Journal of
Sustainable Agriculture, Food Ecology, and Natural Resource Systems

Volume 1
Issue 1
March, 2026

Open Access

RESEACH ARTICLE

Nutritional composition of *A. heterophyllus*, *A. altilis* and *A. camansi*

Ebele Josephine Ikwuanusi
Department of Biology Education, Nwafor Orizu College of Education, Nsugbe, Anambra State, Nigeria.

ARTICLE INFO

Article History:
Received: May 05, 2026;
Revised: May 21, 2026;
Accepted: June 14, 2026.

Keywords:
Artocarpus heterophyllus;
Artocarpus altilis;
Artocarpus camansi;
Proximate composition;
Nutritional analysis

ABSTRACT

This study investigated the nutritional composition of the leaves and stems of *Artocarpus heterophyllus*, *Artocarpus altilis*, and *Artocarpus camansi* with a view to assessing their nutritional potential. Fresh plant materials were collected from Aguluezechukwu, Aguata Local Government Area, Anambra State, Nigeria, and authenticated by a plant taxonomist. Proximate analyses were conducted using standard AOAC procedures to determine moisture, protein, fat, ash, crude fibre, carbohydrate, and dry matter contents. Data obtained were subjected to Analysis of Variance (ANOVA) at a 5% level of significance. The results showed that the leaves of the three species generally contained higher levels of fat, ash, carbohydrate, protein, and dry matter than their respective stems. In *A. heterophyllus*, the leaf recorded higher fat (2.39%), ash (12.77%), carbohydrate (18.40%), protein (4.56%), and dry matter (42.66%), while the stem had higher moisture (58.55%) and fibre (25.12%). Similar trends were observed in *A. altilis*, where the leaf contained higher fat (2.25%), ash (13.55%), carbohydrate (22.99%), protein (4.15%), and dry matter (44.74%), whereas the stem exhibited higher moisture (58.62%) and fibre (26.65%). In *A. camansi*, the leaf showed higher moisture (62.26%), fat (2.46%), ash (13.30%), carbohydrate (21.45%), and protein (4.72%), while the stem had higher fibre (25.05%) and dry matter (40.47%). The study concluded that the leaves of the three *Artocarpus* species possess superior nutritional qualities compared with the stems and may serve as valuable sources of nutrients for food, feed, and nutraceutical applications.

1. Introduction

Nutritional composition of related plant species has attracted increasing attention because many tropical fruits and nuts possess significant potential for improving food security, human nutrition, and sustainable diets. Species within the genus *Artocarpus* are particularly valued for their rich supply of carbohydrates, proteins, dietary fibre, vitamins, minerals, and bioactive compounds that contribute to health promotion and disease prevention. Among the most important members of this genus are *Artocarpus heterophyllus* (jackfruit), *Artocarpus altilis* (breadfruit), and *Artocarpus camansi* (breadnut), all of which provide valuable nutrients that support human dietary needs.

Artocarpus heterophyllus is widely recognized as a nutrient-dense fruit with considerable economic and nutritional value. The edible pulp contains high levels of carbohydrates, making it an important source of dietary energy. Jackfruit also supplies appreciable amounts of dietary fibre, vitamins, and essential minerals. Potassium, calcium, magnesium, and vitamin C are particularly abundant in the fruit, contributing to proper metabolic and physiological functions. Research has shown that the seeds possess substantial quantities of

Corresponding author's E-mail address: obijekwuebelejg@gmail.com

protein and starch, making them useful as alternative plant-based protein sources (Ajayi, 2008; Ajayi & Adewale, 2013). The fruit additionally contains carotenoids, phenolic compounds, and antioxidants that contribute to its health-promoting properties and nutritional significance (Prakash et al., 2009; Umesh *et al*., 2010). Nutritional evaluations have further indicated that nutrient concentrations vary with maturity stage, with ripe fruits generally containing higher sugar levels while immature fruits are richer in starch (Tiwari & Vidyarthi, 2015).

