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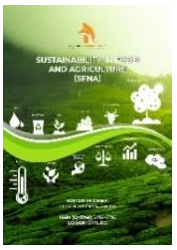

RESEARCH ARTICLE

PROXIMATE COMPOSITION AND PHYTOCHEMICAL PROPERTIES OF PEPPER FRUIT (*DENNETTIA TRIPETALA)*

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ABSTRACT

The objective of this study is to identify the proximate composition and the phytochemical constituents of Pepper fruit (*Dennettia tripetala)* fruit powder (DTFP). The fresh fruits of *D. tripetala* were harvested at a farm location in Akure. The fruits were washed with fresh water, drained, and allowed to dry under the sun, milled to DTFP, and analyzed for the proximate and phytochemical compositions. The carbohydrate (47.22%) is relatively high in proportion in DTFP, while the ash (4.4%) has the lowest proportion. DTFP has a relatively high concentration of alkaloids, saponins, and phenol (43.6mg/g, 42.48mg/g, and 42.5mg/g, respectively). The concentration of tannin, terpenoid, steroid, and flavonoids were 38.77mg/g, 36.55mg/g, 32,88mg/g, and 38.31mg/g, respectively, while phlobatannin, cardiac glycosides, and reducing sugar concentration were 28.19mg/g, 28.14mg/g, and 25.47mg/g, respectively. The proximate composition of DTFP and its significant levels of phytochemicals present it as a substance that could be employed as a natural feed/food supplement in animal and human nutrition.

KEYWORDS

Natural, Feed, Food, Proximate, Phytochemicals, Supplements

1. INTRODUCTION

Health-conscious consumers have been increasing their demand for organic food. As a result, research on plant-based growth promoters that are abundant in nutrients and phytochemicals has begun. Due to residues of inorganic compounds and the associated health risks, consumers are making a conscious effort to reduce their use of inorganically generated substances (Bhanu et al., 2020). Numerous phytochemicals, including terpenoids, alkaloids, carotenoids, terpenes, polyphenols, and sulfur-containing groups, which are rich in nutrients and antioxidants, can be found in plants (Bhanu et al., 2020). Numerous studies have been conducted utilizing a variety of plants and their parts to increase animal output, strengthen their immune systems, and improve the quality of animal products. These studies include those on Ficus species, Acalypha wilkesiana, *Ocimum gratissimum* leaf powder, and *Irvingia gabonensis* kernel powder; pawpaw, mustard, and black cumin seed meal; soursop juice; and moringa leaf meal and garlic rhizome meal (Gbore et al., 2021; Osowe et al., 2021; Adeola et al., 2025; Oloruntola et al., 2021; Adegbeye et al., 2020; Jimoh et al., 2018). Supplementing poultry rations with these plant-based phytogenic substances has improved animal performance, improved carcass characteristics and health status, reduced the negative effects of oxidative stress, and improved animal products (Oloruntola et al., 2021; Gbore et al., 2021; and Adu et al., 2020). One of the most useful plants with many amazing benefits is the pepper fruit. *Dennettia tripetala,* the formal name for pepper fruit, is a member of the Annonaceae family (Graf, 2005). On both young and old woods, the bloom is typically found in small clusters and has a light brown outside with a scarlet interior. When ripe, the fruit is red; when unripe, it is green. The carpel constriction in the middle of the seed resembles a finger. When ripe, the fruit and young leaves are chewed with a spicy, peppery flavor (Khadijah, 2015). According to the study, pepper fruits can be used as food and as herbs to make herbal remedies (Okwu and Morah, 2004). It has been established that the fruit works well for ethnomedical reasons (Egharevba and Idah, 2015). Alkaloids, tannins, saponins, flavonoids, terpenoids, steroids, and cardiac glycosides were found in pepper fruit seeds, according to the study (Eghareuba and Idah, 2015). The medicinal potential of pepper fruit is based on these bioactive components (Khadijah, 2015). Ascorbic acid, thiamine, riboflavin, and niacin are among the water-soluble vitamins that pepper fruits are known to have, according to (Okwu and Morah, 2005). This supported its use in the management of prostate cancer and the treatment of the common cold (Okogun, 2002). Additionally, pepper fruit has a high iron content (17.75%), which is necessary for the hememoiety of hemoglobin (Okwu and Morah, 2005). It is essential to the body's metabolism, particularly in humans, and aids in the delivery of oxygen (Okogun, 2002). Furthermore, it has been observed that pepper fruit has antioxidant, antihyperglycemic, and chemotherapeutic qualities (Iseghohi, 2015).

