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Assessment of bioactive compounds in five breadfruit (*Treculia Africana*) cultivars in Anambra State, Nigeria

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ABSTRACT

This study aimed to assess and compare the bioactive compounds present in five different cultivars of breadfruit (*Treculia africana*) grown in Anambra State, Nigeria. *Treculia africana* is a staple crop in many tropical regions and is valued for its nutritional and medicinal properties. The five cultivars selected for this study were chosen based on their prevalence and importance in local agriculture. Various bioactive compounds, including phenolics, flavonoids, carotenoids, and vitamin C, were analyzed using established analytical techniques such as spectrophotometry and chromatography. These compounds were selected due to their known antioxidant, anti-inflammatory, and other health-promoting properties. Preliminary findings indicate significant variations in the concentrations of bioactive compounds among the different *Treculia africana* cultivars. These variation suggest potential differences in their nutritional and medicinal values. The results of this study contribute to the understanding of the diversity of bioactive compounds in *Treculia africana* cultivars and may inform future breeding programs and dietary recommendations.

Keywords: *Treculia africana*, bioactive compounds, cultivars, Anambra State, Nigeria

INTRODUCTION

Breadfruit (*Treculia africana)* is a tropical fruit that belongs to the Moraceae family. The breadfruit tree (*Treculia africana)*(Parkinson) Fosberg) is an evergreen multipurpose and traditional agro forestry species mainly grown for its fruits. Its starchy fruits are a staple food in the Pacific Islands [1]. The *T. Africana* var inversa is found in Anambra State and other Eastern States of Nigeria [2], [3]. The *T. africana* var inversa has smaller fruit head but more fruit [4]. The name breadfruit (*Treculia africana*) is due to the flavour of the fruit after being cooked, which is similar to that of freshly cooked bread [5]. The fruit is nutritious and a valuable staple food in Nigeria. The mature fruits are eaten raw or cooked, steamed, fried, made into flour and baked, roasted or freeze-dried, or traditionally fermented [6], [7]. It is canned and sold in the Caribbean and in the USA, Europe and Canada [5]. *Treculia africana* trees provide valuable fuel wood and low density, flexible timber, which is resistant to termites [5]. The fibrous parts are used to make traditional clothes, ropes and fish nets. The latex is used as a chewing gum and adhesive, and for the caulking of canoes. The burning of dried male flowers repels mosquitoes and other flying insects [3]. The *Treculia africana* tree is used as an ornamental tree in Hawaii. It has many ethno-medicinal uses [8]. The parts of the fruits that are discarded can be used to feed animals as a source of energy (due to the presence of carbohydrates) and protein and the leaves are valuable fodder for cattle. *Treculia africana* trees host and feed many birds and bats. The pollen and the latex are collected by honeybees [9], [3], [5]. Consumption of *Treculia africana* has been linked to potential health benefits, including improved glycemic control due to its low glycemic index and the presence of dietary fiber [10]. These properties make it suitable for managing diabetes and promoting overall metabolic health. African breadfruit is a food security that helps meet the nutrient needs of people and also provides income to rural poor household that produce, process and preserve this crop [11].

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Treculia africana contains bio-active compounds such as phenolic acids, flavonoid, and carotenoids. These compounds contribute to its antioxidant properties, which scavenge free radicals which harm the cells and strengthen the immune system to fight diseases, thus promoting good health and longevity [12], [13].

Beyond its nutritional and health benefits, breadfruit is valued for its versatility in culinary applications and potential industrial uses. Research continues to explore its potential in food security, sustainable agriculture, and economic development in tropical regions [14]. Bioactive compounds are naturally occurring chemicals in foods, plants, and other biological sources that have a physiological effect on the human body. Bio-active compounds contribute to various aspects of human health and disease prevention. They play essential roles in antioxidant activity [12], [15], which can help in managing inflammatory conditions like arthritis [16]. They have potential to reduce the risk of certain types of cancer through mechanisms such as modulation of carcinogen metabolism and inhibition of cancer cell proliferation [18], support cognitive function and potentially delay the onset of neurodegenerative diseases [18].

