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Bioactive profiling of essential oil of Terminalia arjuna stem bark collected from Orathur village, Tamilnadu, India

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Abstract

Bioactive profiling of Terminalia arjuna stem bark essential oil by GC/MS intends to showcase the medicinal properties and characterization of bioactive compounds. Bioactive profiling of essential oils from Terminalia arjuna stem bark revealed the presence of 31 bioactive compounds with their retention time. Cyclohexylhexanoate (10.78 %), D-limonene (9.57 %), ethyltrans-4-decenoate (9.52 %), α-himachalene (7.21 %), β-sesquiphellandrene (6.09 %), β-caryophyllene (5.66 %), Trans-2-Tetradecen-1-ol (4.09 %), β-Guaiene (4.02 %), 2-methyldecahydronaphthalene (3.72 %), cis-7-hexadecane (3.11 %), α-cadinol (3.04 %), 1-octanal (2.57 %) and ethylbenzene (2.02 %) were the major compounds above 2 % while compounds less than 2.0 % includes, 3-Hexenylhexanoate (0.97 %), 2,6,11-Trimethyldodecane (1.36 %), 2,3,6,7-Tetramethyloctane (0.25 %), β-Selinenol (1.77 %), (-)δ-Cadinol (0.01 %), Cubenol (0.03 %), α-Bisabolol (0.04 %), α-Himachalene (1.88 %), 1,3,5,8-Undecatetraene (1.02 %), Ethyltrans-4-Decenoate (0.05 %), α-Terpinolene (0.94 %), Trans-2-Nonenal (0.06 %), Geranyl Acetone (1.67 %), Cis-6-Pentadecen-1-ol (0.51 %) and Hexahydrofarnesol (0.87 %). It was concluded that essential oil from Terminalia arjuna stem bark is rich in several phytocomponents with medicinal properties and can be used to reduce the increasing cases of antimicrobial resistance.

Keywords: terminalia arjuna; phytocomponents; safety; medicine; antimicrobial; resistance

Introduction

Terminalia arjuna is an evergreen plant belonging to the family Combretaceae (Kapoor et al., 2014). The tree is found in most parts of India, Sri Lanka, China, Pakistan, Bangladesh and Malaysia (Pashazanousi et al., 2012). The tree can grow up to 30 meters in height and is highly medicinal due to the presence of tannins, alkaloids, flavonoids, saponins, glycosides, phenolic compounds amongst others (Saha et al., 2012; Bharani et al., 2004). These phyto-components performs numerous biological functions including, anti-inflammatory (Alagbe et al., 2021), antifungal, antiviral, antimicrobial, immune stimulator, cytotoxic, gastro-protective, anti-ulcer, anti-diabetic, hypolipidemic, antioxidant, osteogenic, anti-helminthic and cardio-protective amongst others (Bharani et al., 2004; Paul et al., 2016). The plant parts (leaves, stem bark and root extracts) has reportedly been used for the treatment of severe diarrhoea and dysentery, urethral discharge, gastro-intestinal infection, chest, pain, waist pain, irregular menstruation, internal pile, malarial, quick ejaculation, headache, hypertension, dysentery, premature aging, memory improvement, blood cleansing, chronic venous, insufficiency, mental function, minor burns, scars, skin ulcers, varicose veins, wound healing, rheumatism and congestive heart failure (Khalil, 2005; Bharani,et al., 1995).

The stem bark from the plant is characterized with sweet, cooling, styptic, tonic, anti-dysenteric, and febrifuge properties (Desai et al., 2015). Extracts from the leaves and roots of Terminalia arjuna can inhibit the growth of some pathogenic organisms such as, Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli, Bacillus subtilis and Candida albicans (Yaidikar and Thakur, 2015). According to Singh et al. (2022; Alagbe, 2023), concentration of phytocomponents in medicinal plants can be influenced by age of plant, specie, geographical location, extraction technique amongst others. These phyto-components have been reported to be safe, environmentally friendly and has no withdrawal period (Alagbe et al., 2020). However, errors in botanical identification, Interference of medicinal plants and conventional pharmacological therapy and dearth of reports on the side effects of medicinal plants can cause toxicity in phytomedicine in human and animals (Olujimi et al., 2024).

Therefore, this study was carried out to determine the bioactive profiling of essential oil of Terminalia arjuna stem bark collected from Orathur village, Tamilnadu, India

Materials and methods

Description of experimental area

The experiment was carried out at the department of Biochemistry, Sumitra Research Institute, Gujarat located between 28º 20' N and 75º 30' East India in the months of August to October, 2022.

Collection and extraction of essential oil from Terminalia arjuna stem bark

Fresh mature stem bark from Terminalia arjuna was collected from different sites at Orathur village, Tamilnadu, India and sent to taxonomy department of the same institute for proper authentication before it was assigned an identification number (HF/008C/2023). Extraction of essential oil from Terminalia arjuna stem bark was carried out using steam distillation technique with Clevenger apparatus. Extracted oil was sent to the laboratory for further analysis.