Despite the pepper fruit's enormous potential, it is still underutilized, and little is known about its importance. Examining the many potential uses and health advantages of pepper fruit is essential, given the growing cost of inorganic medications and supplements and the move toward organic medications and supplements. In order to ascertain their applicability and potential use as nutraceuticals, this study aims to investigate the proximate and phytochemical components of pepper fruit.

2. MATERIALS AND METHODS

2.1. *Dennettia tripetala* Fruit Powder (DTFP) and Reagent

The fresh fruits of *Dennettia tripetala* were harvested from the mother plants at a farm location in Akure, Nigeria. A Crop scientist from the Department of Crop, Soil and Pest Management at The Federal University of Technology, Akure, Nigeria, validated the plant. After being thoroughly

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cleansed with fresh water, the fruits were drained and allowed to dry in the shade for 21 days. Having been ground into *Dennettia tripetala* Fruit powder (DTFP), they were stored at 4°C until analysis. The parameters were examined in three copies. For each parameter, three iterations of analyses were performed on the DTFP samples. All of the chemicals of the analytical reagent grade used for chemical analysis were purchased from Sigma-Aldrich.

2.2 *Dennettia tripetala* Fruit Powder Proximate and Phytochemical Analysis

2.2.1 Proximate analysis

The Association of Official Analytical Chemists' established techniques were used for proximate analysis (AOAC, 1995). It reported the methods for determining alkaloids, saponins, flavonoids, tannins, and phenols (Osowe et al., 2022).

2.2.2 Tannin

The Folin-Ciocal method was used to determine total tannins (Biswas et al., 2020). 1 mL of fruit extract was mixed with 49 mL of purified water, 1.7 mL of 75 percent ethanol, 0.1 mL metaphosphoric acid, 1.0 mol/ml Na_2CO_3 (10 mL), and 2.5 mL Folin-Ciocalteu in a volumetric flask (100 mL). The mixture was thoroughly blended and allowed to rest at room temperature for 15 minutes. In a spectrophotometer set to 680 nm, the absorbance of normal solutions and fruit powder combinations was measured against a blank. The standard curve (R^2 = 0.9972) was utilized as a reference, and tannic acid was used to reflect the overall tannin content of the sample (TA) mgTA/g DW.

2.2.3 Flavonoids

It procedures were used to assess the flavonoid content of fruit samples. In a test tube, 0.50 mL of fruit powder extract was carefully measured (Surana et al., 2016). The test tube was then filled with a 0.1 mL aluminum chloride solution, 1.50 mL methanol, 0.1 mL potassium acetate solution, and 2.8 mL distilled water mixed. Sample blanks for extract and rutin standard dilutions (10-100 g/ml) were generated in the same method, but with distilled water rather than aluminium chloride solution. The solutions were filtered using Whatman filter paper (No. 1) to determine the absorbance. The absorbance ratios were compared to blanks at 510 nm. 1 mg rutin per gram of extract was used to calculate the overall flavonoid content.

2.2.4 Phenols

The fruit sample's total phenolic content was determined using the Folin-Ciocalteau method, which was created by (Otles and Yalcin, 2012). 250 µL of Folin-Ciocalteau reactive was added to 50 µL of nettle extract or standard solution. For five minutes, this combination was left at room temperature in a dark place. 750L of a 7% Na2CO3 solution was added after this period. Using this method, water might receive H from the hydroxyl groups in phenolics. The mixture was diluted to 5 mL using pure water. After that, the mixture was allowed to react for 120 minutes at room temperature in a dark atmosphere. The absorbance of the standards and samples was measured at 760 nm. An 80 percent methanol solution was added to the blank solution in place of the 50L extract. To calculate the total phenolic content, a calibration curve was created using gallic acid equivalent standards.

2.2.5 Total saponins

Saponin was measured using the vanillin and concentrated sulfuric acid colorimetric method, which was published by (He et al., 2014). After mixing the 0.1 ml sample with 0.5 ml of 50% ethanol, 4.0 ml of 77% (w/w) sulfuric acid, and 0.5 ml of freshly prepared vanillin solution, it was allowed to cool to room temperature before being heated for 15 minutes in a water bath to 60°C. Utilizing a UV/V spectrophotometer, the absorbance at 545 nm was measured. A tea saponin calibration curve was used to determine each sample's total saponin content, which was expressed as milligrams of tea saponin equivalent per gram (TSE/g DW).

