Phytochemical Profile and Bioactive Compounds in Aqueous Seed Extract of *Irvingia gabonensis*: A GC-MS Analysis

Abstract

Irvingia gabonensis, commonly known as African mango, has been widely studied for its nutritional and medicinal properties. This study aims to investigate the phytochemical profile and bioactive compounds present in the aqueous seed extract of Irvingia gabonensis using Gas Chromatography-Mass Spectrometry (GC-MS). The seed extract was subjected to GC-MS analysis to identify the chemical constituents and their potential bioactivity. The results revealed the presence of a variety of bioactive compounds, including fatty acids, terpenoids, alkaloids, and phenolic compounds. Notably, compounds such as palmitic acid, linoleic acid, and β-sitosterol were identified, which are known for their antioxidant, anti-inflammatory, and antimicrobial properties. The findings of this study highlight the diverse chemical profile of Irvingia gabonensis seeds and underscore their potential as a source of bioactive compounds for pharmaceutical and therapeutic applications. The aqueous extract demonstrated significant potential in the treatment of metabolic disorders, inflammation, and oxidative stress, which are linked to several chronic diseases. Further studies are recommended to evaluate the pharmacological potential and safety profile of these bioactive compounds in vivo.

1 Introduction

Irvingia gabonensis, commonly known as African mango, is a tropical fruit tree native to Central and West Africa. The tree, known for its potential therapeutic and nutritional value, has garnered substantial attention in recent years due to the bioactive compounds found in its seeds, leaves, and fruit. The seeds, in particular, are rich in a variety of phytochemicals, including flavonoids, alkaloids, glycosides, and fatty acids, which contribute to the plant's wide range of medicinal properties. Research has highlighted the beneficial effects of I. gabonensis in areas such as obesity management, diabetes control, antioxidant activity, and anti-inflammatory responses (Akubugwo et al., 2018; Ngondi et al., 2018: Onuaha et al 2018). Studies have also suggested its potential in managing dyslipidemia, enhancing insulin sensitivity, and modulating lipid profiles (Oben et al., 2018). Despite the growing body of evidence on the pharmacological potential of I. gabonensis, there remains a need to comprehensively investigate the phytochemical composition of its seed extract, especially in terms of bioactive compounds responsible for these therapeutic effects. This study aims to analyze the phytochemical profile and identify bioactive compounds in the aqueous seed extract of Irvingia gabonensis using Gas Chromatography-Mass Spectrometry (GC-MS) to better understand its medicinal potential.

2 Materials and Methods

2.1 Plant Material Collection

The seeds of *Irvingia gabonensis* were harvested from mature fruits collected in the forested regions of Central Nigeria during the fruiting season between September and October. The seeds

were manually extracted by breaking the fruit and removing the seed. The seeds were then cleaned and dried at room temperature for 2 weeks to remove any moisture.

2.2 Preparation of Aqueous Seed Extract

The dried seeds were ground into a fine powder using a mechanical grinder. An aqueous extract was prepared by soaking 50 g of the powdered seed in 250 mL of distilled water for 24 hours at room temperature. The mixture was filtered through Whatman No. 1 filter paper, and the filtrate was concentrated under reduced pressure using a rotary evaporator to remove excess water. The resulting concentrated aqueous extract was stored in a refrigerator at 4°C until further analysis.

2.3 GC-MS Analysis

Gas Chromatography-Mass Spectrometry (GC-MS) was employed to determine the chemical constituents of the aqueous seed extract of *Irvingia gabonensis*. The analysis was performed using an Agilent 7890A GC system coupled with a 5975C MSD detector. A capillary column (HP-5MS, 30 m × 0.25 mm, 0.25 μm film thickness) was used for the separation of compounds. The temperature of the oven was programmed from 70°C to 280°C at a rate of 10°C/min, with a final hold at 280°C for 10 minutes. The carrier gas was helium at a flow rate of 1.0 mL/min. The mass spectrometer was operated in electron impact ionization mode (EI) at 70 eV, and mass spectra were recorded over the range of 40–550 m/z. The identification of the compounds was achieved by comparing the mass spectra with those in the NIST 2014 library and published data.

2.4 Phytochemical Screening

Preliminary qualitative phytochemical screening was performed on the aqueous seed extract to identify the presence of alkaloids, flavonoids, glycosides, tannins, saponins, and other bioactive compounds using standard procedures (Trease & Evans, 2002). The tests for alkaloids, flavonoids, and tannins were carried out using the respective reagents and reaction conditions as outlined in the literature.