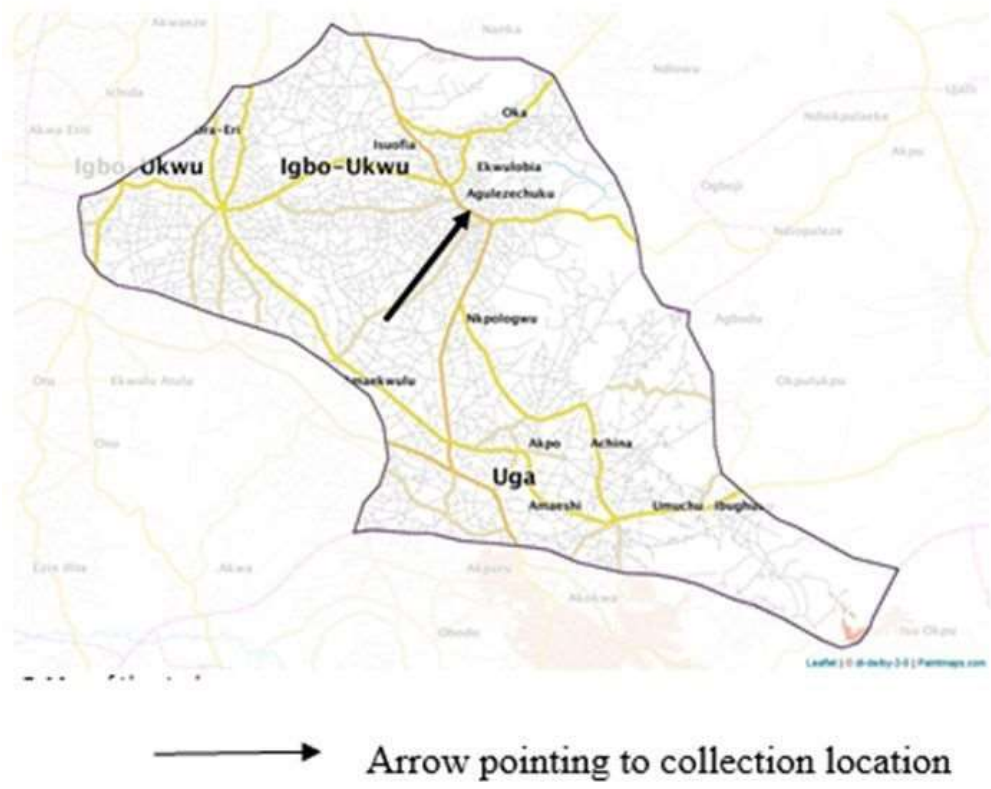
Artocarpus altilis, commonly known as breadfruit, is regarded as one of the most important staple foods in many tropical regions. The fruit is characterized by a high starch content and serves as an excellent source of carbohydrates. Breadfruit is naturally low in fat while providing moderate levels of protein and substantial amounts of dietary fibre. Fibre consumption is associated with improved digestive health and reduced risk of several chronic diseases, thereby increasing the nutritional importance of breadfruit (Alahmari, 2024). Essential minerals such as potassium, phosphorus, calcium, and magnesium are present in significant quantities. Breadfruit also contains vitamin C and several phytochemicals with antioxidant potential. Reviews of the species have highlighted its nutritional superiority among tropical fruits due to its balanced nutrient composition and suitability as a staple food crop (Ragone, 2011; Sikarwar *et al*., 2014). Phytochemical investigations have revealed the presence of flavonoids and other bioactive compounds that may contribute to antimicrobial and therapeutic activities (Mohanty & Pradhan, 2014; Sivagnanasundaram & Karunanayake, 2015).

Artocarpus camansi (breadnut) differs nutritionally from breadfruit because its seeds constitute the primary edible component. Breadnut seeds are exceptionally rich in protein, making them one of the most valuable plant-based protein resources among tropical food crops. Studies have reported considerable amounts of carbohydrates, lipids, crude fibre, and ash in the seeds, indicating their potential for addressing nutritional deficiencies (Adeleke & Abiodun, 2010). The seeds also contain important fatty acids and minerals, including potassium, phosphorus, calcium, and magnesium. Processing methods such as boiling, roasting, germination, and fermentation have been shown to influence nutrient composition and improve nutrient availability in breadnut products (Adaku *et al*., 2019). Rabeta and Nor Syafiqah (2016) further reported that breadnut fruits possess significant levels of phenolic compounds and antioxidant activity, enhancing their nutritional and functional value.

