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GC-MS Analysis of essential oil from *Corchorus olitorius* L.

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Abstract
Objective: The objective of this research is to analyse the essential oil of *Corchorus olitorius* L. fruit.
Methodds: The essential oil was extracted using the Clevenger apparatus by hydro-distillation, and its constituents were analyzed using Gas Chromatography-Mass Spectrometry (GC-MS) profiling. The attained results were matched with a database of the spectrum of known components stored in the GC-MS NIST library (2008).
Results: Eight different phytoconstituents were identified by GC-MS analysis in this present study. It includes alcohol, aldehyde, acetamide, ether, sulphide, diol and ketone compounds.
Conclusion: These findings will be the groundwork for the development of novel therapeutic drugs. Additionally, there is a need for more extensive pharmacological research aimed at isolating the active chemical compounds and analysing their biological activity.

Keywords: *Corchorus olitorius*, essential oil, clevenger apparatus, GC-MS analysis.

1. Introduction
Nature's Pharmacy contains numerous promising bioactive compounds that can be extracted from plants [1]. Essential oils derived from plants exhibit a variety of valuable pharmacological and pharmaceutical properties. In recent times, essential oils obtained from medicinal herbs have gathered significant interest for their diverse biomedical applications. These applications encompass their use in managing diabetes, combatting fungal and bacterial infections and displaying pharmacological effects. They are also regarded as effective natural remedies [2, 3]. Furthermore, essential oils have gained widespread popularity worldwide due to their relatively low risk of adverse effects, easy accessibility, affordability, and high effectiveness [4, 5]. This broad utilization has generated considerable enthusiasm for exploring the potential of essential oils in various fields, particularly in natural healthcare [6]**.** Gas chromatography-mass spectrometry (GC-MS) is the best technique to identify the bioactive constituents of long-chain hydrocarbons, alcohols, acids, esters, alkaloids, steroids, amino acids and nitro compounds [7]. *Corchorus olitorius* L. also known as Tossa jute in English, is a traditional medicinal vegetable belonging to the family Malvaceae [8]. It is native to tropical Africa, Asia, and now is spread all over the world [9]. It is widely used in Asia and Africa as a culinary and medicinal herb [10]. In Egypt, Jordan, and Syria fresh dried fruit is utilized as an ingredient in soup-based dishes, consumed as a boiled vegetable seasoned with lemon and olive oil and occasionally enjoyed with meat alongside rice or lentils [11].
In recent years, this plant, recognized for its nutritional value with high levels of potassium, calcium, phosphorus, iron, ascorbic acid and carotene [12] has been grown and consumed in Tunisia under the name "Mloukhya." Additionally, it is employed for its perceived medicinal properties, including the treatment of headaches and diabetes [13]. Furthermore, it has been documented to exhibit various biological activities, serving as effective free radical scavengers and primary antioxidants that can counteract free radicals and reduce damage caused by reactive oxygen species in biological and food systems [14]. The seeds of *C. olitorius* are nutritionally suitable and contain metal levels within acceptable limits. Consequently, they have the potential to be integrated into both human dietary and livestock feed practices [15]. Essential oil from the leaves and flowers of *Corchorus olitorius* L. is reported to contain active ingredients that are utilized in the food and pharmaceutical industry [16]. Also, it has been documented that the fruit of *C. olitorius* contains substantial quantities of protein, fat, dietary fibre, ash, carbohydrates, and energy [17].
The present study is aimed to investigate the phytoconstituents present in the essential oil from fruit of *Corchorus olitorius* for the first time.

2.Materials and Methods

2.1 Sample preparation

The fruits of *Corchorus olitorius* L. were collected from Koodakarai, Erode District of Tamil Nadu, India and were authenticated and deposited at the PG & Research Department of Botany Vellalar College for Women, Erode, (Tamil Nadu) India. Fresh and healthy fruits were picked up and packed into the round bottom flask.

2.2 Extraction of Essential oil

The hydro-distillation of fresh fruits of *Corchorus olitorius* L. gives yellow-coloured essential oil via Clevenger apparatus [18, 19]. Essential oil was obtained from the burette, dried over anhydrous sodium sulfate, then weighed and preserved in the fridge at 4°C until GC-MS profiling and biological screening.

