

Comparative Analysis of Biochemical Compounds in Aqueous Extracts of Two *Cyperus* Species

Zainab H. Al-Bayati^{1*}, Nagham Y. Al-Bayati¹

¹Biological Department-College of Education for Pure Sciences –University of Diyala, Iraq

ABSTRACT

This study presents a comparative phytochemical analysis of the roots of *Cyperus rotundus* L. and *Cyperus alternifolius* using gas chromatography-mass spectrometry (GC-MS). Bioactive plant compounds were identified based on retention time, mass spectral fragmentation patterns, and molecular weight. The analysis revealed 22 bioactive compounds in the roots of *Cyperus rotundus* L. and 30 bioactive compounds in the roots of *Cyperus alternifolius*. These findings highlight the phytochemical diversity of the two *Cyperus* species and their potential biological applications, paving the way for further research into their therapeutic and pharmacological properties.

Keywords: *Cyperus Rotundus*, *Cyperus Alternifolius*, GC-MS

INTRODUCTION

The main source of chemicals with therapeutic activity is plants. The use of medicinal and aromatic plants to treat various diseases has become widespread worldwide, which has led to increased attention to their cultivation, incorporation into industries, and extraction of their active ingredients for use in the manufacture of pharmaceutical preparations instead of harmful chemicals with side effects [1]. The Arab world possesses a vast natural wealth of these plants, which have been used in traditional recipes. One of these medicinal plants is *Cyperus rotundus*. It is one of the most important plants that has been used extensively by ancient civilizations to treat various diseases. *Cyperus rotundus* is one of the medicines that were commonly employed in conventional Eastern medicine, mostly for the management of illnesses specific to women, including hormonal regulation in the body [2]. *Cyperus rotundus* is used to treat a variety of diseases. The rhizomes of *Cyperus rotundus* can safeguard the gastric mucosa from damage as a result of stomach ulcers [3]. Due to its alkaloid content, this plant is used to lower blood cholesterol, treat stomach disorders and inflammations, and treat obesity, diabetes, malaria, and cancer [4]. *Cyperus alternifolius* is a natural plant with many health benefits. It is used in traditional medicine and has several uses. It is considered an anti-inflammatory and it is believed that some of the compounds found in *Cyperus alternifolius* can help relieve pain from conditions such as headaches and joint pain [5]. Some studies indicate that *Cyperus alternifolius* contains antioxidant, antibacterial, and antifungal compounds and is used as an analgesic and nerve relaxant [6]. The current study's objective was to investigate the physiologically active chemical compounds present in the aqueous extract of the roots of the *Cyperus rotundus* plant and the *Cyperus alternifolius* plant.

MATERIALS AND METHOD

Collect Plants

The roots of the *Cyperus Alternifolius* plant and the *Cyperus rotundus* plant were collected from agricultural land and home gardens in the Baladruz district / in September 2023 in Diyala Governorate. The plants were documented at the Natural History Research and Museum Center / University of Baghdad. Then the plants

were washed with water to remove the soil from them while preserving the Trichoblasts or the (root hairs) and then they were dried by placing them between newspaper sheets in a place that is not dark or sunny and at ambient temperature. Next, each plant's roots were pulverized with an electric grinder.

The Method of Chemically Analyzing the Plant Extract Using (GC-MS)

The plants were extracted using the AOAC 1995 method. A weight of 10 grams of the dried sample was taken and placed in a filter paper. The 250 ml of water was added to it and around five hours passed throughout the extraction procedure. The solvent collected from the device; flask was removed and placed in another flask. It was placed in a water bath at a temperature of 80°C to ensure the evaporation of the solvent residues and the remaining organic matter to be extracted. It was left to cool and then the required tests were performed on it using the special analysis device.

Results and Discussion

The plant compounds of the aqueous extract were identified using GC-MS technology, this is a quick and straightforward analytical method for determining secondary metabolites. It just requires a few grams of plant material. An analysis of the compounds of the aqueous extract of the roots of the *Cyperus rotundus* L. plant was performed. It is shown in Table (1).

And the roots of the *Cyperus alternifolius* plant. It is shown in Table (2). The mechanism used to identify the active compounds in Table (1) and Table (2) is determined by each plant's peak area, retention duration, structural formula, molecular weight, and biological activity.

