Evaluation of Phytochemical Composition, Proximate Analysis and Anti-nutrients of *Ficus Virens* Seed in Mubi North Local Government Area Adamawa State Nigeria

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Abstract- This study investigated the phytochemical composition, anti-nutrient levels, and bioactive compounds of seed samples using different solvent extracts (ethanol, ethyl acetate, and n-hexane). Proximate analysis revealed the presence of essential nutrients, while anti-nutrient screening showed moderate levels of tannins (11.37%), oxalates (13.25%), saponins (16.26%), and phytates (15.06%). GC-MS profiling of the ethanol extract identified key bioactive compounds including globulol, α-amyrin acetate, testosterone cypionate, squalene, and various fatty acid esters, suggesting potential antimicrobial, antioxidant, and anti-inflammatory activities. Ethyl acetate extract contained squalene, bis(2-ethylheptyl) phthalate, linoleic acid ethyl ester, and other bioactive lipids, while n-hexane extract was rich in hydrocarbons and fatty acids such as decane, hexadecane, and tetradecanoic acid. UV–Vis spectroscopy showed distinct λmax values for ethanol (376 nm), ethyl acetate (290 nm), and n-hexane (261 nm) extracts, reflecting differences in chemical composition influenced by solvent polarity. These findings indicate that the seeds are a rich source of nutritionally and pharmacologically valuable compounds, supporting their potential application in food, pharmaceutical, and nutraceutical industries.

Keywords: Anti-nutrients, Ficus virens, phytochemical, Proximate analysis, UV–Vis spectroscopy

I. INTRODUCTION

Ficus virens, known casually as the white fig, represents one of the many diverse species within the *Ficus* genus, which encompasses over 800 species of trees, shrubs, and vines (Bhat & Balakrishnan, 2018). This genus holds significant botanical, ecological, and cultural importance worldwide, with species distributed across tropical and subtropical regions (Schumacher & Schwerdtfeger, 2019). *Ficus virens*, specifically, has been noted for its historical utilization in various indigenous cultures for both nutritional and medicinal purposes, reflecting the broader ethnobotanical significance of the genus (Gupta & Sharma, 2020).

Despite the longstanding traditional uses of *Ficus virens* seed, comprehensive scientific investigations into its chemical composition and potential bioactivity have been relatively limited. Proximate analysis, a fundamental technique in food science and nutrition, provides essential insights into the macroscopic composition of foods, including moisture content, ash content, lipid content, protein content, and carbohydrate content (Smith & Johnson, 2017). Similarly, phytochemical screening offers a means of identifying and characterizing the diverse array of secondary metabolites present in plant materials, which may possess pharmacological or nutritional significance (Patel & Patel, 2016).

Furthermore, partial characterization of key phytochemical constituents present in plant materials enhances our understanding of their chemical composition and potential biological activities (Chen *et al*., 2018). Advanced analytical methods such as thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), and spectroscopic analysis provide valuable insights into the structural properties of phytochemicals, thereby contributing to their characterization (Sarker *et al*., 2019).

Given the rich botanical diversity and traditional knowledge associated with the *Ficus* genus, exploring the proximate composition, elemental composition and phytochemical profile of *Ficus virens* seed presents an opportunity to uncover novel insights into its nutritional and medicinal properties. By elucidating the chemical constituents present in this fruit, as well as their potential health-related benefits, this research aims to contribute to a broader understanding of the multifaceted roles of *Ficus* species in human health and well-being.

II. MATERIAL AND METHODS

Study Area

The study was conducted in Mubi North Local Government Area, located in Adamawa State, Nigeria. Mubi North is situated in the northeastern part of the country and is characterized by a diverse range of ecological features, including savanna woodlands, grasslands, and riparian habitats. The region experiences a tropical climate with distinct wet and dry seasons, with rainfall typically occurring between May and October. Mubi North is known for its rich biodiversity, encompassing a variety of plant species, including indigenous fruit-bearing trees such as *Ficus virens*.

Sample Collection

Sampling was carried out within Mubi North Local Government Area, with an emphasis on areas known to harbor *Ficus virens* trees. A systematic sampling approach was employed to ensure representative coverage of the study area. Fruit samples of *Ficus virens* was collected from trees. Special care was taking to collect fruits at various stages of maturity to capture the full range of chemical constituents present in the seeds.

Phytochemical Screening

Phytochemical screening of the seed samples was conducted to identify the presence of various bioactive compounds using standard protocols. The test was performed sequentially, with positive reactions indicating the presence of the respective phytochemical constituents. The intensity of the reactions was recorded and used to semi-quantitatively assess the abundance of each compound in the samples. The phytochemicals of the seed samples were estimated following the procedure adopted by Williams *et al.,* (2019).

Partial Characterization

Partial characterization of selected phytochemical constituents present in the *Ficus virens* seed was conducted using an extract of ethanol, ethyl acectate and N-hexane by using advanced analytical spectroscopic techniques.

