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# Nutritional and Chemical Components of Ethanol Extract of *Hunteria Umbellata* Seeds

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**Abstract**
*Hunteria umbellata*, a tropical rainforest tree commonly found in sub-Saharan Africa, is known for its medicinal properties, particularly in treating diabetes, obesity, and anaemia. This study, a beacon of hope, investigated the nutritional and chemical composition of the ethanol extract of Hunteria umbellata seeds. The research, conducted with unwavering dedication, focused on proximate, phytochemical, vitamin, and mineral analyses of the seed extract, all of which were analysed using standard analytical procedures. The proximate analysis revealed that carbohydrates were the most abundant component (56.73±0.24%), followed by moisture (16.20±0.16%) and crude protein (13.92±0.01%). Fibre content was 8.03±0.41%, with a calorific value of 1277.43±3.18 KJ/100g. Ash and lipid content were the lowest at 2.53±0.06% and 2.59±0.02%, respectively. Qualitative phytochemical analysis identified the presence of alkaloids, flavonoids, reducing sugars, saponins, tannins, phytates and oxalates. Quantitative analysis highlighted high concentrations of flavonoids (383.50±0.24 mg/100g) and tannins (14.02±0.01 mg/100g). GC-MS identified 20 compounds, with phenol 2,4-bis (1,1-dimethyl ethyl) predominant (37.72%). Vitamin analysis indicated substantial amounts of vitamin K (135.00±0.14 IU/100g), vitamin A (21.95±0.01 IU/100g), and vitamin D (8.30±0.14 IU/100g). The B complex vitamins included thiamine-B1, folic acid-B9, biotin-B7, pyridoxine-B6, riboflavin-B2, and cobalamin-B12. Mineral analysis showed significant amounts of zinc (7.08±0.11 mg/L), iron (3.51±0.02 mg/L), calcium (7.74±0.08 mg/L), magnesium (4.22±0.21 mg/L), phosphorus (3.31±0.01 mg/L), potassium (9.37±0.22 mg/L), and sodium (80.59±0.66 mg/L), with sodium being the highest. These findings, a ray of hope, provided valuable insights into the nutritional and chemical properties of Hunteria umbellata seed extract, thereby supporting its potential health benefits and therapeutic applications. Further studies are recommended to explore its therapeutic applications and clinical efficacy, which are promising prospects for the future.
***Keywords: Hunteria umbellata, ethanol extraction, proximate, phytochemicals, micronutrients***

## Introduction

Medicinal plants globally are valuable sources of new drugs due to the rising demand for natural health products and herbal medications. Among several other medicinal plants in Africa, the different parts of the Hunteria umbellata plant have been explored to cure human diseases. H. umbellata is a member of the Apocynaceae plant family and is frequently available in many sub-Saharan African countries, including Nigeria. It is a small tree with dense, hard-textured leaves, dark brown stems, abundant flowers, and large fruits-bearing seeds (Morakinyo *et al*., 2020; Udinyinwe & Aghedo, 2022; Ahajumobi *et al*., 2022).

The seeds of *H. umbellata*, traditionally used in various forms of medicine, particularly in Nigeria, hold significant potential for therapeutic applications. Known as *'Osu'* in Edo and *'Abeere'* in Yoruba dialects, the plant's rich phytochemical and nutritional composition is the key to its potential. Phytochemical analysis of the seed extract has revealed the presence of various bioactive compounds, including tannins, saponins, steroids, and flavonoids, which have been linked to a range of biological activities, such as antimicrobial, antioxidant, and anti-inflammatory effects (Udinyinwe & Aghedo, 2022). These findings pique the audience's interest and instil hope in the potential health benefits of Hunteria umbellata seed

extract.

The proximate composition of the seed extract is also noteworthy. The seeds contain significant amounts of carbohydrates, proteins, and minerals such as calcium, phosphorus, potassium, and zinc. These nutrients are essential for various physiological processes, including energy production, bone health, and immune function (Morakinyo *et al*., 2020; Udinyinwe & Aghedo, 2022; Ahajumobi *et al*., 2022). Furthermore, the seed extract has been found to contain various anti-nutrients like oxalate and phytate, which can affect nutrient absorption and utilisation (Morakinyo *et al*., 2020; Udinyinwe & Aghedo, 2022).

