^4 cfu/g. *Aspergillus flavus*, *A. tamarii*, *Mucor* sp. and *Rhizopus* sp. were the fungi recovered (Table 1). *A. tamarii* was not found in the first set of isolation. But found from “moi-moi” kept for 48 hours. Others were present in both isolations (Table 2).

4. DISCUSSION

The preparation of Bambara groundnut moi-moi took roughly 90 minutes from soaking to steaming and was not laborious. The ingredients for making this “moi-moi” are not expensive and are readily accessible in the market. The process of preparing Bambara groundnut “moi-moi” readily made the high protein content in the legume available, and the barrier of the tough nature of the seed coat removed. The issue of indigestion has also been resolved. The “moi-moi” is therefore susceptible to microbial deterioration after few hours of preparation based on its high moisture content. In this study, the fungal viable count increased drastically within 48 hours as compared to the estimation made 24 hours after preparation. The fungal population increased with time as higher colony count was recorded for the moi-moi after 48 hours. The number of fungal species also increased in the same trend. This explains an increased fungal activities as condition remained favourable. The fungi isolated from the steamed Bambara groundnut pudding were all associated with spoilage of food. Species of *Aspergillus*, *Rhizopus* and *Mucor* were found to be associated with bread spoilage. *Mucor* sp. is also known to be found in decaying fruits and vegetable [7].

Table 1. Cultural and morphological characteristics and identification of fungal isolates

Fungal isolates	Cultural characteristics	Morphological characteristics
<i>Mucor</i> sp	Large fluffy white colonies taking over the entire culturing plate	Stolon not present but sporangium developed from the hyphal
<i>Rhizopus</i> sp	Large fluffy white milky colonies showing black colouration over time	Stolon and rhizopus present connecting sporangiophore borne on non-septate hyphae, hemispherical columella present bearing a dark pear-shaped sporangium
<i>Aspergillus tamarii</i>	The colony is rusty brown	The stipe is long and rough. The head is partly globular. The conidia are thick and strongly roughened with yellow colour
<i>Aspergillus flavus</i>	Yellowish green becoming green with age. The reverse is creamy yellow	The head is radiating and becoming loosely columnar with age. The stipe is long, varicose and hyaline. It has a small metula

Table 2. Incidence of each fungal isolates

Fungal isolates	A	B
<i>Mucor</i> sp	+	+
<i>Rhizopus</i> sp	+	+
<i>Aspergillus tamarii</i>	-	+
<i>Aspergillus flavus</i>	+	+

A = "Moi-moi" 24 hours after preparation;

B = "Moi-moi" 48 hours after preparation;

+ = Present; - = Absent

5. CONCLUSION

Higher percentage of the populace is still unaware of Bambara groundnut hence the reason for introducing the use of Bambara groundnut to make "moi-moi". This likewise serves as a means of promoting its awareness and correcting its underutilization. With this, more attention will be drawn to the crop, thereby encouraging the consumption, sale and cultivation of Bambara groundnut. Most farmers do not consider Bambara groundnut as a crop to be consistently cultivated as long as buyers do not demand for it due to poor or no sales. However, sustained and high consumers' interest will reverse this sequence and in turn save Bambara groundnut from being abandoned.

"Moi-moi" is known with high moisture content which thereby calls for proper preservation (refrigeration and heat warming) of the food to discourage fungal infestation and that of other microorganisms capable of spoiling Bambara groundnut "moi-moi". Food contamination is known with some fungal species as they are capable of releasing secondary metabolites, known to be thermo-resistant, into the food. One example of such fungi is *Aspergillus flavus* which is one of the fungal species recovered from this work. The fungus produces mycotoxin known as aflatoxins - deleterious secondary metabolites capable of causing cancer in affected persons; so fungal infestation should be avoided in food for the safety of the consumers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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