The most effective chemical compounds for *Cyperus rotundus* have been identified: n-Hexadecanol, Henicosane, Palmitic acid, n-tetracosan, Nonadecanol, Docosane, Petroselinic acid, n-tetracontane, Tetratriacontane, Dotriacontane, Oleic acid amide, Hexatriacontane, Glycidyl oleate, 2-Methylhexacosane, Tetratriacontane, n-Hexatriacontane, Triacontane, 1-iodo, n-

Hexatriacontane , Squalene ,Pentatriacontane ,Hexatriacontane, Tetrapentacontane 22 peaks of the chemical compounds used were

obtained, which were displayed in the GC_MS chromatogram, which is shown in Figure 1.

Table 1: Phytocomponents Identified in the Roots of the *Cyperus Rotundas* Plant.

No.	Retention Time	Chemical Compound Name	Molecular Formula	Molecular Weight	Peak Area	Structural Formula	Biological Activity
1	17.512	n-Hexadecanol	C16H34O	242	1.65		antibacterial
2	17.876	Henicosane	C21H44	296	0.88		antibacterial
3	18.659	Palmitic acid	C16H32O2	256	7.56		Antioxidant, antimicrobial, anti-inflammatory Inhibitor
4	18.870	n-Tetracosan	C24H50	338	1.10		antibacterial
5	19.564	Nonadecanol	C19H40O	284	5.19		antibacterial activity
6	19.820	Docosane	C22H46	310	2.32		Inhibitor
7	20.583	Petroselinic acid	C18H34O2	282	15.88		Inhibitor
8	20.747	n-Tetracontane	C40H82	562	4.11		Antimicrobial Activity, Antioxidant
9	21.618	Tetratriacontane	C34H70	562	5.20		antibacterial activity
10	22.457	Dotriacontane	C32H66	450	5.68		antioxidant, antimicrobial, and antitumor agent,
11	23.120	Oleic acid amide	C18H35NO	281	1.88		Antimicrobial
12	23.266	Hexatriacontane	C36H74	506	6.12		antioxidant activity
13	23.549	Glycidyl oleate	C21H38O3	338	1.20		antimicrobial, and antitumor agent,
14	23.676	-2Methylhexacosane	C27H56	380	1.13		Antimicrobial
15	24.039	Tetratriacontane	C34H70	478	5.55		antimicrobial
16	24.789	n-Hexatriacontane	C36H74	506	5.33		antimicrobial
17	25.175	Triacontane, 1-iodo	C30H61I	548	1.24		Antioxidant activity
18	25.518	n-Hexatriacontane	C36H74	506	4.94		Antimicrobial
19	25.650	Squalene	C30H50	410	1.66		anticancer, antioxidant, activities
20	25.887	Pentatriacontane	C35H72	492	3.23		Antimicrobial
21	26.225	Hexatriacontane	C36H74	506	4.43		Antimicrobial
22	26.995	Tetrapentacontane	C54H110	758	4.34		Antimicrobial

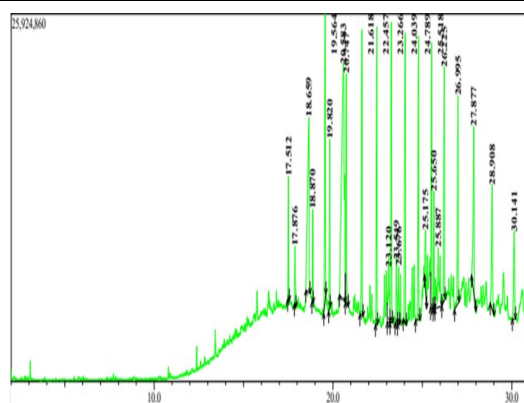


Figure 1: GC-MS Chromatogram of Aqueous Extract *Cyperus Rotundus*

The most effective chemical compounds for *Cyperus Alternifolius* have been identified: H-3a,7-Methanoazulene,3 2,4,5,6,7,8-hexahydro-1,4,9,9-tetramethyl-, [3Ar-(3a.alpha.,4.beta.,7.alpha.), Eugenol, Rotundene, 2-Tetradecenal, Caryophyllene oxide, Pogostole ,8- Isopropyl-1,5-dimethyltricyclo[4.4.0.0.2,7]dec-4-en-3-one3 ,Ar,4R,7R)-1,4,9,9-Tetramethyl-3,4,5,6,7,8-hexahydro-2H-3a,7-methanoazulen-2-one, Pentadecanol , Henicosane1)2 ,H)-Naphthalene, 4a,5,6,7,8,8a-hexahydro-6-[1-(hydroxymethyl)ethenyl]-4,8a-dimethyl-, [4ar-

(4a.alpha.,6.alpha.,8a.beta. , Hexadecanoic acid, Tetracosane, Nonadecanol9, Methoxycalamenene_,Docosan-8 ,Nonadecenoic acid10 , E,12Z-Octadecadienoic acid, Triacontane,, Tetracontane, Ageratriol triacetate, Dotriacontan, Tetracontan, Glycidol oleate, Hexatriacontane, Tetracontane, Dotriacontan 22 ,Tricosenoic acid_ , Hexatriacontane, Ginnon.