Given the potential therapeutic and nutritional benefits of *H. umbellata* seed ethanol extracts, this study is a crucial step in understanding the nutritional and chemical composition of the ethanol extract. Specifically, this research will focus on the seed extracts' phytochemical, proximate, and micronutrient contents to better understand their biological activities. The need for further studies is evident, and the potential impact of this research on the field of pharmacology, botany, and nutrition is significant, making the audience feel the importance of their work and the potential impact of their research.

## Materials and methods

### *Materials*

All the chemicals used in this study, including FeCl3 and disulfiram, were of analytical grade and sourced from May and Baker (England), Merck (Germany), Sigma-Aldrich (Germany), BDH (UK), and MN Kieselgel GmbH (Germany). The remaining reagents used in various experiments were purchased from Merck (Germany), Randox Laboratories (UK), Biovendor (Czech Republic), and Teco Diagnostics (USA). Glassware and equipment included Randox commercial kits from Randox Laboratories Limited, UK, a spectrophotometer (722 N, China), and a haematology analyser (BC-2300, Mindray Medical CO., China). H. umbellata seeds were obtained from Urua Ekpat, Uyo, Akwa Ibom State, and subsequently authenticated by the Department of Plant and Ecological Studies, Faculty of Biological Sciences, University of Calabar, Calabar, where they were assigned the voucher number Bot/Herb/Ucc/095.

### Methods

#### *Ethanol extraction of the powdered seed of H. umbellata*

Seed extraction was carried out according to the method reported by Gahlot *et al*., (2018). Briefly, the seeds were washed, air-dried under shade, and then milled into powder using a manual blender. The powdered seeds were extracted with ethanol (using a Soxhlet apparatus). The solvent in the extract was evaporated using a rotary evaporator and a water bath (50°C). The extract was weighed, and the per cent yield was calculated.

#### *Proximate Composition of Ethanol Extract of H. umbellata Seeds*

The proximate composition of ethanol extract of H. umbellata seeds was analysed as follows: Protein content was quantified using the MicroKjeldahl method, encompassing sample digestion, distillation, and titration. Fat and oil content were determined following the AOAC method (2010). Moisture content was measured by indirect distillation, where a 2.0g sample was dried in an oven at 40°C until a constant weight was achieved and calculated using the equation: Moisture = (loss in weight)/(weight of the sample (g)) × 100. The crude fibre was assessed through sequential treatments with light petroleum, boiling dilute sulphuric acid, boiling dilute sodium hydroxide, dilute hydrochloric acid, alcohol, and ether, with the percentage calculated as Crude fibre (%) = (w1 - w2)/w1 × 100. Total ash content was measured by igniting the sample in a muffle furnace at 550-600°C, calculated using the equation: Ash (%) = (weight of ash)/(weight of the sample (g)) × 100. Available carbohydrates were determined by difference, with % NFE = 100 - (% ash + % crude fat + % crude fibre + % crude protein + % moisture).

#### Qualitative Phytochemical Analysis

The qualitative phytochemical analysis of the ethanol extract of H. umbellata seeds was conducted using established methods (Harborne, 1973; Trease & Evans, 1989; Sofowora, 1993; Deka & Kalita, 2012). To determine tannin content, 1.0 ml of the extract was diluted with distilled water (4:1) and treated with FeCl3, where a blue or green colouration indicated tannins. For saponins, 5 ml of distilled water was added to 2.0 ml of the extract and shaken vigorously with olive oil, and emulsion formation confirmed saponins. Flavonoids were detected by adding 2.0 ml of 5% NaOH to the extract, resulting in a yellow colour. Alkaloid presence was indicated by the formation of an orange colour upon adding Dragendorf reagent to 2.0 ml of the extract. Steroids were identified by adding 2 ml of acetic anhydride to 0.5 g of the extract, followed by sulfuric acid, resulting in violet or blue-green colouration. Phenols were confirmed by mixing the extract with distilled water, warming it, and adding 2 ml of ferric chloride solution, which produced a green or blue colour. Finally, cardiac glycosides were detected by adding 0.5 ml of the extract to 1 ml of glacial acetic acid with ferric chloride, followed by concentrated sulfuric acid, and observing a reddish-brown colour at the junction and a bluish-green upper layer.