Data Analysis

The data obtained from the analysis was subjected to statistical analysis using appropriate software packages. Descriptive statistics such as mean, standard deviation, and percentage composition will be calculated for each parameter. The results were presented graphically and tabulated for clarity and interpretation.

III. RESULTS AND DISCUSSION

Qualitative and Quantitative Phytochemicals

Phytochemical investigation of the seed samples through qualitative (Table 1) and quantitative (Table 2) analyses revealed the presence of important secondary metabolites such as flavonoids, saponins, alkaloids, terpenoids, steroids, and tannins in all three solvent extracts—ethanol, ethyl acetate, and n-hexane. The presence of these bioactive compounds suggests strong therapeutic potential, as such phytochemicals have been widely recognized for their antioxidant, antimicrobial, and anti-inflammatory properties (Kumari *et al.,* 2023). Quantitatively, the ethyl acetate extract had the highest concentration of flavonols (19.64 ± 1.000 mg/g), saponins (17.576 ± 1.000 mg/g), and alkaloids (8.640 ± 1.000 mg/g), indicating its effectiveness in extracting moderately polar bioactive compounds (Table 2). This aligns with the solubility behavior of ethyl acetate and supports its use for intermediate polarity phytochemicals (Patel & Sahu, 2024). In comparison, n-hexane extracts had higher quantities of non-polar compounds like saponins and terpenoids, while ethanol, being a polar solvent, extracted a broad spectrum of phytochemicals at moderate concentrations.

Table 1. Qualitative Phytochemical Analysis of Samples

Phytochemical	Ethanol	N-hexane	Ethyl acetate
Flavonoids	+++	+++	++
Saponin	+++	+++	+++
Steroid	+	+	+
Alkaloid	++	++	++
Terpenoid	++	++	++

Tannins	+++	+++	+++

Table 2. Quantitative Phytochemical Analysis of Samples

Phytochemical	Ethanol	N-hexane	Ethyl acetate
Flavonol	9.456±1.000	15.460±1.000	19.64±1.000
Saponins	11.353±1.000	16.430±1.000	17.576±1.000
Steroid	2.456±1.000	2.656±1.000	3.546±1.000
Alkaloid	6.746±1.000	7.856±1.000	8.640±1.000
Terpenoid	6.863±1.000	7.853±1.000	8.640±1.000
Tannins	11.660±1.000	12.446±1.000	13.263±1.000

Gas Chromatography-Mass Spectrometry Profiles and Phytochemical Correlation

GC-MS analyses provide a deeper understanding of the compounds contributing to the observed phytochemical classes: Ethanol extract (Table 3) was rich in triterpenes such as α-amyrin acetate and steroids like testosterone cypionate, which justify the qualitative presence of steroids and terpenoids in Table 1. Compounds like n-hexadecanoic acid and linoleic acid ethyl ester are known fatty acids with antimicrobial and anti-inflammatory properties, which further validate the biological activity of the ethanol extract (Ali *et al.,* 2023). The presence of globulol (a sesquiterpene alcohol) also supports the terpenoid profile observed. Ethyl acetate extract (Table 4) contained squalene, phthalates, and various fatty acid esters. Squalene, a known antioxidant triterpene, corroborates the high terpenoid and steroid concentrations noted in Table 2. The presence of bis(2-ethylheptyl) phthalate and 2,4-di-tert-butylphenol (a phenolic compound) supports the presence of phenolic-related compounds like tannins, indirectly connecting the antioxidant potential of this extract. N-hexane extract (Table 5) yielded mostly hydrocarbons (decane, hexadecane, pentadecane) and saturated fatty acids, which confirms the extraction of non-polar compounds. These findings support the relatively higher amounts of saponins and terpenoids reported in this solvent (Table 2), as these are also known to be soluble in non-polar solvents.

Table 3. Results of the GC-MS analysis of ethanolic extract

Components	Formula	RT (Mins)
Globulol	$C_{15}H_{26}O$	32.772
Urs-12-en-3-ol, acetate, (3β)- (α-Amyrin acetate)	$C_{32}H_{52}O_2$	32.671
Testosterone cypionate	$C_{27}H_{40}O_3$	31.842
Stigmasteryl tosylate	$C_{36}H_{54}O_3S$	25.577
docosanoic acid, ethyl ester	$C_{24}H_{48}O_2$	19.896
docosanoic acid	$C_{22}H_{44}O_2$	19.585
Squalene	$C_{30}H_{50}$	23.029
Undecanoic acid, ethyl ester	$C_{13}H_{26}O_2$	9.987
Eicosanoic acid	$C_{20}H_{40}O_2$	9.987
Heptadecanoic acid, ethyl ester	$C_{19}H_{38}O_2$	13.231
Linoleic acid, ethyl ester	$C_{20}H_{36}O_2$	14.100
heptadecanoic acid	$C_{17}H_{34}O_2$	12.999
n-hexadecanoic acid	$C_{16}H_{32}O_2$	11.929
Palmitoleic acid	$C_{16}H_{30}O_2$	10.859
Ethyl-13-methyltetradecanoat	$C_{17}H_{34}O_2$	11.023
Undecanoic acid, ethyl ester	$C_{13}H_{26}O_2$	9.987