A comparative assessment of these three species reveals notable nutritional differences. *A. heterophyllus* is distinguished by its abundance of carbohydrates, vitamins, minerals, and antioxidant compounds. *A. altilis* serves primarily as a starch-rich staple food with substantial dietary fibre and moderate protein content. *A. camansi* possesses the highest protein concentration among the three species because of its nutrient-rich seeds. All three species provide valuable minerals and bioactive compounds that contribute to human health. Their combined nutritional attributes highlight their importance as underutilized tropical food resources capable of supporting food security, dietary diversification, and sustainable nutrition in developing countries. The increasing global demand for nutritious, sustainable, and underutilized food resources has intensified research interest in tropical food crops with potential to enhance food security and dietary quality. *Artocarpus heterophyllus* (jackfruit), *Artocarpus altilis* (breadfruit), and *Artocarpus camansi* (breadnut) are valuable tropical species recognized for their rich nutrient profiles and adaptability to diverse ecological conditions. Despite their nutritional and economic importance, existing studies have largely focused on individual species rather than providing a comprehensive comparative assessment of their nutritional compositions (Ranasinghe *et al*., 2019; Jones *et al*., 2011). This limitation creates a knowledge gap regarding the relative nutritional advantages of these closely related species.

Furthermore, available studies have concentrated predominantly on proximate composition, with limited attention given to comparative evaluations of minerals, dietary fibre, and bioactive compounds across the three species (Rabeta & Nor Syafiqah, 2016; Sikarwar *et al*., 2014). Differences in geographical origin, maturity stage, and processing methods have also resulted in inconsistent findings regarding nutrient composition, making it difficult to establish reliable nutritional benchmarks (Ajayi, 2008; Adeleke & Abiodun, 2010). In addition, the underutilization of breadnut and breadfruit in many developing countries may partly stem from inadequate scientific information on their nutritional potentials relative to more widely consumed crops. Therefore, this study is justified because it provides a comparative evaluation of the nutritional composition of *A. heterophyllus*, *A. altilis*, and *A. camansi*, thereby addressing existing knowledge gaps and generating evidence that can support food diversification, nutritional planning, value addition, and sustainable utilization of these important tropical food resources.

2. Method



Source: (Anon, 2026)

Fig 1: Map of the study area

2.1 Source of Materials.

The test samples, (the leaves and stem of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*) were obtained from Aguluezechukwu, in Aguata Local Government Area of Anambra State, Nigeria. The town is known for agriculture and a strong community-driven development approach. It was founded by an individual from Uga who hunted an elephant in the forest ("Agụ"). The town, led by traditional ruler Igwe F.E. Ebelendu, faces erosion issues but is actively growing, developing infrastructure like roads, schools, and the Nkwo market. Chemicals and facilities used in the practical were obtained from the laboratory of Food and Nutrition Department and Plant Science and Biotechnology Laboratory, University of Nigeria Nsukka, Nigeria.

2.2 Identification of Materials

All plant materials for this study were identified by Prof. C. A. Ezeabara, a Plant Taxonomist in Botany Department, Nnamdi Azikiwe University, Awka and given herbarium numbers as NAUH - 264^{A} for *Artocarpus heterophyllus*, NAUH – 077^{B} for *Artocarpus altilis and* NAUH - 265^{A} for *Artocarpus camansi*,

2.3 Nutritional Analysis (Proximate Composition)

This was carried out using the methods described by AOAC (2016), and Anakhu *et al.* (2023)

2.3.1 Determination of Moisture Content

Moisture content was determined on wet basis by heating to a constant weight in an oven. The weight of an empty crucible was measured (Wo), then 1g of the chopped leaves samples was placed on the crucible and the weight was taken (W1). The sample was then oven dried at 105^{o}C to the constant weight and cooled in a desiccator, and the weight was taken (W_2). The percentage of moisture content was calculated as described by Anakhu *et al.* (2023):

$$\% \text{ Moisture} = \frac{W1-W2}{W1-W0} \times 100 \quad \text{(Eqn 1)}$$

Wo - Weight of empty moisture container
W1 - Weight of moisture container with sample
W2 - Weight of moisture container and oven dried sample to the constant weight.