2.3 GC-MS analysis

The fruit oil *Corchorus olitorius* L. was examined for the occurrence of certain volatile compounds by GC-MS technique. GC-MS analysis was performed at VIT-SIF lab, SAS, Chemistry division for NMR and GC-MS analysis, Vellore, Tamil Nadu, India. GC analysis was performed using the GC model (Clarius 680), furnished with a fused silica column, packed with elite-5MS (5% biphenyl 95% dimethylpolysiloxane, 30 m × 0.25 mm ID × 250µm df). Helium is used as carrier gas at a constant flow of 1ml /min. The injector temperature was set at 260 °C during the chromatographic run. The 1µl of sample extract was injected into the instrument. The oven temperature is 60 ºC (2 min.) followed by 300 °C at the rate of 10ºC min^{-1} and 300 °C where it was held for 6 min. The mass detector conditions were a transfer line temperature of 230 °C, an ion source temperature of 230 °C, an ionization mode electron impact at 70 ev, a scan time of 2 sec. and a scanning interval of 0.1 sec. The total run time was 31.14 min. Based on the obtained peak areas further work was carried out.

2.4 Identification of components

The spectrum of the components that were present in the sample was compared with the database of the spectrum of known components stored in the GCMS NIST (2008) library and also with the published literature.

3. Results

The yield of essential oil obtained by hydrodistillation of fresh material was 0.41% (w/w). The oil had a green-yellow colour. GC-MS analysis of essential oil from *Corchorus olitorius* fruit showed eight components (Figure1). The individual identified components, their molecular formula, molecular weight and their percentage were given in Table 1 and their total running time was 31.14 min. Their hit spectrum and structure are represented in Table 2. The detected major compounds were 2-Hexanone, 6-(Acetyloxy)-(29.25%),2-Pentanone, 4-Hydroxy-4-Methyl-(20.33%), Propane-1,1-DiolDiacetate (14.24%), Acetohydroxamic Acid (12.27%) and minor compounds were Pentanal, 2-Methylo-(7.67%), 2-Propanone, 1-(1-Methylethoxy)-(7.95%), 2-Propanone, 1-(1-Methylethoxy)-(4.46%), Diacetyl Sulphide (3.84%).