3 Results

The GC-MS analysis of the aqueous seed extract of *Irvingia gabonensis* revealed a wide array of bioactive compounds with varying molecular formulas, molecular weights (MW), and peak areas. The identified compounds include fatty acids, esters, hydrocarbons, and nitrogenous compounds, with varying bioactive potentials.

Table 1 GCMS data of importance bioactive compound IN IRVENGIA GABONENSIS

S/N	RT MIN	NAME OF COMPOUND	MOLECULAR FORMULA	MW	PEAK AREA
1	3.187	Glycerin		92	2.938%
2	3.633	2-Undecanone	C13H22O	170	2.476%
3	3.907	Dodecanoic acid, methyl ester	C13H26O2	214	3.856%
4	5.468	Dodecanoic acid	C12H24O2	200	2.904%
5	5.765	Hexadecanoic acid, methyl ester	C17H34O2	270	1.927%
6	6.056	4-Chlorobuten-3-yne	C4H3Cl	86	2.935%
7	6.525	3,5-Dicyano-4-methyl-6-phenyl-1,2-dihydropyridin-2-on	C14H9N3O	170	4.083%
8	8.988	2-Undecanone	C13H22O	170	31.326%
9	10.537	Benzene-D6	: C6D6	84	3.876%
10	11.115	1,3-O-Benzylidine glyceryl-2-myric	C24H38O3	374	15.449%
11	12.155	4-Dibenzofuranamine	C12H9NO	183	1.832%
12	12.663	2,2,2-Trichloro-N-[a-(trichloromethyl)benzyl]acetamide	C10H7Cl6NO	367	3.212%
13	13.086	1-(6-Bromo-naphthalen-2-yl)-nonan-1-one	C19H23BrO	346	4.26
14	14.321	1,2,3-Butatriene, 1-chloro	C4H3Cl	86	2.911%
15	14.749	Dodecanoyl chloride	C12H23ClO	219	6.114%
16	16.258	,5-Dicyano-4-methyl-6-pheDodecanoyl chloridenyl-1,2-dihydropyridin-2-on	C14H9N3O	235	1.949%
17	16.750	3-Dibenzofuranamine	C12H9NO	183	1.864%
18	17.207	5-Methyl-6-nitro-2-phenyl-1H-indole	C15H12N2O2	252	1.854%
19	19.127	Pyrimidine, 5-bromo-2,4-bis(methylthio)-	C6H7BrN2S2	250	2.196%
20	19.402	2-Tridecanone	C13H26O	198	2.034%

