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Microbial and Mineral Composition of Fortified Fermented Local Meal from Pigeon Pea (CAJANUS CAJAN) and Unripe Plantain

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Abstract
A fortified fermented local meal was produced from pigeon pea and unripe plantain. 50kg of pigeon pea was subjected to solid state method of fermentation for 72 hrs. Samples of meal were produced from fermented pigeon pea and unripe plantain at different ratios and labeled samples A, B and C. Sample A had 10% fermented pigeon pea and 90% unripe plantain flour, sample B had 20% fermented pigeon pea and 80 % unripe plantain flour while sample C had 30% fermented pigeon pea and 70 % unripe plantain flour. The three samples were subjected to microbial and mineral analysis. *Lactobacillus plantarum* and *Saccharomyces cerevisae* were isolated from all the samples. The microbial count ranged from 1.2x106 CfU /g to 1.8 x 106 CfU/g which was not significant. There was no significant difference ($p \leq 0.05$) in the microbial count of the three samples. Mineral analysis revealed that the samples were rich in sodium, potassium, calcium, iron and phosphorus. However, sample C had the highest sodium, potassium, calcium and phosphorus while sample A had the highest iron value. Sample A had the least value of sodium, potassium, calcium and phosphorus.
Keywords: Microbial, Mineral, Fermentation, Pigeon Pea and Plantain.
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Introduction

Pigeon pea (*Cajanus cajan*) is a legume crop grown in the tropics and widely consumed in Africa, India and the Caribbean. It contains about 19.6% protein (Okpala and Mamah, 2001) and therefore serves as an important source of vegetable protein. Pigeon pea contains 20-22% protein, 1.2% fat, 65% carbohydrate and 3.8% ash (Onweluzo and Nwabugwu, 2009) high levels of cysteine, methionine and lysine (Osagie, 1998) and smaller amount of oligosaccharides (Singh, 1988).

Processing techniques such as boiling, roasting and germination are means of improving the nutritional value of food (Nergiz and Gokgoz, 2007). Fermentation is defined as a bio-processing using microorganisms and their enzymes to achieve desirable quality characteristics of food products (Singhanai, 2009). The origin of fermented foods goes back to thousands of years. It is one of the oldest ways of food processing. According to (Lawal, *et. al,* 2009), fermentation improves food digestibility and nutritional quality.

Plantain (*Musa paradisiacal*) belongs to the genus *Musa* in the family of Musaceae. It is a giant perennial herb and cultivated in the many tropic and subtropical countries of the world. It ranks third after yam and cassava for sustainability in Nigeria. It is used as a source of starchy staple food for millions of people in Nigeria. Mature plantain pulp is rich in iron, potassium and vitamin A but low in protein and fat.

Objectives of this Research

- To produce fortified fermented local meal from pigeon pea and unripe plantain.
- To determine the microbial quality of the fortified fermented local meal from pigeon pea and unripe plantain.
- To determine the mineral composition of the fortified fermented local meal from pigeon pea and unripe plantain.
- To produce meals of high nutritional value to solve the problem of malnutrition particularly in children.

Materials and Methods

- **Sample Collection:** Pigeon pea and unripe plantain used for this research were purchased from Jattu market in Auchi, Edo state, Nigeria. The raw materials were transported to food processing workshop in the department of food Technology, Auchi Polytechnic, Auchi.
- **Sample Processing Prior to Use:** The pigeon peas were sorted to remove dirt's, broken one and extraneous materials which may serve as contaminants. The pigeon peas were washed with portable water treated with 5% sodium metabisulphite and drained. It was then dried in hot air oven at 50C for 24 hours. The unripe plantain was sliced, washed and treated with 5% sodium meta bisulphate and drained. It was then dried in hot air oven at 50C for 72hours. 50kg of the unripe plantain was then grinded into powder. Sample A had 10% fermented pigeon pea and 90% unripe plantain. Sample B had 20% fermented pigeon pea and 80% unripe plantain, while sample C had 30% fermented pigeon pea

and 70% unripe plantain. 200g of dried crayfish was added to 1kg of each sample. The products were well packaged.

- **Microbiological Analysis:** Isolation and identification of microorganisms were carried out from the method of (Fawole and Oso, 2007).
- **Determination of Mineral Contents:** The mineral composition of the samples were determined by ashing method, followed by reading of the level of mineral (AOAC, 2016).
- **Statistical Analysis:** All experiments were carried out in triplicates. Results obtained were analyzed by one way analysis of variance (ANOVA) and Dunca's multiple range tests was used to separate means using statistical package for the social sciences (SPSS) version 16 while P≤ 0.05 was accepted as significant level.