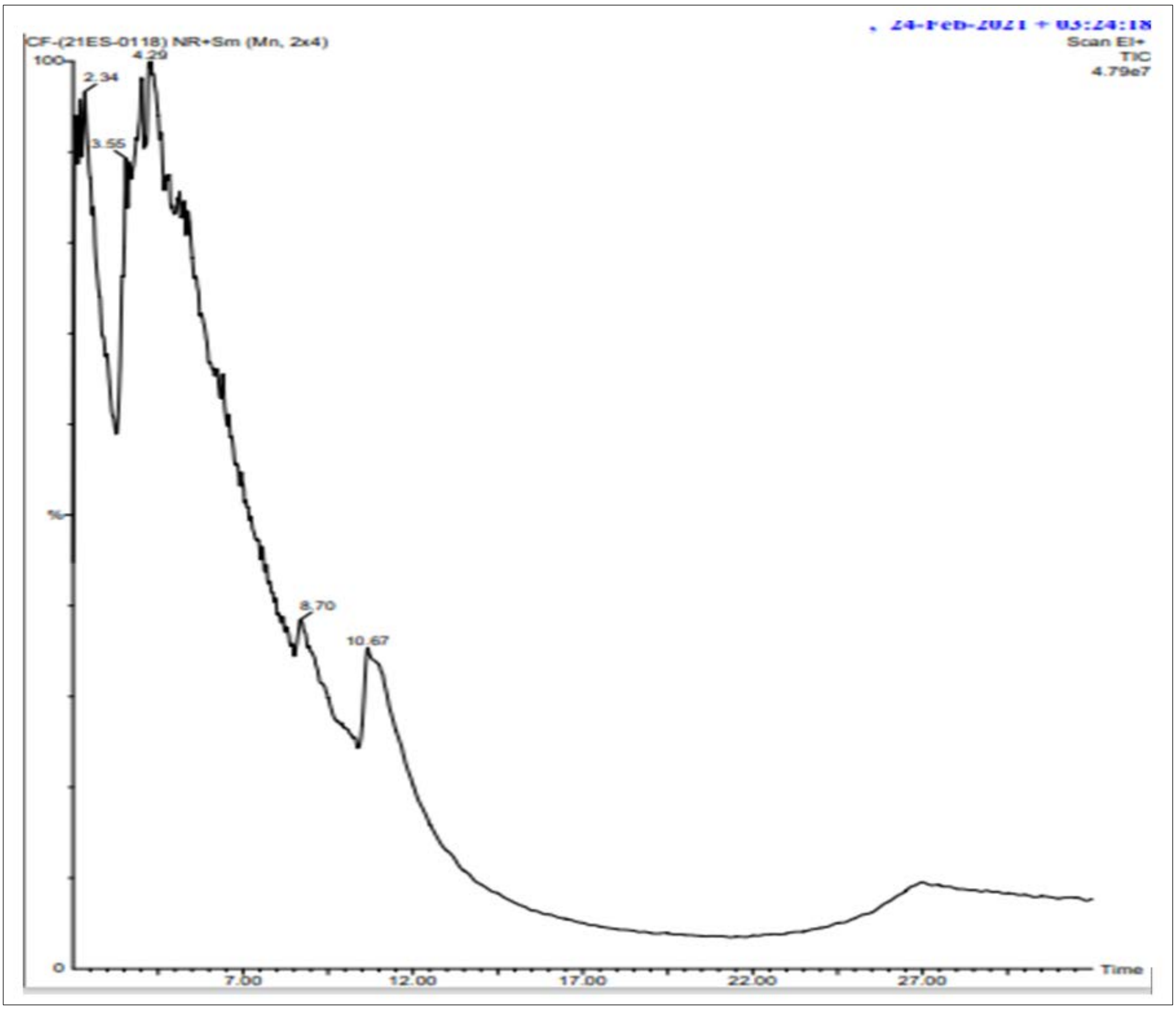
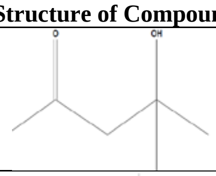
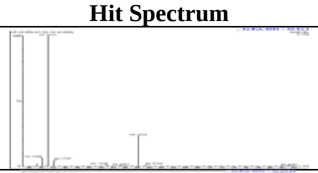
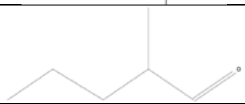
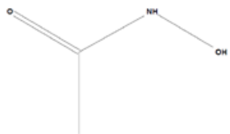
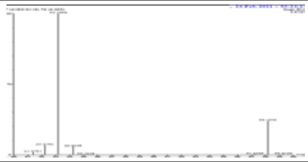
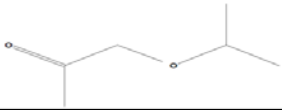
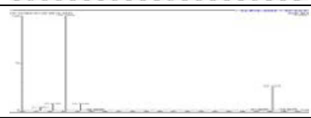
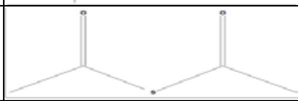
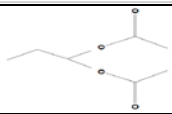
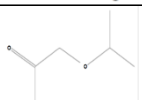


Fig 1: GC-MS Chromatogram of essential oil composition of *Corchorus olitorius* L.

Table 1: Chemical composition of essential oil of *Corchorus olitorius* L. fruit

S. No.	RT	Name of the compound	Molecular formula	Molecular weight	Peak area %
1	2.058	2-Pentanone, 4-Hydroxy-4-Methyl-	$C_6H_{12}O_2$	116	20.33
2	2.188	Pentanal, 2-Methylo-	$C_6H_{12}O$	100	7.67
3	2.359	Acetohydroxamic Acid	$C_2H_5O_2N$	75	12.27
4	2.444	2-Propanone, 1-(1-Methylethoxy)-	$C_6H_{12}O_2$	116	7.95
5	3.564	Diacetyl Sulphide	$C_4H_6O_2S$	118	3.84
6	4.299	Propane-1,1-Diol Diacetate	$C_7H_{12}O_4$	160	14.24
7	5.400	2-Propanone, 1-(1-Methylethoxy)-	$C_4H_6O_2S$	118	4.46
8	10.692	2-Hexanone,6(Acetyloxy)-	$C_8H_{14}O_3$	158	29.25