2.2.6 Alkaloids

The fruit sample's alkaloid content was determined using the gravimetric approach (Adeniyi et al., 2009). Five grams of the sample were dissolved in ten percent ethanol in fifty milliliters of acetic acid solution. The mixture was vibrated and then sieved, leaving it undisturbed for around 240 minutes. On a heated plate, the filtrate was reduced to a fraction of its initial volume. After that, drops of concentrated ammonium hydroxide were used to precipitate the alkaloids. The precipitate was filtered through filter paper and then rinsed with a 1 percent ammonium hydroxide solution. After 30 minutes of oven drying at 60°C, the precipitate was moved to a desiccator and weighed once again until it reached a consistent weight. The alkaloids' weight as a proportion of the total sample weight was determined.

2.2.7 Determination of cardiac glycosides

The Keller-Killiani test procedure was used for the determination of cardiac glycosides. 5ml aqueous extract, 2ml glacial acetic acid, a drop of $FeCl_3$ solution, and 1ml concentrated H_2SO_4 were mixed together to form a brown ring (Ana-Alexandra et al., 2018).

2.2.8 Determination of steroids

0.5 ml of the fruit extract was dissolved in 5 ml of chloroform. An equal volume of sulphuric acid was added to the sides of the test tube and left to stand for a few minutes. If the upper layer turns red and the sulphuric acid layer shows yellow with green fluorescence, it indicates the presence of steroids (Gul et al., 2017).

2.2.9 Fehling's Test for Reducing Sugar

A mixture of 1ml Fehling's solution A and 1ml of Fehling's solution B was added to an empty test tube. To this, 3-4 drops of the fruit extract were added, mixed gently, and place tube was placed in a water bath at 60°C. Changing the blue color to red indicates the presence of reducing sugars.

2.2.10 Determination of Terpenoids

1ml of the fruit extract was placed into the test tube, to which 0.4ml of chloroform and 0.6ml of concentrated sulphuric acid were added gently into the tube at an inclined portion. A reddish-brown coloration was indicative of the presence of terpenoids (Ajiboye et al., 2013).

2.2.11 Determination of Phlobatannins

Deposition of a red precipitate when the sample aqueous extract was boiled with 1% aqueous hydrochloric acid was taken as evidence for the presence of phlobatannins (Ajiboye et al., 2013).

3. Results

The proximate composition of *Dennettia tripetala* fruit powder is shown in Figure 1. The Crude Protein, Crude Fibre, Crude Fat, Ash, Moisture Content, and the Carbohydrate contents are 13.65%, 15.52%, 6.76%, 4.4%, 14.45% and 47.22% respectively.

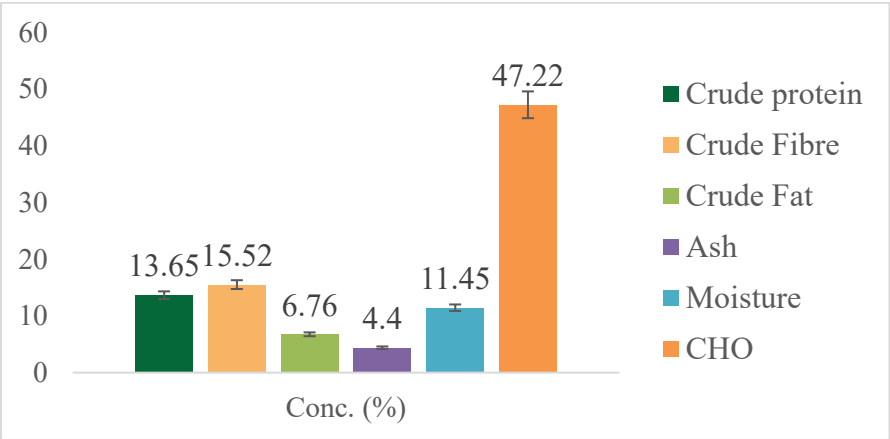

Figure 1: Proximate composition of *Dennettia tripetala* fruit powder

The concentration of the phytochemical constituents of *Dennettia tripetala* fruit powder is presented in Figure 2. The fruit powder contains an appreciable concentration of different phytochemicals. Alkaloids, tannins, phlobatannins, and Saponins contain 43.6mg/g, 38.77mg/g, 28.19mg/g, and 42.48mg/g, respectively. The concentration of Terpenoids, Cardiac glycosides, Steroids, and Reducing Sugar was 36.55mg/g, 28.14mg/g, 32.88mg/g, and 25.47mg/g, respectively. Flavonoids and Phenols were found to be 38.31mg/g and 42.5mg/g, respectively.

