Possible antifungal and antibacterial constituents in inflorescence extract of *Carthamus oxycantha*

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Abstract

The objective of the present study was to identify possible antifungal and antibacterial compounds in methanolic extract of inflorescence of *Carthamus oxycantha*, a weed of family Asteraceae. Methanolic extract was obtained by soaking 5 g of dried and powdered inflorescence in 100 mL methanol for 14 days. Analysis of the methanolic leaf extract revealed the presence of 103 organic compounds. Most abundant compounds were Phosphoric acid, bis(trimethylsilyl)monomethyl ester (7.41%), D-Ribofuranose, 5-deoxy-5-(methylsulfinyl)-1,2,3-tris-O-(trimethylsilyl)- (7.19%), Benzoic acid, 4-hydroxy-3-methoxy-, methyl ester (6.27%), 13-Retinoic acid, (Z)- TMS derivative (5.18%), 9-Octadecenoic acid, (E)-, TMS derivative (4.92%), Bis(2-ethylhexyl) phthalate (4.61%), and 5-Amino-8-hydroxyquinoline, N,O-bis(trimethylsilyl) - (4.14%). Out of 103 compounds, 4 compounds were found having antibacterial and/or antifungal properties. These compounds were 9-Octadecenoic acid, (E)-, TMS derivative (5); Bis(2-ethylhexyl) phthalate (6); 2,4-Thiazolidinedione (19); γ-Sitosterol (32); 4-Hydroxybutanoic acid, 2TMS derivative (40). This study concludes that methanolic inflorescence extract is a rich source of antimicrobial agents.

Keywords: Antibacterial, Antifungal, Asteraceae, *Carthamus oxycantha*, GC-MS, Inflorescence extract.

Introduction

Asteraceae is a family of enormous flowering plants which under 13 subfamilies and 1,911 genera, comprises 32,913 species (Kadereit and Jeffrey, 2007). Recent phylogenetic analysis revealed that it is also well known for its diversity as it includes different types of plants (Panero et al., 2014; Katinas et al., 2016). The most of species of this family have been reported for their bioactivity against microbes and are widely applicable in drugs (Bessada et al., 2015). Similarly, the highest flavonoid and phenolic compounds in this family enhance its medicinal importance (Koc et al., 2015). The plant extracts of Asteraceae family are being reported as antimicrobial agents against the disease (Filho et al., 2008).

*Carthamus oxycantha* (wild safflower) is a weed belonging to the Asteraceae family. It is widely found on barren lands, along the water channels, and the banks of cropping areas. In Pakistan, this medicinal plant is also found along the Motorway linking capital Islamabad with Lahore (Ahmad, 2007). Its seeds and leaves are being used for treatment of Jaundice and ulcer (Mahmood et al., 2011; Marwat and Khan, 2012). Pandey and Singh (2017) enlisted more medicinal uses of this weed in India including itching, bronchitis and for improving blood circulation. The extract of *C. oxycantha* with different solvents has been proved effective against bacteria (Raza et al., 2015). In the current research work, GC-MS analysis of methanolic extract of inflorescence of *C. oxycantha* was carried out to enlist various compounds present in the extract, followed by literature survey to identify antibacterial and antifungal compounds.

Materials and Methods

Preparation of methanolic extract

*C. oxycantha* was collected from a barren land in Lahore. Inflorescence was separated, dried and crushed to change it into powder form. The weighed amount of powdered (5 g) was soaked in 100 mL methanol for 14 days. After the completion of said period, the material was passed from a muslin cloth and the liquid was passed through a filter paper. The extract was used for GC-MS analysis.