The aim of this study is to evaluate the bioactive compounds of five *Treculia africana* cultivars in Anambra state. This study will therefore help to identify and promote cultivars with higher nutritional profile or medicinal value thereby aiding in inbreeding and selection programs. Understanding the nutritional composition of local cultivars like *Treculia africana* will contribute to food security efforts and promotes sustainable agricultural practices by encouraging the cultivation of diverse, nutrient-rich crops.

MATERIALS AND METHODS

Source of materials

Breadfruit (*Treculia africana*) was collected at five Local Government Areas in Anambra state, Nigeria which includes; Awka South, Idemili North, Aniocha, Ihiala and Orumba North.

Treculia africana was harvested at specific stage of maturity from each cultivar at each of the Local Government Areas. Bioactive compounds were extracted using appropriate chemical or biochemical methods (such as solvent extraction, chromatography techniques, or spectrophotometric assays).

Analytical Procedures Utilized

Sample Extraction:

Twenty grams (20g) of the ground sample was soaked in 200ml of 70% ethanol and allowed to stand for 24 hrs at laboratory temperature. This was filtered using 3 layers of muslin cloth, then with Whatman paper No. 4. The filtrate was concentrated at 60^{o}C using a water bath (Techmel & Techmel, USA). The concentrated extract was reconstituted in 70% ethanol at a concentration of 10mg/ml and was stored at 4^{o}C until further analysis.

Assay of Bioactive Compounds

Total Phenol

The total phenol content of the extract was determined using the method of [19]. The stock solution of the sample extract was diluted to 1mg/ml. The diluted extract solution (1 ml) was mixed with Folin and Ciocalteu's phenol reagent (1 ml). After 3 minutes, saturated sodium carbonate solution (1 ml) was added to the mixture and adjusted to 10 ml with distilled water. The reaction was kept in the dark for 90 minutes, after which the absorbance was read at 725 nm using spectrophotometer. Gallic acid were used to prepare the standard curve and the results were expressed as mg of gallic acid equivalents (GAEs) per g of extract

Total Flavonoid

The flavonoid content was determined by the using the slightly modified colorimetry method described previously by [19]. An aliquot, 0.5 ml of appropriately diluted sample solution (250µg/ml), was mixed with 2 ml of distilled water and subsequently with 0.15 ml of 5 % $NaNO_2$ solution. After 6 minutes, 0.15 ml of 10% $AlCl_3$ solution was added and allowed to stand for 6 minutes 2 ml of 4% NaOH solution was added to the mixture. Water was added to bring the final volume to 5 ml, and then the mixture was thoroughly mixed and allowed to stand for another 15 minutes. The absorbance of the mixture was read at 510 nm versus water blank with reference standard prepared with catechin concentrations. The analyses were performed in duplicate. The results were expressed as mg Catechin equivalents per 100g of sample (mg CE/100 g).

Beta Carotene and Lycopene Contents

These were determined by the method of [19]. The concentrated extract (100 mg) was vigorously shaken with 6 ml acetone-hexane mixture in the ratio of (4:6) for one minute and filtered using Whitman No.4 filter paper.

The absorbance of the filtrate was read at 453, 505 and 663 nm respectively. The contents of lycopene and β-carotene were calculated according to the following equations: Lycopene (mg/100ml) = -0.0458A663+0.372A505+0.0806A453. β-carotene (mg/100ml) = 0.216A663+-0.304A505+0.452A453

Ascorbic Acid

Ascorbic acid content of the sample was determined according to the method of Klein and Perry (1982) [20].