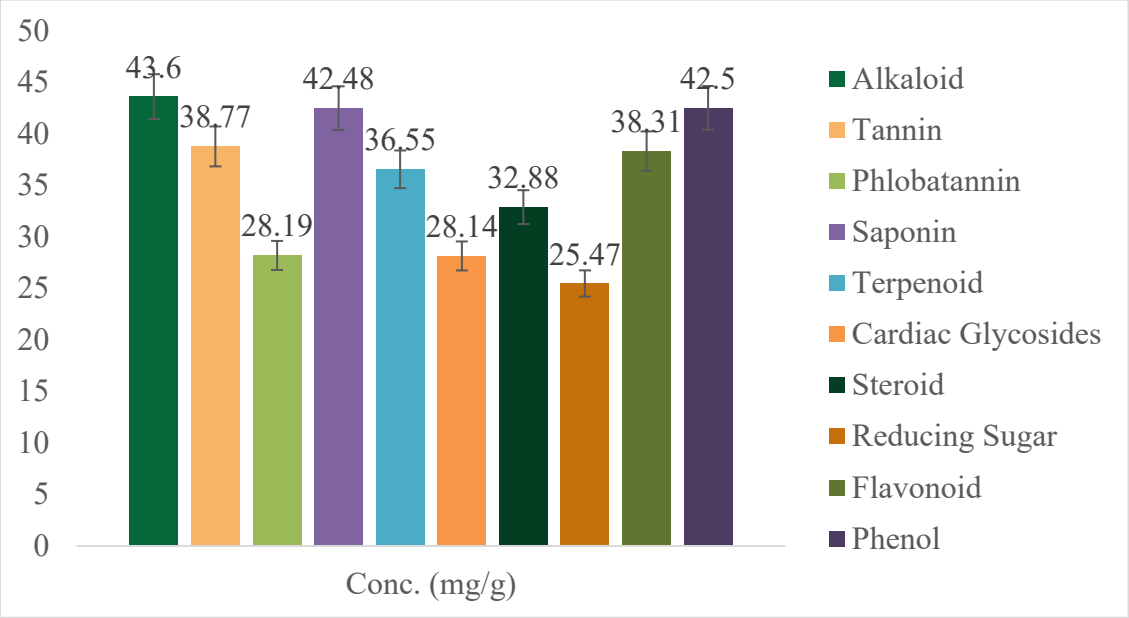

Figure 2: Phytochemical constituents of *Dennettia tripetala*

4. Discussion

The quantitative measurements of food substances, such as moisture, crude protein, total fat, total carbohydrate, and dietary fiber, are estimated using proximate analysis (Gupta et al., 2014). Figure 1 displays the proximate composition of samples of *Dennettia tripetala* fruit powder. The amount of water and volatile materials lost during the drying process is known as the moisture content. (Gupta et al., 2014). Food's moisture content is used to estimate its qualitative state. Owing to the growth of microorganisms like mold and fungi, the moisture level is one of the most important elements in storage. Dennettia tripetala's moisture content, as determined by this study, suggests that it may be preserved for later use, reducing the likelihood that fresh fruits may deteriorate. The fruit powder of D. tripetala has a crude protein concentration of 13.65%, which is lower than the value published for Ficus sycomorus (17.9%) but higher than the value reportedfor *Ficus thonningii* (7.63) (Osagie and Aguebor-Ogie, 2020; Osowe et al., 2021). Tropical vegetable and herb powders and leaf and fruit meals have been widely used as protein sources in animal nutrition, according to a number of studies (Oloruntola et al., 2021). This indicates that *D. tripetala* may be utilized in animal nutrition as a source of dietary protein.

