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Towards the development of shelf stable 'iru' (*Parkia biglobosa*) condiment bouillon cubes using corn, cassava and potato starch extracts as binders

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Abstract

African locust bean (*Parkia biglobosa*), fermented into "iru" or "dadawa" is a nutritious condiment featured frequently in the diet of people of Nigeria and other West African countries. Many consumers benefit from the nutrients, and enjoy the aroma of fermented locust bean seed in their foods. However, some dislike seeing the locust beans and would pick them out of their meals depriving themselves of the nutrients. The availability of iru as fermented, ground and shelf stable bouillon cube may increase the acceptability of this condiment. The objective was to develop a shelf stable iru bouillon with starches as binders. Fermented, dried and ground locust bean with binders were prepared in the ratio of 40:10 and 30:20 locust bean:binder and cubed. Microbial and proximate analyses of the cubes were carried out. *Bacillus* spp., *Lactobacillus* spp., *and Staphylococcus* spp. were isolated following bouillon cube production. Cassava starch bouillons had the highest moisture content (24.5% and 29.3%). Bouillons with corn starch had the highest amount of fat (22.0%), followed by cassava starch (19.6%), while bouillon cubes with potato binder had the highest crude protein content (33.9%). Iru without binders had the lowest moisture (11.5%) and ash (1.7%), the highest crude fat (30.0%) and the highest crude protein (46.3%) contents. Only *Bacillus subtilis* was isolated from all the samples after 9 months of storage, indicating that shelf stable iru bouillon cubes is possible, without chemical preservatives. Conclusively, iru bouillon cubes with binders improved the shelf life from few days to over nine months without compromising the safety of the product.

Keywords: Iru bouillon cube; African locust bean seed; *Parkia biglobosa*; Starch binders; Shelf stable iru

1. Introduction

African locust bean tree (*Parkia biglobosa*) produces the seeds which when fermented is a source of nutritious condiment in the traditional diet of both rural and urban dwellers in at least 17 West African countries including Nigeria (Hopkins and White, 1984; Odunfa, 1986; Achi, 2005; Daramola et al., 2009). The tree is named after the famous Scottish botanist and surgeon, Mungo Park by Robert Brown and is widely recognized as an important indigenous multipurpose fruit tree in many countries of the sub-Saharan Africa.

P. biglobosa seed has been extensively studied. The estimated average consumption per head per day for Nigeria, Togo and Ghana (Campbell-Platt., 1980), and the nutritive and medicinal values of the seeds have been reported (Alabi et al., 2005). Fermented locust bean seeds are used as culinary product to enhance or intensify meatiness in soups, sauces and other prepared dishes (Christiana and Marcel, 2008). They are considered to be a good source of protein for the less wealthy (Diawara et al., 2000). The husks and pods of the fruit have also been reported to be good food for livestock (Obizoba, 1998). The stem can also be carved into household and agricultural equipment (Alabi et al., 2005).

Although consumers generally benefit from the nutrients and enjoy the aroma of the fermented locust bean seed in their foods, some do not like to see the seeds in their dishes. These individuals remove these seeds from their meals depriving themselves of the nutrients in the seeds.

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Starch is a natural biopolymer abundantly available and cheap to use. Starch is used as binders, gelling agents, and thickeners in the food industries (Krueger et al., 1987). The starches extracted from corn and potatoes are frequently used, but recently cassava starch was adopted for use as a binder by British Pharmacopoeia (Mohammed et al., 2011). Furthermore, cassava starch has been used to make pie fillings and to thicken soups, stews, and sauces (Hauber et al., 1996).

Previous efforts to produce 'Dadawa' cubes have not been successful because consumers perceived that the bouillons contain chemical preservatives (Sadiku, 2010). Though consumers prefer iru or dadawa prepared the traditional way, there is concern for the safety of the products (Sadiku, 2010). It is possible that the development of shelf-stable iru bouillon cubes, which can be crushed and sprinkled into the soups and dishes, will increase acceptability of the product by consumers. The objective of this study was to develop shelf stable iru bouillon cubes from locust bean seed using various binders without compromising the safety of the product.