2.3.2 Determination of Protein.

This was done by the Kjeldahl method as described by AOAC (2016). The total N_2 was determined and multiplied with factor 6.25 to obtain the protein content. Half gramme (0.5g) of the sample was mixed with 10mls of conc. H_2SO_4 in a digestion flask. A tablet of selenium catalyst was added to it before it was heated under a fume cupboard until a clear solution was obtained (i.e the digest). The digest was diluted to 100mls in a volumetric flask and used for the analysis. 10mls of the digest was with equal volume of 45% NaOH solution in a kjeldahl distillation apparatus. The mixture was distilled into 10mls of 4% buric acid containing 3 drops of mixed indicator (bromocressol green/ methyl red). A total of 50mls of distillates were collected and titrated against 0.02n EDTA from green to a deep red end point.

2.3.3 Ash Content Determination

The ash content was determined as described by AOAC (2016). Ash content was determined by heating 1g of the powdered sample in a muffle furnance set at 550^{o}C. The sample was left to cool in a desiccator, and the weight was measured. The percentage of ash content was calculated as follows:

$$\% \text{ Ash} = \frac{W2-Wo}{W1-W0} \times 100 \quad \text{(Eqs 2)}$$

Wo - Weight of empty container
W1 - Weight of container with sample
W2 - Weight of container with sample turned ash.

2.3.4 Determination of Crude Fibre

This was determined through the method described by Anakhu *et al.* (2023). Two grams of the plant sample was mixed with 0.25 N sulfuric acid (100 ml) in a flask. The mixture was heated under reflux for 1 h on a water bath and the filtered residue was then transferred into a fibre flask after which 0.313 N sodium hydroxide solution (100 ml) was introduced and heated under reflux for 1 h again. A fibre sieve cloth was then used to filter the mixture followed by the addition of 10 ml of acetone, and the residue was washed with hot water (50

ml) and then transferred into a crucible, which was followed by oven drying at 105^{o}C and cooling in a desiccator. Thereafter, it was weighed and ashed in a muffle furnace at 550^{o}C for 4h, after which it was cooled in a desiccator and weighed. Besides, the percentage of crude fibre was calculated using the following formula:

$$\% \text{ Crude fibre} = \frac{W1-W2}{Weight\ of\ sample} \times 100 \quad \text{(Eqs 3)}$$

W1- Weight of sample residue after oven drying

W2- Weight of sample residue after ashing

2.3.5 Determination of Fat

The crude fat was determined by soxhlet extraction with petroleum ether. One gram of the powdered sample was transferred into the extraction thimble and then plugged with a cotton wool lightly. Then, thimble was placed in the extractor fitted with a reflux condenser and a 250 ml soxhlet flask. The soxhlet flask was previously dried in an oven, cooled, and measured in weight (W0). After that, the flask was filled to three quarters of its volume with petroleum ether and the sample refluxed until the completion of the fat extraction, after which the extracted fat containing flask was removed and dried to a constant weight (W1) at 105 oC. The percentage of fat content was calculated as follows:

$$\% \text{ Fat} = \frac{W1-Wo}{Weight\ of\ sample} \times 100 \quad \text{(Eqs 4)}$$

2.3.6 Determination of Carbohydrate

Carbohydrate was determined by difference where subtraction of the percentage values for moisture, crude protein, fat, crude fibre and ash from 100 gave the carbohydrate content.

Carbohydrate (g/100g) = {100 - (%M + % CP + % Fat + % CF + % Ash)} [Eqs 5]

2.3.7 Determination of Minerals

The calcium, phosphorus, potassium, magnesium and sodium compositions were determined through the methods described by Uddin *et al.* (2016). 1g of the powdered samples was digested on wet basis using 9ml of freshly prepared aqua regia (65 % nitric acid and 37% HCl in 1:3 ratio). The mixture was gently boiled in a water bath at 95^{o}C for 5 h until the samples were dissolved completely. Filtered and deionized water was used to make up to the standard volume. The respective minerals were analyzed using Atomic Absorption Spectrophotometer (Buck Scientific 210VGP) as described by Uddin *et al.* 2016

2.4 Data Analysis

Data collected was analysed using Analysis of Variance (ANOVA) and test of significance was processed using Duncan's Multiple Range Test (Duncan, 1955) and Student's 't' test at 5% level of probability.