#### Quantitative Phytochemical Analysis

The quantitative phytochemical analysis of ethanol extract of *H. umbellata* seeds involved several determinations. Saponin content was assessed using the method of Obadoni and Ochuko (2002). A 50 mg sample was combined with 100 $cm^3$ of 20% aqueous ethanol and heated at 55°C for 4 hours with continuous stirring. The mixture was filtered and re-extracted with 200 ml of 20% ethanol, and the combined extracts were concentrated to 40 ml. This filtrate was transferred to a separating funnel, mixed with diethyl ether, and the

aqueous layer was retained. The process was repeated, and 60 ml of n-butanol was added, followed by washing with 10 ml of 5% aqueous sodium chloride. The solution was heated, evaporated, and dried to constant weight to determine the saponin content. Alkaloid content was determined according to Harborne (1973). A 2.5 g sample was treated with 200 $cm^3$ of 10% acetic acid in ethanol and left to stand for 4 hours. The extract was concentrated, precipitated with concentrated ammonium hydroxide, and filtered. The precipitate was washed, dried, and weighed. Flavonoid content was evaluated using the Boham *et al*. (1974) method, where a 50 mg sample was extracted with 100 ml of 80% aqueous methanol, filtered, evaporated, and weighed. Total phenolic content was measured using the modified Folin-Ciocalteu method (Lawag *et al*., 2023), with absorbance read at 765 nm and results expressed as tannic acid equivalents. Cardiac glycosides were quantified following Harborne (1973), involving filtration, addition of water, glacial acetic acid, FeCl3, and H SO , with absorbance measured at 410 nm. Steroid content was determined using the Madhu *et al*. (2016) method, involving treatment with sulphuric acid, iron (III) chloride, and potassium hexacyanoferrate (III), heated and measured at 780 nm. Terpene content was assessed using the Mboso *et al*. (2013) method, where a 1 g sample was extracted with petroleum ether and measured at 420 nm. Lastly, tannin content was measured by weighing 50 mg of the sample, extracting it with distilled water, and reacting it with FeCl3 and K3Fe (CN)6, with absorbance read at 120 nm.

**Gas Chromatography-Mass Spectrometry (GC-MS) analysis of ethanol seed extract of *Hunteria umbellate for chemical compounds present***

For the Gas Chromatography-Mass Spectrometry (GC-MS) analysis of the ethanol seed extract of *Hunteria umbellata*, 1 g of the sample was weighed and transferred to a test tube, followed by adding 15 mL of ethanol. The mixture was incubated in a water bath at 60°C for 60 minutes. Post incubation, the reaction mixture was transferred to a separating funnel. The test tube was sequentially rinsed with 20 mL of ethanol, 10 mL of cold water, 10 mL of hot water, and 3 mL of hexane, all transferred to the funnel. These extracts were combined and subjected to three washes with 10 mL of 10% v/v ethanol aqueous solution. The solution was dried using anhydrous sodium sulphate, and the solvent was evaporated. The dried sample was reconstituted in 1000 µL of ethyl acetate, and 200 µL of this solution was transferred to a vial for GC-MS analysis (Oshiobugie *et al*., 2019).

Quantification of phytochemicals was carried out using a BUCK M910 Gas Chromatograph equipped with an HP-5MS column (30 m length × 250 µm diameter × 0.25 µm film thickness). Detection was performed using an electron ionisation system at 70 eV. Helium gas (99.995% purity) was used as the carrier gas at a 1 mL/min flow rate. The GC temperature program was initiated at 50°C, increased to 150°C at a rate of 3°C/min with a hold time of 10 minutes, and then ramped to 300°C at 10°C/min. One microliter of the prepared 1% extract solution was injected in splitless mode. The relative quantities of chemical compounds in each extract were determined by calculating the percentage area of each peak in the chromatogram. Bioactive compounds were identified by comparing the GC retention times with those of standards in the GC-MS system's Replib and Mainlab data libraries (Oshiobugie *et al*., 2019).

**Vitamin composition of ethanol extracts of *Hunteria umbellata* seeds**

The amount of vitamins A, E, C, and B12 in the sample was determined using the method described by Achikanu *et al.,* (2013) and AOAC (2010.) Vitamin B1 and B3 were determined using the method described by Okwu and Ndu (2006), while Vitamin B2, K, and folate were determined using the methods described by Okwu and Josiah (2006). The method described by Oulai *et al.,* (2014) was used to determine β-carotene.

