# Assessment of Mineral, Phytochemical And Bacterial Flora of Four Varieties of Breadfruit

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***Abstract*: Studies on the mineral, phytochemical and bacterial Flora of four varieties of breadfruit were carried out in the Department of Plant Science and Biotechnology, Rivers State University. Mineral investigation revealed the presence of calcium, iron, magnesium, phosphorus, potassium and sodium in all tested varieties. *A. altilis* recorded highest contents of iron, phosphorus, potassium and sodium while highest contents of calcium (7.4±0.00) andmagnesium (6.0±0.00) were seen for *A. camansi* and *T. africana* respectively. Phytochemical screening showed that *A.altilis* had highest values (1.5±0.00, 2.6±0.00, 4.7±0.00 and 5.0±00) for oxalate, tannin, carotenoid and polyphenol respectively. *T. africana* recorded highest contents of phytate and lignan while highest concentrations of saponin and flavonoid were observed for *A. camansi*. Seven bacterial isolates were found to be associated with the four varieties of breadfruit and they include *Proteus spp, Staphylococcus aureus, Pseudomonas spp, Bacillus spp, Paenibacilliumspp, Streptococcus spp* and *Escherichia coli*. Highest incidence of occurrence was observed for *Bacillus spp* while *Paenibacilliumspp* recorded least percentage incidence of 4.4. Generally, *A. altilis* contains more mineral and phytochemical contents than every other breadfruit variety investigated.**

***Keywords:* Breadfruit, varieties, mineral, phytochemical and bacterial flora**

## I. INTRODUCTION

The name breadfruit is a common name for fruits belonging to the genera *Artocarpus*[1] although it usually refers to *Artocarpusaltilis*[2]. Breadfruits are main staples in the Caribbean and are covered by the International Treaty on Plant Genetic Resources for Food and Agriculture [3].

Singh [4] reported that a single tree produces between 150 kg and 200 kg of food per season. Breadfruits are used as food and may be eaten ripe as fruit or unripe as a vegetable. Malayans peel firm-ripe fruits, slice the pulp and fry it in syrup until it is crisp and brown. It can also be fried, baked, steamed, boiled and made into pudding. In West Africa, it is sometimes made into puree [1]. In the animal industry, the under-ripe fruits can be cooked for feeding pigs and it is a potential feed material for poultry. Breadfruit leaves and barks are also eaten by domestic livestock. Its latex is used for making chewing gums. The wood is used for furniture and surf boards. The fibre in the bark is fashioned into clothing. In Trinidad and Bahamas a decoction of the breadfruit leaf is believed to lower blood pressure and relief asthma [1]. Additionally, a powder of roasted leaves is employed as remedy for enlarged spleen and toasted flowers are rubbed on gums to soothe aching tooth [5].

Research in breadfruits as dietary component has recently gained attention. Nelson- Quartey *et al*. [6] produced infant formulations from *A. altilis* and *A. camansi* flours while Oduro*et al*. (2007) produced a breakfast meal from *A. altilis* pulp flours. Roberts *et al*. [8] reported on the potential of breadfruits for production of fried chips. To increase the popularity of breadfruits and expand their use in the food industry, Ragone[3] suggested that appropriate postharvest handling and storage should be explored. Enibe[9] as well as Beyer [10] indicated that breadfruits have the potential to contribute to food security and need to be adequately preserved and better utilised through food processing techniques which could be achieved by having information on the biochemical and nutritional status of the fruits.

## II. MATERIALS AND METHODS

### *A. Sample Collection and Preparation*

Breadfruits *Artocarpusspp* and *Treculiaafricana* were harvested within the State. *Artocarpusaltilis* were obtained from Igwuruta while *Artocarpuscamansi* were obtained from Ozuaha all in Ikwerre Local Government Area of Rivers State. *Artocarpusheterophyllus* were obtained from TereAma in Phalga Local Government Area and *Treculiaafricana* were obtained from Bori in Khana Local Government Area respectively.

Freshly harvested matured unripe fruits were washed with clean water and transported immediately to the laboratory for proximate, mineral, vitamin and phyto-chemical content analysis.

Decaying breadfruits were also washed and packaged with sterilised polythene bags and taken to the laboratory for the cultivation of fungi.

### *B. Nutrient Determination*

Mineral and proximate contents of *A. altilis*, *A. camansi*, *A. heterophyllus* and *Treculiaafricana* were determined by atomic absorption spectrometry, flame photometry and spectro-photometry according to the methods of AOAC [11].