35 peaks of the chemical compounds used were obtained, which were displayed in the GC_MS chromatogram, which is shown in Figure 2.

Table 2: Phytocomponents Identified in the Roots of the *Cyperus Alternifolius* Plant.

No.	Retention Time	Chemical Compound Name	Molecular Formula	Molecular Weight	Peak Area	Structural Formula	Biological Activity
1	11.855	H-3a,7-Methanoazulene,3,2,4,5,6,7,8-hexahydro-1,4,9,9-tetramethyl-, [3Ar-(3a.alpha.,4.beta.,7.alpha.)]	C ₁₅ H ₂₄	204	2.57		antibacterial
2	12.391	Eugenol	C ₁₀ H ₁₂ O ₂	164	0.56		antifungal, antibacterial, antioxidant, and anti-inflammatory
3	12.841	Rotundene	C ₁₅ H ₂₄	204	1.07		anti-inflammatory
4	14.353	€-2-Tetradecenal	C ₁₄ H ₂₆ O	210	0.61		anti-bacterial activity
5	15.023	Caryophyllene oxide	C ₁₅ H ₂₄ O	220	0.68		anticancer activities
6	15.719	Pogostole	C ₁₅ H ₂₆ O	222	0.67		antioxidant, antitumor,
7	16.574	8-Isopropyl-1,5-dimethyltricyclo[4.4.0.0.2,7]dec-4-en-3-one	C ₁₅ H ₂₂ O	218	0.95		Antioxidant
8	218:	⊕3Ar,4R,7R)-1,4,9,9-Tetramethyl-3,4,5,6,7,8-hexahydro-2H-3a,7-methanoazulen-2-one	C ₁₅ H ₂₂ O	218	3.46		Antioxidant
9	17.529	Pentadecanol	C ₁₅ H ₃₂ O	228	2.19		antibacterial activity
10	17.885	Henicosane	C ₂₁ H ₄₄	296	0.96		antibacterial
11	18.575	1)2H)-Naphthalenone, 4a,5,6,7,8,8a-hexahydro-6-[1-(hydroxymethyl)ethenyl]-4,8a-dimethyl-, [4ar-(4a.alpha.,6.alpha.,8a.beta.)]	C ₁₅ H ₂₂ O ₂	234	1.88		Unknown
12	18.67	Hexadecenoic acid	C ₁₆ H ₃₂ O ₂	256	3.57		Anti-oxidant, antimicrobial, anti-inflammatory
13	18.878	Tetracosane	C ₂₄ H ₅₀	338	1.08		Inhibitor
14	19.583	Nonadecanol	C ₁₉ H ₄₀ O	284	4.58		antibacterial
15	19.672	-9Methoxycalamenene	C ₁₆ H ₂₄ O	232	2.68		Unknown
16	19.827	Docosan	C ₂₂ H ₄₆	310	2.05		antibacterial
17	20.597	-18Nonadecenoic acid	C ₁₉ H ₃₆ O	548	9.48		antibacterial and antifungal activity
18	20.665	10E,12Z-Octadecadienoic acid	C ₁₈ H ₃₂ O ₂	280	1.09		Anticarcinogen Antic activity
19	20.75	Triacotane	C ₃₀ H ₆₂	422	2.70		Antioxidant activity
20	21.628	Tetracontane	C ₃₄ H ₇₀	478	5.55		antimicrobial
21	21.943	Ageratriol triacetate	C ₂₁ H ₃₀ O ₆	378	1.24		Antimicrobial
22	23.273	Dotriacontan	C ₃₂ H ₆₆	450	4.88		Antimicrobial Activity, Antioxidant
23	23.273	Tetracontan	C ₃₄ H ₇₀	478	5.58		antimicrobial
24	23.551	Glycidol oleate	C ₂₁ H ₃₈ O ₃	338	1.01		antioxidant, antimicrobial, and antitumor agent, antioxidant activity
25	24.048	Hexatriacontane	C ₃₆ H ₇₄	506	4.94		antimicrobial
26	24.799	:Tetracontane	C ₃₄ H ₇₀	478	4.46		antimicrobial
27	25.528	Dotriacontan	C ₃₂ H ₆₆	450	4.52		Antimicrobial Activity, Antioxidant
28	25.691	-22Tricosenoic acid	C ₂₃ H ₄₄ O ₂	352	1.08		Antioxidant activity
29	26.235	Hexatriacontane	C ₃₆ H ₇₄	506	4.25		antioxidant activity
30	27.009	Ginnon	C ₂₉ H ₅₈ O	422	4.08		antioxidant and antimicrobial