Results

Table I: Isolated microorganisms from fermented meal

Sample	Isolated Microorganisms
A	*Lactobacillus plantarum* *Saccharomyces cerevisae*
B	*Lactobacillus plantarum* *Saccharomyces cerevisae*
C	*Lactobacillus plantarum* *Saccharomyces cerevisae*

Table II: Microbial counts from fermented meal

Sample	Bacterial counts (CfU/g)	Fungi counts (SfU/g)
A	$1.2^{a} \times 10^{6} \pm 0.05$	$1.1^{a} \times 10^{6} \pm 0.02$
B	$1.8^{b} \times 10^{6} \pm 0.01$	$0.8^{b} \times 10^{6} \pm 0.01$
C	$1.8^{c} \times 10^{6} \pm 0.05$	$1.4^{c} \times 10^{6} \pm 0.02$

Means with the same superscripts down the Column are not significantly different ($p \leq 0.05$)

Note:
Sample A = 10% fermented pigeon pea and 90% unripe plantain
Sample B = 20% fermented pigeon pea and 80% unripe plantain
Sample c = 30% fermented pigeon pea and 70% unripe plantain

Table III: Mineral composition of fermented meal

Sample	Na (Mg)	Ca (Mg)	K (Mg)	P (Mg)	Fe(Mg)
A	$17.32^{a} \pm 0.02$	$22.14^{ab} \pm 0.01$	$64.23^{bd} \pm 0.05$	$14.16^{dc} \pm 0.01$	$0.98^{e} \pm 0.02$
B	$25.21^{b} \pm 0.02$	$34.26^{ac} \pm 0.02$	$78.14^{cd} \pm 0.05$	$15.23^{db} \pm 0.01$	$0.72^{ed} \pm 0.01$
C	$38.13^{c} \pm 0.02$	$40.16^{ad} \pm 0.02$	$91.83^{d} \pm 0.05$	$18.36^{de} \pm 0.01$	$0.31^{f} \pm 0.02$

Means with the same superscripts along the row are not significantly different ($p \leq 0.05$)

Note:
Sample A = 10% fermented pigeon pea and 90% unripe plantain
Sample B = 20% fermented pigeon pea and 80% unripe plantain
Sample C = 30% fermented pigeon pea and 70% unripe plantain

Discussion

Fermentation as method of food processing helps in conversion of sugar and other carbohydrates into organic acids, enrichment of diet through development of a diversity of flavour, aroma and texture of food substrates, preservation of substantial amount of food through lactic acid, alcohol, acetic acid and alkaline fermentation, biological enrichment of food substrates with protein essential amino acids, elimination of anti-nutrients and decrease in cooking time (Onwuka, 2014).

The microorganisms isolated and identified from the formulated meal were *Lactobacillus plantarum and Saccharomyces cerevisae.* These microorganisms have been found to be responsible for fermentation of most legumes and cereals (Tucker, 2003). These microorganisms have also been isolated in various investigations of fermented products such as alcoholic beverages and Fufu (Ogbona, *et al.*, 1998). *Lactobacillus plantarum* isolated from the formulated meal belongs to the group of lactic acid bacteria which are responsible for fermented process because of their unique metabolic characteristics (Wakil, *et al.*, 2014) the low microbial load of the formulated meal can be attributed to the production of lactic acid, thereby reducing the phipathogenic microorganisms were not isolated. The isolated microorganisms are beneficial to humans.

Potassium was the most abundant mineral in the formulated meal while iron was the least mineral obtained. Potassium and sodium are important in maintaining the normal water balance, conservation of osmosis and acid balance, potassium is necessary for the metabolism of carbohydrates and proteins. It also protects the internal anterior walls against any damages, prevents hemorrhages' and brain/heart attack (Oladele, *et al*., 2009). Calcium is also very essential for bone development.

Conclusion

The formulated, fortified and fermented pigeon pea and unripe plantain local meal produced did not contain pathogenic microorganisms but contained microorganisms that are beneficial to humans. The formulated meal was also rich in minerals.

Recommendation

The formulated meal produced can serve as composite flour which can be used for domestic purpose. It can also be used as weaning food to solve the problem of malnutrition in children.

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