### *C. Bacteriological Studies*

Nutrient agar was prepared according to the manufacturer’s specification where 28g of the powder was dissolved in 1000ml of distilled water using a conical flask which was stopped with cotton wool and aluminium foil.

This was done according to the method of Obire*et al.*,[12] was adopted for normal saline preparation where 8.5g of sodium chloride (NaCl) was dissolved in 1litre of distilled water, 9ml were dispensed into different test tubes which were stopped with cotton wool and sterilised in an autoclave at 121°C for 15 minutes.

1g of the fresh and boiled decaying fruit samples were grounded using sterile mortar and pistle. The ground samples were dissolved in test tube containing 9ml of normal saline. 1ml of the medium was transferred by a sterile pipette from the dilution to a test tube with 9ml normal saline to give 1/100 dilution. Ten-fold dilutions were generally used for the study.Grams staining of bacterial isolates were done using the methods of Chuku and Akani[13].

Biochemical tests were carried out according to the method described by Cowan [14] and Cruickshank *et al.*[15]. Pathogenicity tests and determination of bacterial incidence of the isolates were done using the methods of Ogaraku and Usman[16].

*D. Data Analysis*

All procedures were carried out in triplicates and data obtained were subjected to one way analysis of variance (ANOVA). The means were tested for significance at 5% level using Duncan's multiple range (DMR) test.

## III. RESULTS AND DISCUSSION

Table 1: Mineral composition of four varieties of breadfruit

| Breadfruit Seeds | Mineral Composition(mg/100g) | | | | | |
|---|---|---|---|---|---|---|
| | Ca | Fe | Mg | P | K | Na |
| *A. altilis* | $4.03\pm0.06^b$ | $50.1\pm0^a$ | $3.4\pm0.1^d$ | $16.2\pm0^a$ | $28.9\pm0^a$ | $36.5\pm0^a$ |
| *A. camansi* | $7.4\pm0^a$ | $0.5\pm0^d$ | $4.1\pm0^c$ | $3.2\pm0^c$ | $1.8\pm0^d$ | $3.2\pm0.1^c$ |
| *A. heterophyllus* | $7.1\pm0^a$ | $1.5\pm0^c$ | $5.5\pm0^b$ | $3.6\pm0^b$ | $2\pm0^c$ | $3.27\pm0.06^c$ |
| *T. Africana* | $3.2\pm0^c$ | $4\pm0^b$ | $6\pm0^a$ | $2.9\pm0^d$ | $15.1\pm0^b$ | $6.5\pm0.44^b$ |

Table 2: Phytochemical composition of four varieties of breadfruit

| Breadfruit Seeds | Phytochemicals (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Phytates | Saponins | Oxalates | Tannins | Carotenoids | Polyphenols | Flavonoids | Lignants |
| *A. altilis* | $0.21\pm0^b$ | $0.05\pm0b^b$ | $1.5\pm0^a$ | $2.6\pm0^a$ | $4.7\pm0^a$ | $5\pm0^a$ | $1.5\pm0^b$ | $1.34\pm0^c$ |
| *A. camansi* | $0.12\pm0^c$ | $0.3\pm0.1^a$ | $0.15\pm0^c$ | $0.18\pm0^d$ | $2\pm0^b$ | $1.5\pm0^c$ | $2.1\pm0.1^a$ | $1.75\pm0^b$ |
| *A. heterophyllus* | $0.1\pm0^c$ | $0.2\pm0^a$ | $0.2\pm0^b$ | $1\pm0^b$ | $0.18\pm0^d$ | $2.3\pm0^b$ | $2\pm0^a$ | $1.18\pm0^d$ |
| *T. africana* | $0.5\pm0^a$ | $0.2\pm0^a$ | $0.13\pm0^c$ | $0.3\pm0^c$ | $1.7\pm0^c$ | $0.9\pm0^d$ | $1.5\pm0^b$ | $2.8\pm0^a$ |

Table 3: Frequency of bacterial count and percentage incidence

| Organism | Frequency | Percentage incidence |
|---|---|---|
| *Proteusspp* | 15 | 16.7 |
| *Staphylococcusaureus* | 18 | 20 |
| *Pseudomonasspp* | 15 | 16.7 |
| *Bacillusspp* | 23 | 25.6 |
| *Paenibacilliumspp* | 4 | 4.4 |
| *Streptococcus spp* | 8 | 8.9 |
| *Escherichia coli* | 7 | 7.8 |

The calcium content of breadfruits seeds and pulp varied between 3.2±0 in *T. africana* and 7.4±0 in *A. camansi* (Table1). The calcium content of the breadfruit seeds and pulp were lower than cassava (615mg/100g) and *Prospisafricana* (362.5mg/100g)[17],[18]. NAS[19] recommends calcium intake of between 500mg/day and 800mg/day for children (1-8years old) and 100mg/day to 1300mg/day for adults. Calcium intake is important as it is known to reduce demineralization of bones [20].