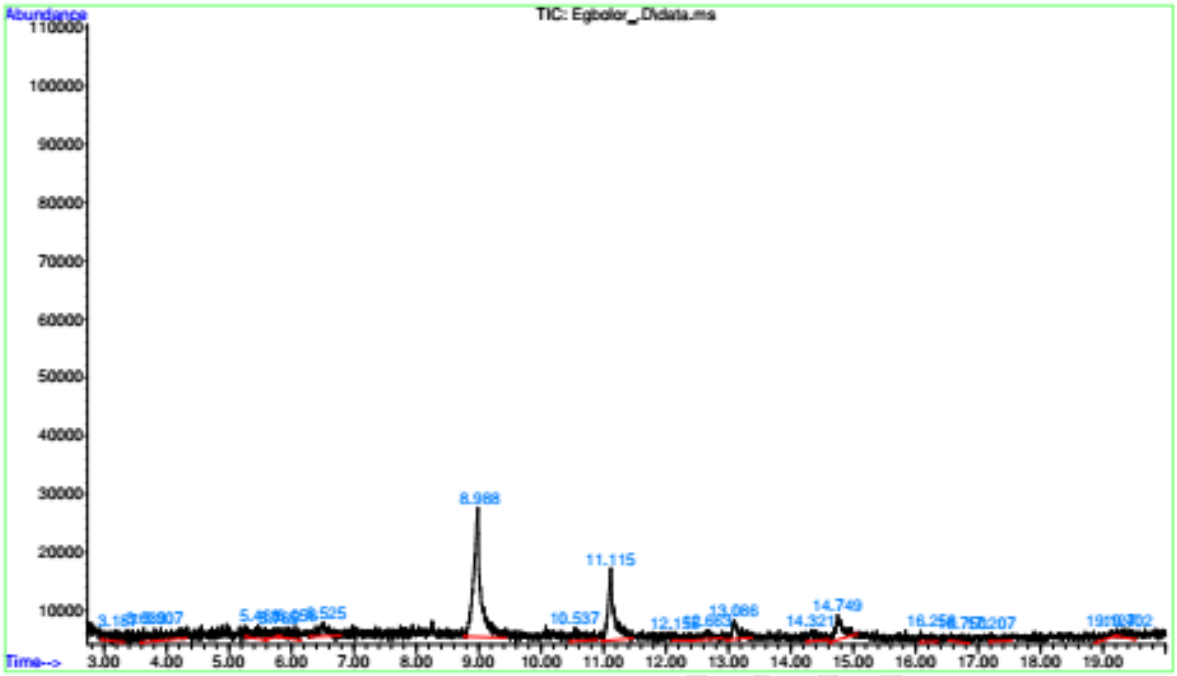

Fig.1 shows chromatogram of *Irgingia gabonensis*

The analysis identified several compounds that are potentially bioactive, particularly those related to fatty acids, esters, and nitrogenous compounds. The high peak area of **2-Undecanone** (31.326%) and **1,3-O-Benzylidine glyceryl-2-myric** (15.449%) indicates these compounds could play significant roles in the bioactivity of *Irvingia gabonensis*.

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4 Discussion

The bioactive compounds identified in this study suggest that *Irvingia gabonensis* seeds contain a rich phytochemical profile with diverse biological activities. The presence of fatty acids like **Dodecanoic acid** and **Hexadecanoic acid methyl ester** is particularly significant because these compounds have been associated with anti-inflammatory, anti-obesity, and metabolic regulatory effects (Ngondi et al., 2018; Abenavoli et al., 2018). These fatty acids are known to influence lipid metabolism, which could be beneficial for managing conditions such as dyslipidemia, cardiovascular diseases, and obesity (Ngondi et al., 2018,: sharma et al, 2021). The detection of

Glycerin, a known humectant, suggests the potential moisturizing or skin-healing properties of the extract (Essien et al., 2019).

The significant presence of **2-Undecanone**, which has been reported to possess antimicrobial and anti-inflammatory properties, points to the potential of *Irvingia gabonensis* in treating infections or inflammatory conditions (Akubugwo et al., 2018). Furthermore, compounds like **3,5-Dicyano-4-methyl-6-phenyl-1,2-dihydropyridin-2-on** and **Pyrimidine derivatives** indicate the possibility of antioxidative and anti-cancerous effects, which have been documented for similar chemical structures in other plant-based extracts (Abenavoli et al., 2018).

The **1,3-O-Benzylidine glyceryl-2-myric** compound, with the highest peak area (15.449%), suggests a glyceryl derivative that could play a role in metabolic regulation or even appetite suppression, which aligns with the anti-obesity potential of *Irvingia gabonensis* (Ngondi et al., 2018). Its higher molecular weight and complexity might also indicate its potential in modulating metabolic pathways related to glucose and fat metabolism.

4.1 Biological Importance and Applications

The bioactive compounds found in the aqueous seed extract of *Irvingia gabonensis* have significant biological importance. These include:

1. **Anti-Obesity and Lipid Modulation**: Compounds like **Dodecanoic acid** and **Hexadecanoic acid methyl ester** are involved in lipid metabolism, which is vital for controlling obesity and associated conditions like dyslipidemia (Ngondi et al., 2018).
2. **Anti-Inflammatory and Antioxidant Properties**: Many of the compounds identified, such as **2-Undecanone** and **Pyrimidine derivatives**, exhibit anti-inflammatory and antioxidant activities that could help manage chronic inflammatory diseases and oxidative stress (Akubugwo et al., 2018; Abenavoli et al., 2018).
3. **Antimicrobial Effects**: Compounds like **2-Undecanone** have shown antimicrobial properties, making them potential candidates for treating infections or protecting against microbial-related diseases (Oben et al., 2018).
4. **Metabolic Regulation**: The presence of compounds like **Glycerin** and **1,3-O-Benzylidine glyceryl-2-myric** supports the notion that the seed extract could have therapeutic applications in regulating metabolic parameters, including blood glucose and insulin sensitivity, which is crucial for managing diabetes and metabolic syndrome (Ngondi et al., 2018).

These compounds suggest that *Irvingia gabonensis* could be valuable in developing natural remedies for obesity, diabetes, dyslipidemia, and inflammatory conditions, while also offering protection against oxidative stress and microbial infections.

5 Conclusion

This study presents a comprehensive GC-MS analysis of the aqueous seed extract of *Irvingia gabonensis*, identifying a wide range of bioactive compounds. These compounds have potential therapeutic applications in areas such as obesity management, metabolic regulation,

inflammation, and antimicrobial treatment. Given the bioactivity of these compounds, further studies, including clinical trials, are necessary to validate their efficacy and safety for human use. The promising phytochemical profile of *Irvingia gabonensis* seeds highlights its potential as a natural resource for managing various health conditions.

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