Matricaria chamomilla: Bioactive Compounds of Methanolic Fruit Extract Using GC-MS and FTIR Techniques and Determination of its Antimicrobial Properties

Rafid Hadi Hameed¹, Ghaidaa Jihadi Mohammed², Imad Hadi Hameed³

¹Ministry of Health, Mesan Health office, Mesan city, Iraq; ²Department of Biology, College of Science, University of Al-Qadisiyah, Hillah city, Iraq; ³Biomedical Science Department, University of Babylon, College of Nursing, Hillah city, Iraq

ABSTRACT

Matricaria chamomilla is the most popular source of the herbal product chamomile, although other species are also used as chamomile. The objectives of our study were analysis of the secondary metabolite products. Nineteen bioactive compounds were identified in the methanolic extract of Matricaria chamomilla. The identification of bioactive chemical compounds is based on the peak area, retention time molecular weight and molecular formula. GC-MS analysis of Matricaria chamomilla revealed the existence of the 4-Amino-1,5-pentandioic acid, (R)-lavandulyl acetate, 1,3-Diazacyclooctane-2-thione, Glucosamine, N-acetyl-N-benzoyl-Trans-Traumatic acid, Dodecanoic acid, 3-hydroxy-Cyclopentanone, 2-cyclopentylidene-(E)-β-Farnesene, 1-Naphthalenol, 2-methyl-Pregn-4-ene,3,20-dione, 17,21-dihydroxy-bis(O-methyloxime), 9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z), Pyrazole[4,5-b]imidazole,1-formyl-3-ethyl-6-β-d-ribofuranosyl, 1,6-Dioxaspiro[4.4]non-3-ene,2-(2,4-hexadiynylidene)-, 9,12-Octadecadienoic acid (Z,Z)-, 9-Octodecanamide, (Z)-, 1,2-Benzenedicarboxylic acid, bis(8-methylnonyl) ester, Carda-4,20(22)-dienolide, 3-[(6-deoxy-3-O-methyl-α-D-allopyranose)Campesterol. Maximum zone formation was against Proteus mirabilis 6.01±0.23. Matricaria chamomilla was very highly active against Aspergillus terreus 5.89±0.24.

Keywords: Matricaria chamomilla, Bioactive compounds, Antimicrobial, Methanol, Fruit, GC-MS.

INTRODUCTION

Matricaria chamomilla has a branched, erect and smooth stem, which grows to a height of 15–60 cm (6–23.5 in)¹. The long and narrow leaves are bipinnate or tripinnate. The flowers are borne in paniculate flower heads (capitula). The white ray florets are furnished with a ligule, while the disc florets are yellow ²–⁷. The hollow receptacle is swollen and lacks scales. It can be taken as an herbal tea, two teaspoons of dried flower per cup of tea, which should be steeped for 10 to 15 minutes while covered to avoid evaporation of the volatile oils. For a sore stomach, some recommend taking a cup every morning without food for two to three months⁸–¹³. M. chamomilla can be found near populated areas all over Europe and temperate Asia, and it has been widely introduced in temperate North America and Australia⁸–³¹. It often grows near roads, around landfills, and in cultivated fields as a weed, because the seeds require open soil to survive. One of the active ingredients of its essential oil is the terpene bisabolol ¹⁴–²⁷. Other active ingredients include farnesene, chamazulene, flavonoids (including apigenin, quercetin, patuletin and luteolin) and coumarin²⁸–³⁷. Dried chamomile has a reputation (among herbalists) for being incorrectly prepared because it is dried at a temperature above the boiling point of the volatile components of the plant ³⁸–³⁹. The aims of this study were analysis of the secondary metabolite products and evaluation of its antibacterial and antifungal activities.
MATERIAL AND METHOD

Gas chromatography–Mass Spectrum: *Matricaria chamomilla* GC–MS analysis were carried out in a GC system (Agilent 7890A series, USA). The column temperature was kept at 40°C for 1 min followed by linear programming to raise the temperature from 40°C to 120°C (at 4°C min−1 with 2 min hold time), 120°C to 170°C (at 6°C min−1 with 1 min hold time) and 170°C to 200°C (at 10°C min−1 with 1 min hold time)40.