The iron content of the breadfruit seeds and pulp ranged between 0.5±0 and 50.1±0 (Table 1). The iron content was highest in *A. altilis* pulp and least *A. camansi* seeds. According to the NAS[19] the recommended daily allowance for iron is between 8mg/day for adult males and 18mg/day for females. *A. altilis* pulp could therefore be a better source of iron than others. Iron is known to be an important constituent of haemoglobin found in blood and contributes to the combat of anaemia [21].

The magnesium content of the breadfruit seeds and pulp varied widely from 3.4±0.1 to 6±0 (Table 1). The magnesium content of *T. africana* was highest and *A. altilis* was least. The magnesium level was however lower than that of Appiah[22] (10.17mg/100g) to 167.71mg/100g. Magnesium is essential in enzyme systems and helps maintain electrical potential in nerves [23].

The seeds and pulp of the breadfruit cultivars had phosphorus content ranging between 2.9±0 to 16.2±0 (Table 4.2). *A. altilis* pulp had the highest phosphorus content while *T. africana* seed had the least. The phosphorus content in this study is low compared to *P. africana* (196.4mg/100g) reported by Aremu*et al.* [18] and Tiger nut (216mg/100g) reported by Oladele and Aina[24]. These differences could be due to geographical location.

The potassium content of breadfruit seeds and pulp varied from 1.8±0 to 28.9±0. The potassium content from this study was lower than that reported by Appiah[22] (533mg/100g to 1313mg/100). Potassium is an important mineral which helps maintain electrolyte balance in humans and it's important in amelioration of hypertension also helps in building up of the body frame work [25].

The sodium content of breadfruit seeds and pulp ranged between 3.2±0.1 to 36.5±0. *A. altilis*s pulp had the highest sodium content (36.5±0) which was significantly (P≤0.05) higher than breadfruit seeds; *A. camansi* (3.2±0), *A. heterophyllus* (3.27±0.06) and *T. africana* (6.5±0.44). The sodium content in this study was lower than *P. africana* (110.7mg/100g) reported by Aremu *et al*. [18] and higher than *A.altilis* reported by Tukura & Obliva[26]. Sodium generally imparts flavour and enhances preservation of foods, but very high level poses serious health risks. NAS [19] recommends sodium intake of between 1.2g/day and 1.5g/day being equivalent to between 2.5-3.5kg of breadfruit seeds/day. Since breadfruits seeds and pulp are not consumed in large quantity daily, they could be incorporated in the diet without exposing the consumer to sodium-related health risks.

The phytate content of the breadfruit seeds and pulp varied widely from 0.12±0 to 0.5±0 (Table 2). The phytate content of *T. africana* was the highest (0.5±0) while *A. camansi* was the least (0.12±0). The phytate content in this study was higher than *P. sativum* (0.03%) reported by Chuku *et al*. [27]. Phytic acid is is an antinutrient that interferes with the absorption of minerals from the diet making them unavailable for absorption in the intestine [28],[29].

The saponin content of the breadfruit seeds and pulp varied from 0.05±0 to 0.3±0.1. *A. camansi* had the highest saponin content (0.3±0) while *A.altilis* pulp had the least (0.05±0). This result is in line with *P. sativum* reported by Chuku [30]. Saponins in plants may act like antifeedants[31], [32] and can be classified as antinutrients[33]. These phytochemicals play vital role in the human health and have the potentials to fight against invading microorganisms [34].

The oxalate content of the breadfruit seeds and pulp ranged from 0.15±0 to 1.5±0 (Table 2). *A. altilis* had the highest oxalate content (1.5±0) while *A. camansi* had the least (0.15±0). This result is line with *P. sativum* (0.11%) reported by Chuku *et al*. [27], varieties of garden egg (1.2%) reported by Chuku & Chuku[35] and *M. domestica* (0.30%) reported by Chuku & Emiri[36]. Oxalates bind to calcium and prevent its absorption in the human body [29]. These phytochemicals posess antimicrobial and anticarcinogenic activities [37], [38], [39].