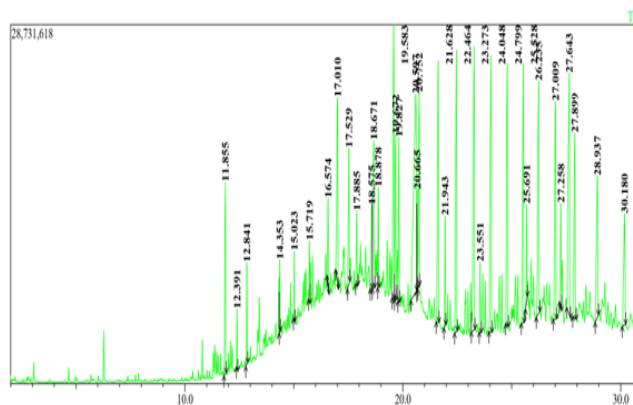


FIGURE 2: GC-MS Chromatogram of Aqueous Extract *Cyperus Alternifolius*

Since ancient times, traditional medical systems have employed plants, and the hunt for novel medications is frequently guided by traditional knowledge of medicinal plants [7, 8]. *Cyperus* was used to treat various ailments worldwide before the development of contemporary clinical medications because it grows wild, is inexpensive, and provides an excellent source for treating many diseases [9]. There is growing knowledge of the connections between the biological roles of phytochemicals [10, 11]. In the present study, GC-MS was used to identify the most potent compounds, which are previously mentioned in Tables 1 and 2. The results were obtained from the aqueous extract of the roots of *Cyperus rotundus* and compared with the alcoholic extract of the roots of *Cyperus rotundus*, which was studied by Rafat *et al.* [12]. The discovery was made that the alcoholic extract contains more potent compounds than the aqueous extract prepared in this study. A major factor in accurately predicting plant components from plant material is the kind of solvent utilized during the extraction procedure. This is due to the solubility of the compounds in alcohol and their insolubility in water [13]. The aqueous extract of *Cyperus rotundus* roots revealed varying quantities of glycosides by quantitative measurement, alkaloids, flavonoids, alkaloids, phenolic acids, and essential oils. These phytochemicals exhibit antibacterial, anticancer, antioxidant, anti-arthritis, anti-menstrual pain, anti-stomach pain, anti-inflammatory,

antimicrobial, and antiviral activities [14, 15]. The results obtained in the present study for the roots of *Cyperus alternifolius* were compared with the alcoholic extract of the leaves of *Cyperus alternifolius* studied by Neepel *et al.* [16]. It was found that the alcoholic extract of *Cyperus alternifolius* leaves is more potent than the aqueous extract of *Cyperus alternifolius* roots, due to the better solubility of the active ingredients in organic solvents. Quantitative analysis of the aqueous extract of *Cyperus alternifolius* roots showed the presence of irregular levels of phenolic acids, alkaloids, flavonoids, sitosterol, and carboxyl. These compounds exhibit biological activities that are beneficial as antioxidants, antimicrobials, anticancer, anti-tuberculosis, anti-vascular, anti-arthritis, anti-neural, anti-diabetic, and anti-osteoporosis [17-19][20].

Conclusion

Using GC-MS, a phytochemical investigation of the roots of *Cyperus alternifolius* and *Cyperus rotundus* L. plants was carried out. The identification of biologically active plant chemicals was conducted using retention time, molecular weight, and MS fragmentation. *Cyperus alternifolius* roots had 30 bioactive compounds, and *Cyperus rotundus* L. roots contained 22 bioactive compounds, according to the research.