Table 4. Results of the GC-MS analysis of ethyl acetate extract

Components	Formula	RT (Mins)
Squalene	$C_{30}H_{50}$	23.035
Bis(2-ethylheptyl) phthalate	$C_{26}H_{42}O_4$	19.309
Octadecanoic acid, ethyl ester	$C_{20}H_{40}O_2$	14.493
linoleic acid ethyl ester	$C_{20}H_{36}O_2$	14.090
docos-1-ene	$C_{22}H_{44}$	14.434
n-hexadecanoic acid	$C_{16}H_{32}O_2$	11.863
Isopropyl myristate	$C_{17}H_{34}O_2$	10.313
Hexadecane	$C_{16}H_{34}$	7.739
Octadecane	$C_{18}H_{38}$	9.997
5-Octadecene, (E)-	$C_{18}H_{36}$	9.928
2,4-Di-tert-butylphenol	$C_{14}H_{22}O$	6.861
6-Tetradecene, (Z)-	$C_{14}H_{28}$	5.214

Table 5. Results of the GC-MS analysis of n-hexane extract

Components	Formula	RT (Mins)
Decane	$C_{10}H_{22}$	6.540
Tetradecanoic acid	$C_{14}H_{28}O_2$	9.758
Hexadecane	$C_{16}H_{34}$	7.736
5-Octadecene, (E)-	$C_{18}H_{36}$	7.654
Dodecanoic acid	$C_{12}H_{24}O_2$	7.551
Pentadecane	$C_{15}H_{32}$	11.07
Tetradecane	$C_{14}H_{30}$	11.63

UV-Vis Absorption and Phytochemical Implications

The absorption spectra of the extracts (table 6) further substantiate the presence of various phytochemicals. The ethanol extract exhibited maximum absorption at 376 nm, which falls within the UV-Vis region and indicates the presence of conjugated double bonds commonly found in flavonoids and phenolic compounds (Kamboj & Saluja, 2024). Ethyl acetate extract absorbed at 290 nm, characteristic of certain alkaloids and saponins, while n-hexane extract absorbed at 261 nm, consistent with the presence of saturated hydrocarbons and lipophilic acids. These wavelength values complement the GC-MS findings and validate the qualitative and quantitative phytochemical results (table 1 and 2), providing a consistent pattern of compound distribution across solvents of varying polarity.

Table 6. UV wavelengths for the Seed Samples

Sample	Wavelength (nm)
Ethanol Extract	376
N-hexane Extract	261
Ethyl acetate Extract	290

Proximate composition of Seed sample

This high carbohydrate content, combined with the protein and fat levels, (table 7) confirms that the seeds are nutrient-rich and energy-dense. The proximate composition shows that *Ficus virens* seeds are a nutritionally balanced food source, with significant amounts of protein, carbohydrates, and fibre, along with moderate fat content and essential minerals. The low moisture enhances storage potential, while the high protein and fibre add value for dietary and possible industrial applications.

Table 7 Proximate composition of Seed sample

Proximate composition	Protein	Fat	Fibre	Ash	Moisture	carbohydrate
Seed %	23.536±0.025	14.236±0.025	17.176±0.025	7.676±0.025	5.526±0.025	34.510±4.746

Anti-nutrients composition of Seed sample

The values recorded (table 8) indicate that *Ficus virens* seeds contain appreciable levels of anti-nutrients, which could limit nutrient bioavailability if consumed raw. However, these levels are within ranges that can be reduced through traditional food processing methods, making the seeds safe and more nutritious for consumption. Importantly, many of these compounds also have health-promoting properties, meaning their presence is not entirely negative.

Table 8. Anti-nutrients composition of Seed samples

Anti-nutrients	Tannins	Oxalates	Saponins	Phytates
Seed %	11.370±0.030	13.246±0.025	16.260±0.040	15.060±0.020

IV. CONCUSION

The findings from this study confirm that the seeds are a valuable source of phytochemicals and nutrients with potential health and therapeutic benefits. The consistency between the qualitative, quantitative, GC-MS, and UV-Vis results underscore the reliability of the analyses and validates the medicinal and nutritional significance of the plant. Among the solvents used, ethyl acetate emerged as the most efficient for extracting a broad spectrum of bioactive compounds, followed closely by n-hexane and ethanol. Additionally, the identification of diverse compounds with antioxidant, antimicrobial, and anti-inflammatory potential further highlights the seeds' suitability for pharmaceutical and industrial applications.

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