The tannin content of the breadfruit seeds and pulp ranged from 0.18±0 to 2.6±0 (Table 4.4). *A. altilis* had the highest tannin content (2.6±0) while *A. camansi* had the least (0.18±0). This is line with sweet orange and lemon (0.32% and 0.40%) reported by Chuku & Akani[15] and M. domestica (0.2%) reported by Chuku & Emiri[36]. However, the tannin content in this study was lower than breadfruit flours (3.44mg/100g to 3.5mg/100g) reported by Appiah[22]. Tannin has been reported to form complexes with proteins including enzymes resulting in reduced digestion and absorption [40],[41]. They are also known to bind iron (Fe) thereby making it unavailable for absorption [42].

The carotenoid content of breadfruit seeds and pulp ranged from 0.18±0 to 4.7±0 (Table 4.4). *A. altilis* pulp had the highest carotenoid content (4.7±0) while *A. heterophyllus* had the least (0.18±0). The carotenoid content in this study was in line with *P. sativum* (0.5%) reported by Chuku *et al*. [27]. Dietary carotenoids serve as precursor for Vitamin A and prevent chronic degenerative diseases [43].

The polyphenols content of breadfruit seeds and pulp ranged from 0.9±0 to 5±0. *A. altilis* had the highest polyphenols (5±0) while *T. africana* had the least (0.9±0). This result is also in line with *P. sativum* (0.5%) reported by Chuku*et al*. [27]. Polyphenols chelate metals such as iron and zinc and reduce the absorption of these nutrients [44]but they also inhibit digestive enzymes and may also precipitate proteins [45].

The flavonoid content of breadfruit seeds and pulp ranged from 1.5±0 to 2.1±0. *A. camansi* had the highest flavonoid content (2.1±0) while *A. altilis* pulp and *T. africana* had the least (1.5±0). The flavonoid content in this study was higher than *P. sativum* (0.41%) reported by Chuku *et al*. [27]. Flavonoids also chelate metals such as iron and zinc and reduce the absorption of these nutrients [44]but they also inhibit digestive enzymes and may also precipitate proteins [45].

The lignant content of breadfruit seeds and pulp ranged from1.18±0 to 2.8±0. *T. africana* had the highest lignant content (2.8±0) while *A. heterophyllus* had the least (1.18±0). The lignant content in this study was higher than *P. Sativum* (0.65%) reported by Chuku *et al*. [27]. According to Belyea & Ricketts [46], lignin ties up cellulose indicating that higher concentrations of lignin result in reduced cellulose digestibility.

Table 3 showed the bacterial isolate from fresh and boiled samples of the various species of breadfruit. They include *proteus, Staphylococcus aureus, Pseudomousspp, Bacillisspp* and *Paenibacillium.* The bacterial isolates observed to be associated with breadfruit seeds and pulp in this research are similar to those of Ogbonna *et al*[47], Ajayi & Adebolu[48] and Buchanan [49]. *Pseudomonas spp* was present in this research which could be as a result of their ability to survive in vast number of habitats. *Bacillus spp* was isolated during this study and it has been found that species of *Bacillus* produce cereulide which is heat stable and produces a vomiting-type syndrome [12], [50]. *Bacillus* and *Staphylococcus* are gram positive bacterial that are associated with normal microbiota of man (skin and nasal passages). They may have been contacted from poor sanitation, processing, packaging and exposure to air [51].*Escherichia coli* are indicators of faecal contamination probably from the environment where the breadfruit (*A. altilis*) was harvested. Passersby must have defecated and urinated around the vicinity of the tree as is always the case in our villages. Similar result of faecal contamination was reported by Somorin *et al*. [52] and Obire*et al.*[12]. Samorin *et al.*,[52] stated that the faecal contamination from the yam (*Dioscorea*) chips and flour could be during the parboiling stage and handling of the yam chip and flour or from the practice of spreading yam chips on bare grounds and thus contact with the soil during drying. The other bacteria such as Paenibacillium and Proteus isolated in this study are also of serious health implications [12].

## IV. CONCLUSION

The present study has shown that breadfruit is a good source of mineral elements and possesses several phytochemicals. It has further shown that *A. altilis* contains more minerals and phytochemicals than other varieties. In addition, several bacterial organisms have also been isolated and associated with breadfruit. Therefore, proper hygienic measures should be adopted by farmer, vendors and consumers to prevent subsequent contamination.

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