**Mineral composition of ethanol extract of *Hunteria umbellata* seed**

Phosphorus was quantified using the method outlined by Oshodi, 1999. Approximately 10mg of the sample was extracted overnight in 250ml of concentrated nitric acid and then per choric acid on a hot plate. Distilled water (20ml) was added to the sample and boiled until white fumes appeared. This was followed by adding 5ml of ammonia solution and further boiling until crystals formed. The crystals were dissolved using 20ml of acidified water and 80ml of distilled water, followed by 20ml of mixed reagent for colour development. The mixed reagent consisted of 250ml sulphuric acid-antimony, 50ml distilled water and 2gl ascorbic acid. The sample was left for 15 minutes for the colour to develop. The quantity of phosphorus was then determined using a spectrophotometer (Cecil Elegant Technology, UK). Other minerals (calcium, iron, magnesium, manganese, sodium, potassium and zinc) were quantified using a thermo x series 2 inductively coupled plasma mass spectrophotometer (ICP MS) (Thermo Scientific, USA). Samples weighing approximately 80mg were digested in nitric acid for 1hr in a mass Xpress microwave (CEM Corporation, USA) and then diluted to 10ml with distilled water ready for qualification.

**Results**

***Proximate composition of ethanol extract of H. umbellata seed***

Table 1 presents the proximate composition of ethanol extract of *H. umbellata* seeds. Carbohydrates exhibited the highest percentage at 56.73±0.24 %, followed by moisture (16.20±0.16 %) and crude protein (13.92±0.01 %). The fibre content of *H. umbellata* seeds was recorded as 8.03±0.41 %, while the calorific value was determined to be 1277.43±3.18 KJ/100g. On the other hand, the ash and lipid content of the ethanol extract of *H. umbellata* seeds showed the lowest values at 2.53±0.06 % and 2.59±0.02 %, respectively.

**Qualitative phytochemical analysis of ethanol extract of *H. umbellata* seed**

Table 2 presents the preliminary qualitative phytochemical analysis of the ethanol extract obtained from *H. umbellata* seeds. The analysis revealed the presence of alkaloids, flavonoids, reducing sugar, saponins, tannins, phytates, oxalates and cyanogenic glucosides. Notably, the extract exhibited a prominent presence of flavonoids and saponins.

**Quantitative phytochemical analysis of ethanol extract of *H. umbellata* seed**

The result of selective quantitative phytochemical screening of ethanol extract of *H. umbellata* seeds is presented in Table 3. Among the analysed compounds, the extract exhibited the highest concentration of flavonoids (383.50±0.24 mg/100g), saponins (150.27±0.11 mg/100g) and tannins (14.02±0.01 mg/100g). Relatively lower amounts of oxalates (10.42±0.17 mg/100g), cyanide (6.21±0.04 mg/L), alkaloids (1.80±0.28 mg/100g), and phytates (0.26±0.05 mg/100g) were found in the extract.

**Gas Chromatography-Mass Spectrometry (GC-MS) analysis of ethanol *Hunteria umbellata* seed extract**

Table 4 shows the chemical composition of the ethanol seed extract of *Hunteria umbellata*, identified using Gas Chromatography-Mass Spectrometry (GC-MS). About 20 compounds were identified from the ethanol extract of *H. umbellata* seeds. The main compounds identified based on the percentage contents were phenol, 2,4-bis (1,1-dimethyl ethyl) (37.72%), 4-Amino-7-diethylamino-chromen-2-one (10.75%), trans-13-Octadecenoic acid (9.47%), (Z)-9-Octadecenamide (8.71%),cis-Vaccenic acid (6.13%), 1-(ethenyloxy)-Octadecane (3.17).

**Vitamin composition of ethanol extract of *Hunteria umbellata* seeds**

Table 5 presents the analysis of the vitamin content of the Hunteria umbellata seeds' ethanol extract. The result demonstrates that the seeds possess substantial amounts of vitamin K (135.00±0.14 IU/100g), vitamin A (21.95±0.01 IU/100g), and vitamin D (8.30±0.14 IU/100g). However, vitamin E (1.25±0.07 mg/100g) and beta-carotene (0.41±0.00 mg/100g) were present in smaller quantities. The vitamin B complex content of the seed under study is shown in Table 6. The detected vitamins include thiamine-B1 (0.0446 mg/100g), folic acid-B9 (0.3375 mg/100g), biotin-B7 (8.789 mg/100g), pyridoxine-B6 (0.2025 mg/100g), riboflavin-B2 (88.5138 mg/100g), and cobalamin-B12 (0.5757 mg/100g).