3. Result

3.1 Nutritional (Proximate) Investigation of the Parts of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

3.1.1 Quantitative Proximate Composition of the Leaf and stem of *A. heterophyllus*

Result of the proximate compositions of the leaf and stem of *A. heterophyllus* revealed that leaf extract gave higher percentage composition of fat (2.39±0.53%), ash (12.77±0.30%), carbohydrate (18.40±0.77%), protein (4.56±0.40%) and dry matter (42.66±0.99%) while the stem extract gave the higher percentage composition of moisture (58.55±1.48%) and fibre (25.12±0.52%) as presented in Table 1.

3.1.2 Quantitative Proximate Composition of the Leaf and stem of *A. altilis*

Result of the proximate compositions of the leaf and stem of *A. altilis* revealed that leaf extract gave higher composition of fat (2.25±0.21%), ash (13.55±0.33%), carbohydrate (22.99±1.40%), protein (4.15±0.12%) and dry matter (44.74±1.63%) while the stem extract gave higher composition of moisture content (58.62±0.92%). fibre (26.65±1.15%) as presented in Table 2.

3.1.3 Quantitative Proximate Composition of the Leaf and stem of *A. camansi*

Result of the proximate compositions of the leaf and stem of *A. camansi* revealed that leaf extract gave higher composition of moisture content (62.26±7.56%). fat (2.46±0.51%), ash (13.30±0.51%), carbohydrate (21.45±0.49%) and protein (4.72±0.62%) while the stem extract gave higher composition of fibre (25.05±1.44%) and dry matter (40.47±0.64%) as presented in Table 3.

Table 1: *Proximate Composition of the Leaf and stem of A. heterophyllus*

Plant parts	Moisture (%)	Fat (%)	Ash (%)	Fibre (%)	Carbohydrate (%)	Protein (%)	Dry matter (%)
Leaf	57.34±0.99	2.39±0.53	12.77±0.30	4.77±0.50	18.40±0.77	4.56±0.40	42.66±0.99
Stem	58.55±1.48	0.74±0.06	9.18±0.47	25.12±0.52	3.71±0.24	3.28±0.18	41.45±1.48

Results are in Mean ± Standard Deviation

Table 2: *Proximate Composition of the Leaf and stem of A. altilis*

Plant parts	Moisture (%)	Fat (%)	Ash (%)	Fibre (%)	Carbohydrate (%)	Protein (%)	Dry matter (%)
Leaf	55.26±1.64	2.25±0.21	13.55±0.33	5.59±0.31	22.99±1.40	4.15±0.12	44.74±1.63
Stem	58.62±0.92	0.79±0.23	9.97±0.45	26.65±1.15	4.13±0.30	3.98±0.70	41.38±0.92

Results are in Mean ± Standard Deviation

Table 3: *Proximate Composition of the Leaf and stem of A. camansi*

Plant parts	Moisture (%)	Fat (%)	Ash (%)	Fibre (%)	Carbohydrate (%)	Protein (%)	Dry matter (%)
Leaf	62.26±7.56	2.46±0.51	13.30±0.51	5.50±0.33	21.45±0.49	4.72±0.62	37.74±7.58
Stem	59.53±0.64	0.79±0.25	9.78±0.67	25.05±1.44	3.92±0.26	4.24±0.14	40.47±0.64

Results are in Mean ± Standard Deviation

Discussion

The result of the proximate composition of *A. heterophyllus* revealed that the leaf contained higher fat, ash, carbohydrate, protein, and dry matter contents than the stem, whereas the stem had higher moisture and fibre contents. The relatively higher carbohydrate (18.40%) and protein (4.56%) contents of the leaf suggest its nutritional importance. This finding agreed with Prakash *et al*. (2009), who reported that *A. heterophyllus* contains appreciable nutrients capable of supporting dietary requirements. The higher protein content observed in the leaf is also consistent with the report of Ajayi and Adewale (2013), who noted the nutritional richness of jackfruit tissues. In contrast, the high fibre content of the stem (25.12%) differs from the findings of Tiwari and Vidyarthi (2015), who reported greater

nutrient accumulation in edible fruit portions than in structural plant tissues. The elevated moisture content in the stem may support the physiological transport functions of plant stems, a trend similarly observed in the stem extracts investigated by Sivagnanasundaram and Karunanayake (2015).