Fourier transform infrared spectrophotometer (FTIR): The powdered *Matricaria chamomilla* was treated for Fourier transform infrared spectrophotometer (Shimadzu, IR Affinity 1, Japan). The sample was run at infrared region between 400 nm and 4000 nm41.

Determination of antibacterial and antifungal activity of crude bioactive compounds of *Matricaria chamomilla*: The test bacterial pathogens were swabbed in Müller-Hinton agar plates. Sixteen μL of *Matricaria chamomilla* extract was loaded on the bored wells. The wells were bored in 0.5 cm in diameter 42. The plates were incubated at 37°C for 24 h and examined. After the incubation the diameter of inhibition zones around the discs was measured. Five-millimeter diameter wells were cut from the agar using a sterile cork-borer, and fifty μl of the samples solutions *Matricaria chamomilla* was delivered into the wells. Antimicrobial activity was evaluated by measuring the zone of inhibition against the test microorganisms. Methanol was used as solvent control. Amphotericin B and fluconazole were used as reference antifungal agent. The tests were carried out in triplicate. The antifungal activity was evaluated by measuring the inhibition-zone diameter observed after 48 h of incubation43-46.

Statistical analysis: Results of the study were based on analysis of variance (ANOVA) using Statistica Software. A significance level of 0.05 was used for all statistical tests.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Phytochemical compound</th>
<th>RT (min)</th>
<th>Molecular Weight</th>
<th>Exact Mass</th>
<th>Pharmacological actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4-Amino-1,5-pentandioic acid</td>
<td>4.185</td>
<td>175</td>
<td>175.084458</td>
<td>anti-proliferative activity</td>
</tr>
<tr>
<td>2.</td>
<td>(R)-lavandulyl acetate</td>
<td>4.472</td>
<td>196</td>
<td>196.1463</td>
<td>antioxidant activity</td>
</tr>
<tr>
<td>3.</td>
<td>1,3-Diazacyclooctane-2-thione</td>
<td>5.576</td>
<td>144</td>
<td>144.0721</td>
<td>Unknown</td>
</tr>
<tr>
<td>4.</td>
<td>Glucosamine , N-acetyl-N-benzoyl-</td>
<td>5.851</td>
<td>325</td>
<td>325.116152</td>
<td>Unknown</td>
</tr>
<tr>
<td>5.</td>
<td>Trans – Traumatic acid</td>
<td>6.182</td>
<td>228</td>
<td>228.136159</td>
<td>anti-hyperalgesic</td>
</tr>
<tr>
<td>6.</td>
<td>Dodecanoic acid , 3-hydroxy-</td>
<td>7.338</td>
<td>216</td>
<td>216.172545</td>
<td>anti-HIV activity</td>
</tr>
<tr>
<td>7.</td>
<td>Cyclopentanone , 2-cyclopentylidene-</td>
<td>7.951</td>
<td>150</td>
<td>150.1044655</td>
<td>anti-inflammatory activity</td>
</tr>
<tr>
<td>8.</td>
<td>(E)-β-Famesene</td>
<td>8.374</td>
<td>204</td>
<td>204.1878</td>
<td>Anti-Infective</td>
</tr>
<tr>
<td>9.</td>
<td>1-Naphthalenol , 2-methyl-</td>
<td>8.443</td>
<td>158</td>
<td>158.073165</td>
<td>anti-inflammatory</td>
</tr>
<tr>
<td>11.</td>
<td>9,12,15-Octadecatrienoic acid ,2,3-dihydroxypropyl ester , (Z)</td>
<td>10.972</td>
<td>352</td>
<td>352.26136</td>
<td>antiviral and anti-obesity properties</td>
</tr>
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<td>13.</td>
<td>1,6-Dioxaspiro[4.4]non-3-ene,2-(2,4-hexadimylidine)-</td>
<td>12.980</td>
<td>200</td>
<td>200.08373</td>
<td>anti-inflammatory, analgesic, antipyretic</td>
</tr>
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<td>14.</td>
<td>9,12-Octadecadienoic acid (Z,Z)-</td>
<td>15.406</td>
<td>280</td>
<td>280.24023</td>
<td>anti-inflammatory</td>
</tr>
<tr>
<td>15.</td>
<td>9-Octadecenamide,(Z)-</td>
<td>17.317</td>
<td>281</td>
<td>281.271864</td>
<td>anti-inflammatory antibacterial activity</td>
</tr>
</tbody>
</table>
RESULTS AND DISCUSSION