Fatty acids, oil-soluble colors, fat-soluble vitamins, and steroids are all included in total fat, also known as ether extract (Gupta et al., 2014). The fruit powder samples from *D. tripetala* had a total fat content of 6.76%, higher than the 2.11% reported for *Moringa oleifera* (Ogbe and Affiku, 2011). According to the study, like other vegetables, leaves and herbs are often poor suppliers of lipids. Therefore, using these leaf and herb powders won't contribute to body fat formation, which is a risk factor for cardiovascular diseases (Ornish et al., 1990; Bello et al., 2015). Non-fibrous carbs like sugar and starch are estimated by the carbohydrate (CHO) (Rodrigues et al., 2014). The fact that the CHO value in this study was greater than the value for *Acanthopanax trifoliatus* (16.47%) reportedsuggests that their leaf powder may help provide the nutritional energy needed for the body to function normally (Ganogpichayagrai and Suksaard, 2020). The quantity of carbohydrates, one of the primary constituents of plant structural elements, is known as total carbohydrates. According to studies, fiber may slow down the pace at which glucose is absorbed and lower insulin secretion, both of which are crucial for diabetic patients (Ijeomah et al., 2012). Given that D. tripetala's crude fiber content is similar to that of F. carica and F. exasperata as described, it may have significant nutritional significance for both humans and animals (Osowe et al., 2021). This supports the findings of, who found that vegetables with high dietary fiber are beneficial for their functions in controlling intestinal transit, boosting dietary bulk, and improving fecal consistency because of their capacity to absorb water (Bello et al., 2015). A food or feed's ash content serves as a gauge for the mineral concentrations in any particular sample. When utilized as a feed additive or ingredient, D. tripetala's observed degree of ash content suggests that it may supply extra dietary minerals that are required. The ash content found in this investigation, however, is less than the range for *Acalypha wilkesiana* reported by (Adeola et al., 2025). According to the study, minerals found in herbs may be essential for both human and animal nutrition (Gupta et al., 2014). While plants with flavonoids offer immunological benefits like antioxidants and anti-inflammatory actions, plants with tannins have been widely used as astringents, diuretics, and against stomach and duodenal tumors (Saxena et al., 2013; Saxena et al., 2012). According to the study, D. tripetala's tannins and flavonoids support its potential as an antimicrobial, anti-inflammatory, and anti-tumor agent as well as a way to scavenge harmful free radicals and reactive oxygen species (Teiten et al., 2013). As preventive agents against disease processes mediated by free radicals, phenolics' antioxidant properties are essential (Koche et al., 2016). When added to the diets of animals and humans, the fruit powder's stated phenol levels (42.5 mg/g) suggest that it may be a good source of phenols. In addition to being simple dietary supplements, saponins may have antimicrobial qualities. According to the study, they help to improve blood glucose response, lower the risk of cancer, regulate blood lipids, and have antioxidant qualities (Igidi and Edene, 2014). A significant amount of saponins is present in D. tripetala fruit powder, which may indicate that it has antimicrobial properties. In line with the findings, the presence of alkaloids in D. tripetala fruit powder indicates that the fruit possesses a number of pharmacological properties, such as antihypertensive, antiarrhythmic, anti-malaria, and anti-cancer properties (Saxena et al., 2013). According to the study, cardiac glycosides are natural steroid chemicals that are actively employed in the therapeutic treatment of heart disorders, including congestive heart failure (Skubnik et al., 2021). They also have extremely promising anticancer properties and can be used to treat a variety of autoimmune and inflammatory conditions. *D. tripetala's* potential as a true organic supplement for human and animal feed/food is shown by the presence of cardiac glycosides. However, these advantages depend on a number of variables, including the feed's composition, the animal species that eat it, and the degree of dietary inclusion (Liu et al., 2009). Due to new research showing their ability to reduce oxidative stress and other related disorders, natural compounds derived from plants have attracted a lot of attention (Sudan et al., 2014). Secondary metabolites from plants, including terpenoids, flavonoids, and phenolics, are important natural immunomodulators and antioxidants (Estrada et al., 2013).

5. Conclusion

The results of this study reveal that pepper fruit (*Dennettia tripetala*) contains a significant proportion of phytochemicals with considerable biological value in its proximate composition. Consequently, the fruit powder could be employed as a natural feed supplement in animal nutrition. More research is needed to assess the efficacy of DTFP as feed supplements on animal productivity and immune status.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because there was no study on animals or humans.

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