For *A. altilis*, the leaf exhibited higher fat, ash, carbohydrate, protein, and dry matter contents, while the stem recorded higher moisture and fibre contents. The high carbohydrate content of the leaf (22.99%) supports the assertion of Ragone (2011) that breadfruit is a carbohydrate-rich species with significant nutritional value. This finding also agreed with Sikarwar *et al.* (2014), who identified breadfruit as an important source of nutrients and phytochemicals. The higher ash content observed in the leaf indicates a greater concentration of minerals, which is consistent with the observations of Mohanty and Pradhan (2014) on the nutrient richness of breadfruit leaves. In contrast, the considerably higher fibre content in the stem (26.65%) suggests that structural tissues contribute more to fibre accumulation than leaves.

The result for *A. camansi* showed that the leaf possessed higher moisture, fat, ash, carbohydrate, and protein contents, whereas the stem contained higher fibre and dry matter contents. The higher protein content in the leaf (4.72%) agreed with the findings of Adeleke and Abiodun (2010), who reported that *A. camansi* is nutritionally rich, particularly in protein-containing tissues. Similarly, the elevated carbohydrate content of the leaf corroborates the report of Rabeta and Nor Syafiqah (2016), who documented substantial carbohydrate levels in breadnut. In a related study, Adaku et al. (2019) observed that breadnut products possess considerable nutritional quality, especially regarding fibre and lipid components. The high fibre levels recorded in the stem further support the nutritional significance of plant fibre as emphasized by Alahmari (2024), who highlighted the health benefits of fibre in reducing risks of chronic diseases. The findings indicate that the leaves of the three *Artocarpus* species are richer in protein, fat, ash, and carbohydrates, whereas the stems generally contain higher fibre and moisture contents. This pattern agrees with previous reports that leaves often serve as sites of nutrient synthesis and storage, while stems provide structural support and fibre accumulation (Mohanty & Pradhan, 2014; Sivagnanasundaram & Karunanayake, 2015).

Conclusion

This study evaluated the nutritional composition of the leaves and stems of *Artocarpus heterophyllus*, *Artocarpus altilis*, and *Artocarpus camansi* and demonstrated that all three species possess valuable nutritional attributes. The findings revealed that the leaves generally contained higher levels of fat, ash, carbohydrate, protein, and dry matter, whereas the stems were characterized by higher moisture and crude fibre contents. Among the species investigated, the leaves consistently exhibited superior nutrient concentrations, indicating their greater potential as sources of essential nutrients. The appreciable levels of protein, carbohydrates, minerals (indicated by ash content), and dietary fibre observed in the plant materials suggest that these species can contribute significantly to human and animal nutrition. The high fibre content recorded in the stems further highlights their potential usefulness in promoting digestive health and in the formulation of fibre-enriched products. The study also confirms the nutritional importance of underutilized *Artocarpus* species and provides scientific evidence supporting their wider utilization. *A. heterophyllus, A. altilis,* and *A. camansi* represent promising plant resources with considerable nutritional value. Increased cultivation, utilization, and further investigation of these species could enhance food security, support dietary diversification, and promote the development of functional foods and nutraceutical products. Future studies should focus on detailed mineral, vitamin, phytochemical, and bioavailability assessments to fully exploit their nutritional and economic potentials.

References

Adaku, J., Amadi, C., Ndukwu, S. O., & Nwachukwu, N. C. (2019). Dietary fibre and fatty acid evaluation of boiled, roasted, germinated and fermented breadnut seed flours. *Journal of Food Science and Engineering, 9*, 182–190.