**Mineral composition of ethanol extract of *Hunteria umbellata* seeds**

The selected mineral composition of the ethanol extract of Hunteria umbellata seeds is shown in Table 7. The results reveal appreciable amounts of zinc (7.08±0.11 mg/L), iron (3.51±0.02 mg/L), calcium (7.74±0.08 mg/L), magnesium (4.22±0.21 mg/L), phosphorus (3.31±0.01 mg/L), potassium (9.37±0.22 mg/L) and sodium (80.59±0.66 mg/L). Among these minerals, sodium exhibits the highest concentration, with a sodium-potassium ratio (Na: K) 8.60.

**Discussion**

Medicinal plants are important in traditional medicine and are often used as home remedies (Welz *et al.,* 2018). The use of herbal medicinal products has increased in recent years due to their low side effects, ease of access and acceptance, especially in developing countries (Sofowora *et al.,* 2013; Ozioma & Chinwe, 2019). Today, many people worldwide use medicinal plants extensively to alleviate and treat diseases due to their gentle nature and limited side effects (Mintah *et al.,* 2019). These plants are rich in natural antioxidants such as phenolic compounds, tocopherols, carotenoids and ascorbic acid (Lourenço *et al.,* 2019). Research has shown that consuming natural antioxidants can reduce the risk of various diseases (Zhou *et al.,* 2021). Generally, vitamins such as tocopherols, carotenoids and ascorbic acid are active components that have a protective effect (Okwu, 2005; Liu *et al.,* 2018).

*Hunteria umbellata* (K. Schum.), a member of the *Apocynaceae* family, is well-known in folklore for its traditional use in managing labour, pain and swellings, stomach ulcers, diabetes, obesity, and anaemia (Falodun *et al.,* 2006; Adejuwon & Olufunmilayo, 2009). These therapeutic properties have been attributed to various bioactive compounds, vitamins, and minerals in the plant's seeds. However, there is a lack of comprehensive scientific information regarding the physicochemical, phytochemical, and reversibility profile of the ethanol extract derived from *Hunteria umbellata* seeds. Therefore, the main objective of this study was to investigate the proximate, phytochemical composition (both quantitative and qualitative), mineral and vitamin of the ethanol extract obtained from *H. umbellata* seeds. According to the proximate composition result of *H. umbellata* seeds, it was found that they contain a high percentage of available carbohydrates (56.73%), which was in agreement with the research carried out by Morakinyo *et al*., (2020), while ash was present in the lowest amount (2.53%). The ash content in the seed extract (2.53%) was similar to the values obtained for *Prunus persica* seed (3.36%) (Ashraf *et al.,* 2011), calabash seed (3.70%) (Abolaji *et al.,* 2007), and calabash whole seed (4.0%) (Oyeleke *et al.,* 2011). The ash content indicates the presence of inorganic elements in the seeds. The ash content in *H. umbellata* seeds was a little above the recommended threshold of 1.5-2.5% for animal feed, as suggested by Pomeranz and Cliffton (2015), who stated that seeds with an ash content above 2.5% are unsuitable for animal consumption.

Furthermore, the carbohydrate content of *H. umbellata* seeds (56.73%) was higher than the values reported for *Adansonia digitata* (44.60%), baobab pulp seed (44.6%), and *Prunus persica* (47.44%) (Oyeleke *et al.,* 2012). Carbohydrates serve as a significant energy source. The protein content of *H. umbellata* seeds (13.92%) was similar to that reported for *Cola millenii*,

*Megaphrynium mascosterchyum*, and *Rauwolfia Victoria*, which are 12.52%, 10.78%, and 8.65%, respectively. However, it was lower than the protein content of *Ceasalpinia bonduc* (19.67%), baobab pulp seed (19.05%), and *Prunus persica* (19.70%) (Ajayi *et al.,* 2015). Protein plays a crucial role in tissue repair within the body. The crude fibre content of the seeds was determined to be 8.03%, which was lower than the value reported for the dehulled seed of calabash (23.90%) (Oyeleke *et al.,* 2011) but close to the values reported for *Canna bidentata* (12.68%) and baobab seed (15.6%). The high crude fibre level in H. umbellata seeds indicated their potential to maintain proper digestion. It may positively affect managing conditions such as diabetes, cholesterol absorption, cardiovascular disease, colorectal cancer, and obesity (Ganong, 2003).

The moisture content of *H. umbellata* seeds (16.20%) was higher than that reported for baobab pulp seed (11.2%) (Oyeleke *et al.,* 2013) and calabash whole seed (9.2%) (Oyeleke *et al.,* 2011). This suggested that the seeds have good storage stability. The lipid content in *H. umbellata* seeds was reported as 2.59%, comparable to the values reported for *Solanum dasyphyllum* (2.65%) and *Canna bidentata* (3.25%). However, it was lower than the lipid content of *Hydrocotyle aziata* (8.15%) (Ajayi *et al*., 2015) and lower than that of baobab pulp seed (13.4%). Due to the low-fat content in *H. umbellata* seeds, they may have potential benefits in reducing obesity and maintaining healthy skin.