An aliquot (20mg) of the extract was extracted with 10ml of 1% metaphosphoric acid. It was allowed to stand for 45 min at a temperature of 28oC (Laboratory temperature) after which it was filtered through Whatman No.4

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filter paper. An aliquote (1ml) of the filterate was mixed with 9ml of 50µM 2,6-dichlorophenolindophenol sodium salt hydrate. The absorbance was measured at 515nm using a UV-Vis spectrophotometer after 30min. Ascorbic acid content was calculated from the calibration curve of authentic L-ascorbic acid and the result expressed as mg ascorbic acid equivalent per gram (mgAE/g) of the sample.

RESULTS

The findings from the assessment of bioactive compounds in five different cultivars of breadfruit (*Treculia africana)* collected from Anambra State, Nigeria, were presented in a systematic manner, highlighting the composition and concentration of bioactive compounds found in each cultivar. The result on flavonoid content in the samples showed that Idemili had the highest value of (950.44 ± 21.25 mgCE/100g) and Aniocha had the lowest value of 670.73 ± 126.05 mgCE/100g). There was slightly significant difference (P<0.05) between Awka (811.64±2.61mgCE/100g) and Aniocha (670.73±126.05mgCE/100g), but there was no significant difference (P>0.05) between Awka (811.64±2.61mgCE/100g), Idemili North (950.44±21.25mgCE/100g), Ihiala (945± 149.62mgCE/100g) and Orumba North (931.60 ± 42.02mgCE/100g). The result on phenol content in the sample showed that Ihiala had the highest value of (1406.92 ± 43.61mgGEA/g) and Idemili North had the lowest value of (1196.64 ± 253.77mgGEA/g).There was no significant difference(P>0.05) between the samples.

The result on vitamin C content of the samples showed that Awka had the highest value of (0.43± 0.43mgAAE/100g) and Aniocha had the lowest value of (0.07 ± 0.08mgAAE/100g).There was significant difference (P<0.05) between Awka (0.43±0.43mgAAE/100g) and Aniocha (0.07±0.08mgAAE/100g), there was however, slight significant difference (P<0.05) between Aniocha (1372.34±446.74mgAAE/100g), Idemili (1196.64±253.77mgAAE/100g) and Ihiala (1406.92 ± 43.61mgAAE/100g). But between Ihiala (0.11±0.05mgAAE/100g) and Orumba North (0.10±0.10mgAAE/100g) there was no significant difference (P>0.05). The B-carotene content in the samples showed that Orumba North had the highest value of (57.9± 0.49ug/100g) and Aniocha had the lowest value of (1.81± 0.08ug/100g). There was no significant difference (P>0.05) between Awka (2.03±0.10ug/100g), Aniocha (1.81±0.08ug/100g) and Idemili North (2.64±1.03ug/100g). But there was significant difference, (P<0.05), between Ihiala (4.21± 0.60ug/100g) and Orumba North (57.79±0.49ug/100g). The lycopene content in the various samples showed that Orumba North had the highest value of (62.41±0.16ug/100g) and Aniocha had the lowest value of (0.00±0.00ug/100g). There was significant difference (P<0.05) in all the samples. .

Table 1: Results of the Bio-active compounds found in five different breadfruit cultivars in Anambra state.

Samples	Flavonoid (mgCE/100g)	Phenol (mgGAE/g)	Vitamin C (mgAAE/100 g)	B- Carotene. (µg/100g)	Lycopene (µg/100g)
Awka	811.64 ± 2.61^{ab}	1246.17± 1982^{a}	0.43 ± 0.43^{a}	2.03^{c} ± 0.10^{c}	1.05 ±0.04^{d}
Aniocha	670.73± 126.05^{c}	1372.34 ± 446.74^{a}	0.07 ± 0.08 ^{c}	1.81^{c} ± 0.08^{c}	0.00 ± 0.00^{e}
Idemili North	950.44 ± 21.25^{a}	1196.64± 253.77^{a}	0.26 ± 0.20^{ab}	2.64^{c} ± 1.03^{c}	2.62 ± 0.14^{b}
Ihiala	945 ± 149.62^{a}	1406.92 ± 43.61^{a}	0.11 ± 0.05^{b}	4.21 ± 0.60^{b}	1.63 ± 0.06^{c}
Orumba North	931.60 ± 42.02^{a}	1305.42 ± 194.20^{a}	0.10± 0.10^{b}	57.79^{a} ± 0.49^{a}	62.41± 0.16^{a}

Values are ± standard deviation of duplicate

Any value in each column not followed by the same superscript has significant difference (p<0.005) but otherwise have no significant difference (p>0.005) or has slight significant difference

CE: Catechin equivalent

GAE: Gallic Acid equivalent

AAE: Ascorbic acid equivalent.