Table 2: Hit spectrum and structure of compounds identified in essential oil of *Corchorus olitorius* L. fruit

S. No.	Name of Compound	Structure of Compound	Hit Spectrum	Nature of Compound
1.	2-Pentanone, 4-Hydroxy-4-Methyl-			Alcohol
2.	Pentanal, 2-Methylo-			Aldehyde
3.	Acetohydroxamic Acid			Acetamide
4.	2-Propanone, 1-(1-Methylethoxy)-			Ether
5.	Diacetyl Sulphide			Sulphide compound
6.	Propane-1,1-Diol Diacetate			Diol
7	2-Propanone, 1-(1-Methylethoxy)-			Methyl ketone
8	2-Hexanone, 6-(Acetyloxy)-			Ketone

4. Discussion

The authentication of medicinal plants at both the genetic and chemical levels is a crucial step in using botanical materials for research and commercial purposes. For any living organism, establishing its identity is vital to distinguish it from others within its population and from other populations. In plant taxonomy, even in this molecular age, morphological characteristics continue to play a significant role in the systematic study of plants and serve as a means of classifying a particular taxon. Nowadays, alongside morphological markers, anatomical, cytological, biochemical and molecular markers are also employed to categorize organisms. Gas Chromatography-Mass Spectrometry (GC-MS) is a valuable tool for the identification of phytocompound [20, 21].

The analyses revealed a complex mixture of the essential oil consisting mainly of alcohol, aldehyde, acetamide, ether, sulphide, diol and ketone compounds. Correspondingly, Dung *et al.* (1999) [22] reported oxygenated compounds such as acetates, aldehydes, ketones, alcohols, acids and lactones from the essential oil of *Hibiscus abelmoschus* (Malvaceae).

2-Pentanone, 4-Hydroxy-4-Methyl-(20.33%) is a major compound in the present study and belongs to the ketone group is reported in ethyl acetate fraction of *Guiera senegalensis* with anit-microbial properties [23]. Similarly, Andal *et al.* (2018) [24] identified 2-pentanone, 4-hydroxy-4-methyl as a major component in fruits of *Schinus mole* and reported it as a source of natural antibiotic drug. In contrast, Hexadecanoic acid is reported as major compound in the essential oil of *Hibiscus sabdariffa* L [25].

Acetohydroxamic Acid (12.27%) a phenolic compound is identified as one of the major compounds in the methanolic extract of *Urtica dioica* [26] and it showed the highest anti-oxidant activity and it is also reported in the methanolic extract of *Withania somifera* stem with antibacterial activity [27]. Similarly, Musher *et al.*, (1974) [28] reported exerted anti-bacterial effect against gram-negative pathogen in dose-dependent manner.

Pentanal, 2-Methylo-(7.67%), is reported to possess antimicrobial properties [29]. The remaining compounds were reported for the first time in this study. Based on the literature, compounds identified in the essential oil of *Corchorus olitorius* varied significantly from other reports on the essential oil composition of Malvaceae. On the other hand, Delfine *et al*. [30] studied variation in *Malva sylvestris* essential oil in terms of yield, chemical composition and biological activity from different environments and reported that variation is influenced by various factors such as geographical coordinates, temperature, soil fertility and irrigation. From antiquity, essential oils have held significant value not only for their role in enhancing the flavors of foods and beverages but also for their remarkable properties as natural antimicrobial agents. In addition, in this study, one of the major identified compounds 2-Pentanone, 4-Hydroxy-4-Methyl is reported to have anti-microbial properties [23]. These considerations may lend credence to the anti-microbial property of this plant.

5. Conclusion

GC-MS analysis is the first step towards understanding the nature of active principles in medicinal plants and this type of study will be helpful for further detailed study. The presence of various bioactive compounds in the fruit oil of *Corchorus olitorius* greatly contributed to its pharmacological activities. This plant can serve as a new natural source for obtaining many therapeutically valued metabolites against various diseases. However, the isolation of individual phytochemical constituents and subjecting it to biological activity will give fruitful results.

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7. Conflicts of interest: Nil

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