The phytochemical analysis of the ethanol extract of *Hunteria umbellata* seeds has revealed a rich composition of bioactive compounds consistent with the plant's traditional use in herbal medicine. The qualitative analysis indicated a strong presence of flavonoids and saponins. The prominence of these compounds is significant, as flavonoids are known for their antioxidant properties, which play a crucial role in combating oxidative stress and related chronic diseases. On the other hand, Saponins have been recognised for their cholesterol-lowering abilities and potential to boost the immune system. Flavonoids, renowned for their antioxidant properties, could potentially contribute to preventing chronic diseases such as cancer and cardiovascular diseases. (Fadahunsi *et al*., 2021). The high flavonoid content (383.50+0.24 mg/100g) in *H. umbellata* seeds suggests that the plant could be a potent source of natural antioxidants1. This is further supported by a study that screened and analysed the anti-hyperlipidaemic potential of ethanolic extracts of *H. umbellata* seeds, indicating that the plant's phytochemicals could be harnessed (Morakinyo *et al*., 2020).

Saponins, another prominent compound (150.27±0.11) in *H. umbellata* seeds, have been recognised for their cholesterol-lowering and immune-boosting effects. The presence of saponins in the extract aligns with the plant's reported use in traditional medicine for treating various ailments (Fadahunsi *et al*., 2021). Tannins, also found in significant amounts (14.02±0.01 mg/100g), are known for their astringent properties and potential to treat diarrhoea and other gastrointestinal disorders. However, they can also inhibit the absorption of certain nutrients, necessitating a balance in their consumption (Riaz *et al*., 2023). The presence of anti-nutrients, such as oxalates (10.42±0.17 mg/100g), cyanogenic glycosides (6.21±0.04 mg/L), alkaloids (1.80±0.28 mg/100g), and phytates (0.26±0.05 mg/100g), although in relatively lower amounts, is noteworthy. These anti-nutrients can potentially interfere with the bioavailability and utilisation of certain nutrients and may pose toxicity risks at higher levels. Their levels should be considered when evaluating the safety and potential applications of the H. umbellata seed extract. Therefore, the consumption of *H. umbellata* seeds should be moderated, and further studies are needed to understand the safe dosage and potential side effects (Salisu *et al*., 2024).

The ethanol seed extracts of *H. umbellata* were subjected to gas chromatography-mass spectrometry (GC-MS) analysis, resulting in the identification of 19 different compounds. The predominant compounds of interest, based on their percentage contents, were phenol, 2,4-bis(1,1-dimethylethyl) (37.72%), 4-Amino-7-diethylamino-chromen-2-one (10.75%), trans-13-Octadecenoic acid (9.47%), (Z)-9-Octadecenamide (8.71%), cis-Vaccenic acid (6.13%), and 1-(ethenyloxy)-Octadecane (3.17%). As a natural compound, Phenol, 2,4-bis(1,1-dimethylethyl) has been reported to possess various medicinal, food, and agricultural functions. It exhibits antioxidant properties (Choi & Lee, 2009), anticancer activity (Pereira *et al.,* 2009; Ren *et al.,* 2019), antifungal properties (Zhou *et al.,* 2011; Ren *et al.,* 2019), antibacterial activity (Abdullah *et al.,* 2011; Nathar *et al.,* 2018), and provides protection against trimethyltin (TMT)-induced cognitive dysfunction (Kim *et al.,* 2017). Furthermore, 4-Amino-7-diethylamino-chromen-2-one has been found to exert diverse biochemical and physiological effects. It displays anti-inflammatory, antioxidant, and anticancer activities and neuroprotective and cardioprotective effects (Vidhu & Evans, 2015). Additionally, it exhibits immunomodulatory and anti-diabetic effects (Ansary & Taher, 2019). Moreover, (Z)-9-octadecenamide exhibits potent anti-inflammatory properties (Ano *et al.,* 2015) and demonstrates analgesic and ulcerogenic effects on health (Hadi *et al.,* 2016). However, Cis-vaccenic acid, an omega-7 7-fatty acid, contains antioxidant properties, which involve the neutralisation of free radicals and a reduction in oxidative stress (Malek *et al*., 2009). Also, it displays anti-inflammatory, anticancer, antidiabetic and anti-obesity properties (Zahid *et al.*, 2017).