Bioactive profiling of essential oil from Terminalia arjuna stem bark

Bioactive profiling of essential oil from Terminalia arjuna stem bark was carried out using Lauret gas chromatography - mass spectrometry (Model FG/008, Netherlands). Identification of each bioactive compound was carried out by comparing their mass spectra with those of reference compounds from the Library of National Institute of Standard and Technology (NIST, 2011) database.

S/N	Compounds	Reaction time (min)	% Area
1	3-Hexenylhexanoate	5.62	0.97
2	2,6,11-Trimethyldodecane	6.27	1.36
3	β-Caryophyllene	6.33	5.66
4	Cyclohexylhexanoate	7.07	10.78
5	γ-Cadinene	7.55	2.67
6	β-Sesquiphellandrene	7.92	6.09
7	β-Linalool	8.09	2.51
8	D-Limonene	8.47	9.57
9	2,3,6,7-Tetramethyloctane	8.84	0.25
10	β-Selinenol	8.93	1.77
11	α-Cadinol	9.62	3.04
12	(-)δ-Cadinol	9.95	0.01
13	α-Bisabolol	10.50	0.04
14	Cubenol	11.10	0.03
15	α-Himachalene	11.55	7.21
16	β-Guaiene	12.35	4.02
17	α-Himachalene	12.67	1.88
18	1,3,5,8-Undecatetraene	12.85	1.02
19	Ethyltrans-4-Decenoate	13.06	0.05
20	α-Terpinolene	14.54	0.94
21	1-Octanal	15.12	2.57
22	1,8-Cineole	15.76	3.5
23	Ethyltrans-4-Decenoate	16.27	9.52
24	2-methyldecahydronaphthalene	17.16	3.72
25	Ethylbenzene	18.09	2.02
26	Trans-2-Nonenal	19.22	0.06
27	Geranyl Acetone	19.85	1.67
28	Cis-6-Pentadecen-1-ol	20.06	0.51
29	Trans-2-Tetradecen-1-ol	21.38	4.09
30	Cis-7-Hexadecane	22.40	3.11
31	Hexahydrofarnesol	22.75	0.87
	Total	91.51	
	Number of compounds		
	Monoterpenes	27.51	
	Diterpenes	7.96	
	Triterpenes	1.03	
	Sesquiterpenes	-	
	Non-terpenes	55.01	

Table 1: Bioactive profiling of Terminalia arjuna stem bark essential oil by GC/MS

Results And Discussion

Bioactive profiling of essential oils from *Terminalia arjuna* stem bark revealed the presence of 31 bioactive compounds with their retention time. Cyclohexylhexanoate (10.78 %), D-limonene (9.57 %), ethyltrans-4-decenoate (9.52 %), α-himachalene (7.21 %), β-sesquiphellandrene (6.09 %), β-caryophyllene (5.66 %), Trans-2-Tetradecen-1-ol (4.09 %), β-Guaiene (4.02 %), 2-methyldecahydronaphthalene (3.72 %), cis-7-hexadecane (3.11 %), α-cadinol (3.04 %), 1-octanal (2.57 %) and ethylbenzene (2.02 %) were the major compounds above 2 % while other compounds reported were less than 2.0 %. It is worthy to note that all these bioactive compounds or phytochemicals possess medicinal or therapeutic properties (Alagbe and

Shittu, 2020; Alagbe et al., 2021). This result aligns with a previous study by Kokkiripati et al. (2013); Hafiz et al. (2014); Chaudhari and Mengi (2006). For instance, cyclohexylhexanoate, β-caryophyllene, β-Linalool, β-sesquiphellandrene, β-selinenol and α-cadinol have been reported to possess antimicrobial, antifungal, antidiarrhoea, antibacterial, anticancer, antioxidant and anti-helminthic properties (Subavathy and Thilaga, 2015; Mangrove et al., 2014). 2, 6, 11-trimethyldodecane, 2, 3, 6, 7-tetramethyloctane, α-himachalene, α-terpinolene and cis-6-pentadecen-1-ol have antimicrobial and gastro-protective activities (Doughari, 2012; Olajuyige et al., 2011).α-bisabolol, 2-methyldecahydronaphthalene, ethyltrans-4-decenoate have been suggested to have antibacterial and cardio-protective effects (Devendran and Ba;asubramanian, 2011; Lima et al., 2010).Trans-2-nonenal, geranyl acetone and ethylbenzene have antifungal and anti-diarrhoea properties (Mamza et al., 2012; Awa et al., 2012). Screening of bioactive compounds from herbal plants can lead to the discovery of new medicinal drugs which have efficient protection and treatment roles against various diseases (Soma et al., 2010; Alagbe et al., 2024). The concentrations of phytochemicals in herbal plants can be influenced age of plant, geographical location, specie, processing methods amongst others (Alagbe et al., 2023a; Alagbe et al., 2023b).

Conclusion

Naturally, medicinal plants are loaded with phytochemicals with medicinal properties. These compounds can perform numerous biological roles such as, antimicrobial, antifungal, anti-helminthic, hepato-protective, immune-stimulatory, cytotoxic, antioxidant, antiviral amongst others.

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