References

- [1] R. Nieder, D. K. Benbi, F. X. Reichl, R. Nieder, D. K. Benbi, and F. X. Reichl, "Reactive water-soluble forms of nitrogen and phosphorus and their impacts on environment and human health," *Soil components and human health*, pp. 223-255, 2018.
- [2] M. J. Pennino, J. E. Compton, and S. G. Leibowitz, "Trends in drinking water nitrate violations across the United States," *Environmental science & technology*, vol. 51, no. 22, pp. 13450-13460, 2017.
- [3] K.-J. Soumaya *et al.*, "Pharmacological, antioxidant, genotoxic studies and modulation of rat splenocyte functions by *Cyperus rotundus* extracts," *BMC Complementary and Alternative Medicine*, vol. 13, pp. 1-11, 2013.
- [4] A. Amer, "Biotechnology approaches for in vitro production of flavonoids," *The Journal of Microbiology, Biotechnology and Food Sciences*, vol. 7, no. 5, p. 457, 2018.
- [5] A. H. Ahmed, "Chemical and biological studies of *Cyperus alternifolius* flowers essential oil," 2012.
- [6] A. S. Awaad, G. A. Soliman, D. F. El-Sayed, O. D. El-Gindi, and S. I. Alqasoumi, "Hepatoprotective activity of *Cyperus alternifolius* on carbon tetrachloride-induced hepatotoxicity in rats," *Pharmaceutical Biology*, vol. 50, no. 2, pp. 155-161, 2012.
- [7] K. Balamurugan, A. Nishanthini, and V. R. Mohan, "GC-MS analysis of *Polycarpaea corymbosa* (L.) Lam whole plant," *Asian Pacific Journal of Tropical Biomedicine*, vol. 2, no. 3, pp. S1289-S1292, 2012.
- [8] K. G. Karikalan Gopalakrishnan and R. U. Rajangam Udayakumar, "GC-MS analysis of phytochemicals of leaf and stem of *Marsilea quadrifolia* (L.)," 2014.
- [9] P. M. Richardson, "Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.: By Jeffrey B. Harborne. Routledge, Chapman & Hall, 29 West 35th St., New York, NY 10001. ISBN 0-412-34330-4. Paper edition 1988. 288 pp. \$39.50," ed: Springer, 1990.
- [10] G. Selvamangai and A. Bhaskar, "GC-MS analysis of phytochemicals in the methanolic extract of *Eupatorium triplinerve*," *Asian Pacific Journal of Tropical Biomedicine*, vol. 2, no. 3, pp. S1329-S1332, 2012.
- [11] L. W. Sumner, P. Mendes, and R. A. Dixon, "Plant metabolomics: large-scale phytochemistry in the functional genomics era," *Phytochemistry*, vol. 62, no. 6, pp. 817-836, 2003.
- [12] B. Z. Rafat, B. Kareppa, and A. S. Kadam, "GC-MS analysis of ethanol extract of aerial and underground parts of *Cyperus rotundus* L.," *Journal of Pharmacognosy and Phytochemistry*, vol. 12, no. 2, pp. 204-208, 2023.

- [13] H. J. de Boer, A. Kool, A. Broberg, W. R. Mziray, I. Hedberg, and J. J. Levenfors, "Anti-fungal and anti-bacterial activity of some herbal remedies from Tanzania," *Journal of ethnopharmacology*, vol. 96, no. 3, pp. 461-469, 2005.
- [14] N. Singh, B. Pandey, P. Verma, M. Bhalla, and M. Gilca, "Phyto-pharmacotherapeutics of *Cyperus rotundus* Linn. (Motha): an overview," 2012.
- [15] Z. A. AL-Hilli, E. F. AL-Jumaily, and N. Y. Yaseen, "Role of volatile oils fraction of *Cyperus rotundus* in induction of apoptosis on cancer cell lines in vitro," *Iraqi J. Biotech*, vol. 9, no. 2, pp. 286-298, 2010.
- [16] a. Al-Gara, Neepal Imtair, N. A. Abu-Serag, K. A. Alee Shaheed, and Z. K. A. Bahadly, "Analysis of bioactive phytochemical compound of (*Cyperus alternifolius* L.) by using gas chromatography–mass spectrometry," in *IOP conference series: Materials science and engineering*, 2019, vol. 571: IOP Publishing, p. 012047.
- [17] G. Belz, K. Breithaupt-Grögler, and U. Osowski, "Treatment of congestive heart failure—current status of use of digitoxin," *European journal of clinical investigation*, vol. 31, no. S2, pp. 10-17, 2001.
- [18] H. A. Elbaz, T. A. Stueckle, W. Tse, Y. Rojanasakul, and C. Z. Dinu, "Digitoxin and its analogs as novel cancer therapeutics," *Experimental hematology & oncology*, vol. 1, pp. 1-10, 2012.
- [19] X. Luo, P. Su, and W. Zhang, "Advances in microalgae-derived phytosterols for functional food and pharmaceutical applications," *Marine drugs*, vol. 13, no. 7, pp. 4231-4254, 2015.
- [20] M. T. Ghaneian, M. H. Ehrampoush, A. Jebali, S. Hekmatimoghaddam, and M. Mahmoudi, "Antimicrobial activity, toxicity and stability of phytol as a novel surface disinfectant," *Environmental Health Engineering and Management Journal*, vol. 2, no. 1, pp. 13-16, 2015.



This is an open-access article distributed under the terms of the Creative Commons Attribution License.