The findings of this research regarding the nutritional composition of *H. umbellata* aligned with the results of Morakinyo *et al*. (2020), indicating the presence of essential minerals like calcium, iron, sodium, phosphorus, magnesium, and zinc. These elements found in the seeds of *H. umbellata* are beneficial for disease prevention and control, maintaining acid-base

balance, regulating osmotic pressure, facilitating nerve impulse conduction, aiding muscle contraction (especially the cardiac muscle), regulating bones and teeth, and supporting cell membrane function (Murray *et al.,* 1999).

In terms of vitamins, the analysis revealed that *H. umbellata* seeds contain high amounts of vitamins A (21.95 IU/100g), E (1.25 mg/100g), and K (135.00 IU/100g). These findings were consistent with the results obtained by Morakinyo *et al.* (2020), which also indicated the abundant presence of vitamins A, E, and K in *H. umbellata* seeds. Vitamin E acts as an antioxidant that inhibits the progression of free radical reactions involved in various disease processes (Herrera & Barbas, 2001). Vitamin A, a group of retinoid compounds with the biological activity of all-trans-retinol, plays a crucial role in physiological functions such as vision, growth, reproduction, haematopoiesis, and immunity (Villamor & Fawzi, 2005). Notably, vitamins A and E (a-tocopherol) have been recognised as chemo-preventive agents against certain types of cancer (Sirimanne, 1998).

In this study, the analysis of the vitamin B complex in *H. umbellata* seeds revealed that Riboflavin-B2 and Biotin-B7 were the most abundant. The B vitamins function as coenzymes in various enzymatic processes essential for cellular physiological functions, including vital functions within the brain and nervous system (Hanna *et al.,* 2022). Deficiencies in any of the B vitamins can adversely affect the mitochondrial metabolism of amino acids, glucose, and fatty acids through the citric acid cycle and electron transport chain (Kennedy, 2 016).

**Conclusion**

In this study, we analysed the ethanol extract of *H. umbellata* seeds to understand their composition and potential therapeutic benefits. The seeds were rich in carbohydrates, proteins, crude fibre, minerals, and vitamins, making them nutritionally valuable. The presence of bioactive compounds such as alkaloids, flavonoids, glycosides, saponins, and phenols suggests potential therapeutic benefits. Gas chromatography-mass spectrometry analysis identified specific bioactive compounds associated with medicinal properties.

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**Table 1: Proximate composition of ethanol extract of *H. umbellata* seed**

| Proximate composition | Values (%) |
|---|---|
| Moisture content (dry wt.) | 16.20±0.16 |
| Crude protein | 13.92±0.01 |
| Lipid | 2.59±0.02 |
| Ash | 2.53±0.06 |
| Available carbohydrate | 56.73±0.24 |
| Fibre | 8.03±0.41 |
| Calorific Value (KJ/100g) | 1277.43±3.18 |

*Values are Mean ± SD of triplicate determination: wt=weight*

**Table 2: Qualitative phytochemical composition of ethanol extract of *H. umbellata* seeds**

| Phytochemical composition | Result |
|---|---|
| Alkaloids | + |
| Flavonoids | ++ |
| Glycosides | - |
| Reducing sugar | + |
| Saponins | ++ |
| Steroids | - |
| Tannins | + |
| Terpenoids | - |
| Phytates | + |
| Oxalates | + |
| Cyanogenic glycosides (mg/L) | + |

(+): present, (++): strong presence

**Table 3: Quantitative phytochemicals composition of ethanol extract of *H. umbellata* seeds**

| Phytochemicals | Values (mg/100g) |
|---|---|
| Alkaloids | 1.80±0.28 |
| Flavonoids | 383.50±0.24 |
| Reducing sugar | 26.16±0.52 |
| Saponins | 150.27±0.11 |
| Tannins | 14.02±0.01 |
| Phytates | 0.26±0.05 |
| Oxalates | 10.42±0.17 |
| Cyanogenic glycosides (mg/L) | 6.21±0.04 |

Each value is expressed as mean ± standard deviation of triplicate determinations.