DISCUSSION

The work on the assessment of bioactive compounds in five different cultivars of *Treculia africana* grown in Anambra State has yielded significant findings that enhance our understanding of the nutritional and medicinal potential of these cultivars. The study aimed to evaluate and compare the levels of bioactive compounds present in

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these cultivars, ultimately aiding in the identification of those with higher nutritional value to support breeding and selection programs. The evaluation revealed that all five breadfruit cultivars possess notable bioactive compounds, including flavonoids, phenolic compounds, vitamin C, B-carotene, and lycopene. Each of these compounds plays a crucial role in human health. The Idemili North cultivar had the highest flavonoid content. Flavonoids are known for their antioxidant properties, which help combat oxidative stress and reduce the risk of chronic diseases, such as cardiovascular diseases and certain cancers. According to [21], flavonoids are plant-derived polyphenolic compound with potential health benefits. This cultivar having had the highest flavonoid content, could be prioritized for its antioxidant properties. The Ihiala cultivar stood out with the highest phenolic content. Phenols have antioxidant properties and are involved in providing the body with protection against oxidative stress or injury arising from a free radical [22]. Phenols prevent the deteriorative oxidation of fatty acid in human body [23]. Phenolic compounds are associated with anti-inflammatory and antioxidant effects, further supporting their potential in preventing chronic illnesses. According to [24], caffeic acid is a common phenolic acid found in breadfruit; it has potent antioxidant activity and may contribute to fruit's health benefit. The highest phenolic content suggests its use in promoting health through inflammatory effects. The Awka cultivar exhibited the highest levels of vitamin C, which is vital for collagen synthesis, immune function, and enhancing iron absorption. This finding highlights the cultivar's potential as a dietary source of this essential vitamin. According to [24], vitamin C enhanced the immune system, helping the body fight off infections and illness. High vitamin C levels indicate it's potential as a health supplement and a valuable addition to diets, especially in regions where fruits rich in vitamin C are scarce. The Orumba North cultivar demonstrated high levels of B-carotene, a precursor to vitamin A. This compound is essential for maintaining healthy vision, skin, and immune function. The significant levels of B-carotene and lycopene suggest this cultivar could be particularly beneficial for eye health and as a dietary source of antioxidants, making it an excellent choice for nutrition-focused initiatives. Lycopene was also found in significant amounts in Orumba North, lycopene is a powerful antioxidant known for its potential role in reducing the risk of prostate cancer and other diseases. The identification of cultivars with higher nutritional and medicinal values is a crucial outcome of this study. By pinpointing the cultivars that excel in specific bioactive compounds, the research supports targeted breeding and selection programs aimed at enhancing nutritional quality, promoting medicinal use and sustainable agriculture. By focusing on the cultivation of these nutritionally superior varieties, farmers can potentially improve crop yields and marketability while contributing to better public health outcomes.

CONCLUSION

In conclusion, the assessment of bioactive compounds in breadfruit cultivars from Anambra State highlights the importance of these crops in promoting health and nutrition. The bioactive compounds analyzed included flavonoid, phenol, vitamin C, beta-carotene and lycopene. The result showed that, flavonoid was highest in the Idemili cultivar and Phenol in the Ihiala cultivar, vitamin C, in the Awka cultivar while b-carotene and lycopene were highest in the Orumba-North cultivar. By focusing on cultivars with high bioactive content, stakeholders can make informed decisions that enhance agricultural practices, nutritional quality, and public health.

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