2. Materials and methods

African locust bean (*P. biglobosa*) seeds, fresh cassava tubers (*Manihot esculenta*), domestic refined iodized salt (Dangote, Ikoyi, Nigeria), onions (*Allium cepa*) and fresh meat were purchased from Odo-ori market, Iwo, Osun state, Nigeria. Potato tuber (*Solanum tuberosum*), and maize grain (*Zea mays*) were purchased from Gbagi market, Ibadan, Oyo state, Nigeria. The potato, maize grain, African locust bean seeds, onions and the iodized salt were stored in the laboratory at room temperature, while the meat was kept in the freezer until processing commenced. Cassava was purchased fresh and used within two days after harvest.

2.1. Preparation of African locust bean seeds

The raw African locust bean seeds were sorted and prepared according to Christiana and Marcel's (2008) protocol, with little modification. About 725 g of seeds was soaked in 3 L of water for 12 h; mashed to de-pulp the seeds, boiled in a pressure cooker (Master Chef, Australia) at 128 kpa for 2 h, de-hulled and boiled again for 30 min under pressure. Excess water was drained and the seeds were fermented for 72 h in a covered container. Following fermentation, the seeds were dried in a cabinet drier (Model F300, Chris Alex Engineering, Ibadan, Nig.) at 65 °C for 2 days followed by grinding and storage in air tight polyethylene bags.

2.2. Preparation of binders

Potato and cassava tubers were thoroughly cleaned to remove soil and debris. The potatoes were diced and ground; starch was extracted by screening using a muslin cloth, to remove the chaff. The starch slurry was sedimented, de-watered, sun dried for 2 days, then pulverized into powder. Cassava starch was prepared as described by Intergrated cassava project (ICP, 2010). Briefly, cassava roots were peeled, grated, mixed with water and screened using muslin cloth. The starch was de-watered, sun dried for 2 days, milled and sieved with 150 μm mesh sieve. Maize grains were soaked in water for 24 h, then ground and screened using muslin cloth and then starch was extracted using the method described for cassava.

2.3. Preparation of meat broth

Approximately 300 g of lean meat was thoroughly washed, and cut into smaller pieces. About 0.4 g of salt was added; medium sized onion was chopped and added to the meat together with 150 mL of water. The mixture was cooked for 30 min. The broth was decanted off, cooled and refrigerated and used within hours of preparation.

2.4. Preparation of the iru bouillon cubes

Two samples (40:10 and 30:20) of iru bouillon cubes were prepared. Fermented oven-dried and milled locust bean (40 g) was weighed and added to 10 g of binder in a container. Meat broth (30 mL) was added to locust bean/binder mixture and mixed thoroughly. Then 1 g of iodized salt was added to the mixture and was stirred on a hot plate for 2 min. The mixture was kneaded, cubed and dried for 5 min at 50 °C in the cabinet drier to produce the 40:10 bouillon cube samples. The fermented locust bean (30 g) and the binder (20 g) were used in the 30:20 bouillon cube samples. All other parameters remained the same as for the 40:10 bouillon cubes. Each cube was wrapped in aluminum foil; the samples were placed in polyethylene bags and stored at ambient temperature (30 ± 2 °C) in the laboratory for up to 9 months. The control sample in this study was ground dried iru without binder, salt or meat broth. The control was not cubed into bouillon.

2.5. Microbial analysis of iru bouillon

Microbial analyses were carried out on bouillon cubes immediately after the production and also after nine months of storage. Microbial load of the iru bouillon cubes and other biochemical analyses was performed in duplicates. The bouillon samples were randomly selected for microbial analysis. Approximately 1 g of the cube was homogenized in 9 ml of peptone water, followed by serial dilution up to final dilution of 10^{-4}. About 10 μl of 10^{-4} dilutions was plated in duplicates on nutrient agar, potato dextrose agar, MacConkey agar and Eosin Methyl Blue agar (Lab M, UK) and incubated at 37 °C for 24–48 h. The isolates were characterized using Gram staining, motility, Indole production, Methyl red–Voges Proskauer (MR–VP), citrate utilization, catalase and carbohydrate fermentation tests (Pollack et al., 2002).

2.6. Proximate analysis of iru bouillon

Samples used for proximate analysis were randomly selected and analyzed for moisture, ash, crude fat and crude protein contents in triplicates. Moisture content was determined as described by AOAC (1984) method; ash content was determined according to AOAC (1984) method; crude fat determination according to Nielson (2002) procedures; and crude protein by the AOAC (1984) method.