**Table 4: Chemical composition of ethanol seed extract of *Hunteria umbellata*, identified using Gas Chromatography-Mass Spectrometry (GC-MS)**

| Pk no | Retention time | Area % | Library/ID | Molecular Formula | Quality |
|---|---|---|---|---|---|
| 1 | 3.665 | 0.31 | Hexamethyl-Cyclotrisiloxane | C6H18O3Si3 | 72 |
| 2 | 8.285 | 0.51 | 2-methyl-Benzaldehyde | C8H8O | 96 |
| 3 | 9.835 | 0.74 | 3,5-dimethyl-Benzaldehyde | C9H10O | 95 |
| 4 | 9.665 | 1.27 | 3,5-dimethyl-Benzaldehyde | C9H10O | 94 |
| 5 | 11.44 | 0.60 | 4-Butyl-5-(3-methylbutyl)-6-(1-methyl phenyl)-2H-pyran-2-one | C9H13NO2 | 25 |
| 6 | 11.975 | 37.72 | Phenol, 2,4-bis(1,1-dimethylethyl) | C14H22O | 97 |
| 7 | 12.511 | 10.75 | 4-Amino-7-diethylamino-chromen-2-one | C13H16N2O2 | 64 |
| 8 | 13.018 | 0.98 | Z-11-Pentadecenal | C15H28O | 93 |
| 9 | 13.159 | 0.44 | Oleic Acid | C18H34O2 | 90 |
| 10 | 14.06 | 6.13 | cis-Vaccenic acid | C18H34O2 | 94 |
| 11 | 14.201 | 1.36 | 18-Nonadecenoic acid | C19H36O2 | 84 |
| 12 | 14.398 | 2.65 | Z-(13,14-Epoxy) tetradec-11-en-1-ol acetate | C16H28O3 | 91 |
| 13 | 14.623 | 2.09 | Cyclopentadecanone, 2-hydroxy- | C15H28O2 | 92 |
| 14 | 14.877 | 1.41 | Butyl 9-octadecenoate or 9-18:1 | C22H42O2 | 80 |
| 15 | 15.159 | 9.47 | trans-13-Octadecenoic acid | C18H34O2 | 91 |
| 16 | 15.553 | 2.94 | -Octadecene, (E)- | C18H36 | 83 |
| 17 | 16.088 | 3.17 | 1-(ethenyloxy)-Octadecane, | C20H40O | 83 |
| 18 | 16.37 | 1.41 | 1-Nonadecene | C19H38 | 89 |
| 19 | 18.088 | 8.71 | 9-Octadecenamide, (Z)- | C18H35NO | 64 |

**Table 5: The fat-soluble vitamin content of *Hunteria umbellata* seeds**

| Vitamins | Values |
|---|---|
| Vitamin A (iU /100g) | 21.95±0.01 |
| Beta Carotene (mg/100g) | 0.41±0.00 |
| Vitamin D (IU/100g) | 8.30±0.14 |
| Vitamin E (mg/100g) | 1.25±0.07 |
| Vitamin K (IU/100g) | 135.00±0.14 |

Values presented are mean ± Standard deviation triplicate determination.

**Table 6: Vitamin-B complex content of ethanol extract of *Hunteria umbellata* seeds**

| Peak No. | Peak ID | Ret Time | Height | Area | Conc (mg/100g) |
|---|---|---|---|---|---|
| 2 | Niacin | 0.473 | 320.906 | 436.28 | 0.0481 |
| 4 | Thiamine | 0.59 | 299.143 | 404 | 0.0446 |
| 6 | Folic acid | 1.123 | 1165 | 3059.9 | 0.3375 |
| 7 | Biotin | 1.515 | 7552.552 | 79686.2 | 8.789 |
| 10 | Pyridoxine | 2.857 | 620.085 | 1835.821 | 0.2025 |
| 13 | Riboflavin | 3.973 | 16790.8 | 802520.8 | 88.5138 |
| 15 | Cobalamin | 6.032 | 647.92 | 5219.2 | 0.5757 |

**Table 7: Selected Minerals composition of ethanol extract of *Hunteria umbellata* seeds**

| Minerals | Values (mg/L) |
|---|---|
| Calcium (Ca) | 7.74±0.08 |
| Phosphorous (P) | 3.31±0.01 |
| Iron (Fe) | 3.51±0.02 |
| Magnesium (Mg) | 4.22±0.21 |
| Manganese (Mn) | 5.47±0.44 |
| Sodium (Na) | 80.59±0.66 |
| Potassium (K) | 9.37±0.22 |
| Zinc (Zn) | 7.08±0.11 |

Values presented are mean ± Standard deviation of triplicate determinations.