Adeleke, R. O., & Abiodun, O. A. (2010). Nutritional composition of breadnut seeds (*Artocarpus camansi*). *African Journal of Agricultural Research, 5*(11), 1273–1276.

Ajayi, I. A. (2008). Comparative study of the chemical composition and mineral element content of *Artocarpus heterophyllus* and *Treculia africana* seeds and seed oils. *Bioresource Technology, 99*(11), 5125–5129.

Ajayi, I. B., & Adewale, R. A. (2013). Amino acid composition and short-term toxicological evaluation of *Artocarpus heterophyllus* seed cake in rat diet. *New York Science Journal, 6*(7), 91–96.

Alahmari, L. A. (2024). Dietary fiber influence on overall health, with an emphasis on CVD, diabetes, obesity, colon cancer, and inflammation. *Frontiers in Nutrition, 11*, 1510564.

Anakhu, A. E., Victor, I. A., Oregbeme, H., Anetokhe, A. M. and Etsugaba O. E. (2023), Production and determination of the drying parameters of *solanum esculentum* powder. *Nigerian Research Journal of Chemical Sciences, 11*, (1)

Anon (2026), Map of Aguluezechukwu. Tools.paintmaps.com

AOAC (2016), Official Methods of Analysis of AOAC International; AOAC International: Gaithersburg, MD, USA. Ed: Latimer G. W. Breadfruit, Breadnut, and Jackfruit: himalayan by Fred Prescod https://himalayanblossoms.com/PDF%20Files/Breadnuts/Breadfruit%20BreadnutJackfruit.pdf

Duncan, D.B. (1955), Multiple Range and Multiple F test. Biometrics. 11:1-42

Mohanty, M., & Pradhan, C. (2014). Phytoconstituent analysis and comparative bioefficacy assessment of breadfruit fruit and leaf extracts for antipathogenic potentiality. *American Journal of Phytomedicine and Clinical Therapeutics, 2*(1), 77–87.

Prakash, O. M., Rajesh, K., Anurag, M., & Rajiv, G. (2009). *Artocarpus heterophyllus* (Jackfruit): An overview. *Indian Journal of Pharmacognosy, 3*(6), 353–358.

Rabeta, M. S., & Nor Syafiqah, M. J. (2016). Proximate composition, mineral and total phenolic contents, and scavenging activity of breadnut fruit (*Artocarpus camansi*). *Journal of Tropical Agriculture and Food Science, 44*(1), 1–7.

Ragone, D. (2011). Farm and forestry production and marketing profile for breadfruit (*Artocarpus altilis*). In C. R. Elevitch (Ed.), *Specialty Crops for Pacific Island Agroforestry*.

Sikarwar, M. S., Hui, B. J., Subramaniam, K., Valeisamy, B. D., Yean, L. K., & Balaji, K. (2014). A review on *Artocarpus altilis* (Parkinson) Fosberg (Breadfruit). *Journal of Applied Pharmaceutical Science, 4*(8), 091–097.

Sivagnanasundaram, P., & Karunanayake, K. O. L. C. (2015). Phytochemical screening and antimicrobial activity of *Artocarpus heterophyllus* and *Artocarpus altilis* leaf and stem bark extracts. *Open University of Sri Lanka Journal, 9*, 1–17.

Tiwari, K., & Vidyarthi, A. S. (2015). Nutritional evaluation of various edible fruit parts of jackfruit (*Artocarpus heterophyllus*) at different maturity stages. *International Journal of Chemical Pharmacy Review and Research, 1*, 21–26.

Uddin, M. T., Rukanuzzaman, M., Khan, M. M. R. and Islam, M. A. (2016), Jackfruit (*Artocarpus heterophyllus*) Leaf Powder: An Effective Adsorbent for Removal of Methylene Blue from Aqueous Solutions. *Indian Journal of Chemical Technology 16*(2):142-149.

Umesh, B. J., Shrimant, N. P., & Bapat, V. A. (2010). Evolution of antioxidant capacity and phenol content in jackfruit (*Artocarpus heterophyllus* Lam.) fruit pulp. *Plant Foods for Human Nutrition, 65*(2), 99–104.