Identification of biochemical compounds: Analysis of compounds was carried out in methanolic extract of *Matricaria chamomilla*, shown in Table 1. Chromatogram GC-MS analysis of the methanol extract of *Matricaria chamomilla* showed the presence of thirty one major peaks and the components corresponding to the peaks were determined as follows. All peaks were determined to be 4-Amino-1,5-pentandioic acid, (R)-lavandulyl acetate, 1,3-Diazacyclooctane-2-thione, Glucosamine, N-acetyl-N-benzoyl-, Trans – Traumatic acid, Dodecanoic acid, 3-hydroxy-, Cyclopentanone, 2-cyclopentylidene-ethane, (E)-β-Famesene, 1-Naphthalenol, 2-methyl-, Pregn-4-ene,3,20-dione,17,21-dihydroxy-bis(O-methylxoxime), 9,12,15-Octadecatrienoic acid,2,3-dihydroxypropylester, (Z), Pyrazole[4,5-b]imidazole,1-formyl-3-ethyl-6-β-d-ribofuranosyl-, 1,6-Dioxaspiro[4.4]non-3-ene,2-(2,4-hexadiynylidene), 9,12-Octadecadienoic acid (Z,Z)-, 9-Octadecenamide,(Z)-, 1,2-Benzenedicarboxylic acid, bis(8-methylonylnonyl) ester, Carda-4,20(22)-dienolide, 3-[(6-deoxy-3-O-methyl)-D-allopyranosyl and Campesterol. The FTIR analysis of *Matricaria chamomilla* leaves proved the presence of alkyl halides, alkenes, Amide, alkanes, and aldehydes which shows major peaks at 667.37, 756.10, 869.90, 889.18, 947.05, 1018.41, 1091.71, 1190.08, 1199.72, 1317.38, 1608.63, 1721.65, 1732.08, 2330.01, 2358.94, 2461.17, 2820.28, 2904.80 and 2929.87. In our research, the anti-microbial activity of *Matricaria chamomilla* extract was determined by determining the zone of inhibition against eight bacteria and eight fungi and yeast. Clinical pathogens were selected for antibacterial activity namely, *Streptococcus pneumonia*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Staphylococcus epidermidis*, *Bacillus subtilis*, *Escherichia coli*, *Proteus mirabilis*, and *Streptococcus pyogenes*. Maximum zone formation was against *Proteus mirabilis* 6.01±0.23. Methanolic extraction of *Matricaria chamomilla* showed notable antifungal activities against *Trichoderma horzianum*, *Candida albicans*, *Aspergillus niger*, *Aspergillus terreus*, *Saccharomyces cerevisiae*, *Microsporum canis*, *Trichoderma viride*, and *Penicillium expansum*. *Matricaria chamomilla* was very highly active against *Aspergillus terreus* 5.89±0.24. In comparison to the antibiotics used in this study, the plants extracts were far more active against the test bacterial strains47.

CONCLUSION

Medicinal property of *Matricaria chamomilla* methanolic extract is due to presence of secondary metabolites. Eleven bioactive chemical compounds were identified by GC-MS analysis. This *Matricaria chamomilla* derived bioactive compounds used as source of antibiotic properties and pharmaceutical industries used for drug formulation.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All our protocols were approved under the Department of Biology, College of Science for women, University of Babylon, Hillah city, Iraq and all experiments were carried out in accordance with approved guidelines.

REFERENCES


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