GC-MS Analysis

A volume of 0.3 mL of methanolic inflorescence extract was transferred to GC vials and dried overnight in a SpeedVac system. The extract was subjected to methoximation with methoxamine hydrochloride (Sigma) at 30 °C for 90 min. The sample was silylated with BSTFA/TCMS (Sigma) at 60 °C for 30 min, and then subjected to gas chromatography-mass spectrometry (GC-MS) on an Agilent 7890C gas chromatograph in tandem with a 5975C MSD. The GC oven program began with at 80 °C and was held for 1.0 minute ramped at 15 °C min⁻¹ to 320 °C which was held for 3 min. The mass range was set from 40–800 m/z. The separation column was an HP5MSI (30 m long, 0.250 mm ID, 0.25 μm film thickness). The mass spectrometer operated under standard conditions with a 230 °C ion source. Identification and quantification was conducted using AMDIS with a manually curated retention indexed GC-MS library with additional
Results and Discussion

Methanolic extract contained 103 compounds which are presented in Table 1 along with their molecular masses, formulae, retention time and peak area (%). Among these, predominant compounds were Phosphoric acid, bis( trimethylsilyl) monomethyl ester (7.41%); D-Ribofuranose, 5-deoxy-5-(methylsulfanyl)-1,2,3-tris-O-(trimethylsilyl)- (7.19%); Benzoic acid, 4-hydroxy-3-methoxy- methyl ester (6.27%); 13-Retinoic acid, (Z)-, TMS derivative (5.18%); 9-Octadecenoic acid, (E)-, TMS derivative (4.92%); Bis(2-ethylhexyl) phthalate (4.61%); and 5-Amino-8-hydroxyquinoline, N,O-bis(trimethylsilyl)-(4.14%).

Moderately abundant compounds included 2-methylidene-6,10,14-trimethylpen-2-methylidene-6,10,14-trimethylpentadecanoic acid silylated (3.69%); 1-(Palmitolloyl)-3-(trimethylsilyl)oxy)-propan-2-yl (Z)-hexadec-9-enolate (3.06%); 2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylallyl)-(2.48%); 1-Isoluecine, N-trifluoroacetyl- (2.46%); γ-Tocopherol, TMS derivative (2.16%); Cetene (2.12%); Dehydroabietic acid, TMS derivative (2.03%); and Decanedioic acid, bis(2-ethylhexyl) ester (2.02%). Nine compounds namely Benzoic acid, 3-[trimethylsilyloxy]-, trimethylsilyl ester (1.64%); D-Glucose, 2,3,4,5,6-pentakis-O-(trimethylsilyl)-, O-methylxime (1.51%); Pentanedioic acid, 2TMS derivative (1.44%); 2,4-Thiazolidinedione (1.36%); Glyceral, 1,2-di(TMS)- (1.26%); Benzene, [3-butylnoyloxy)methyl]- (1.17%); Undecanedioic acid, 2TMS derivative (1.12%); 2-Aminoethanol, N-acetyl-, O-TMS (1.11%); and Benzoic acid, 3,4,5-tris(trimethylsiloxy)-, trimethylsilyl ester (1.04%) were less abundant. Remaining 79 compounds were least abundant with peak areas 0.95% to 0.05%.

Among 103 compounds identified in inflorescence extract of C. oxyacantha, 4 compounds were found in literature having antifungal and/or antibacterial properties (Table 2, Fig. 1). 9-Octadecenoic acid, (E)-, TMS derivative (5) was identified as an abundant compound in the present study. It is a derivative of oleic acid with replacement of –H of –COOH with –Si(CH3)3. Oleic acid identified from neem has been known to possess antibacterial activity against a number of pathogenic bacteria namely Escherichia coli, Staphylococcus aureus and Salmonella sp. (Zhong-hui et al., 2010). Bis(2-ethylhexyl) phthalate (6) a predominant compound in this study with 4.61% peak area. The compound is a well known plasticizer but has been reported in many plant species including Aloe vera, Alchornea cordifolia and Euphorbia seguieriana (Toth-Soma et al., 1993; Lee et al., 2000; Mavar-Manga et al., 2008). This compound has also been isolated from Calotropis gigantean with antibacterial activity against various species of Gram negative namely Shigella sonnei, S. shiga and Escherichia coli, and Gram positive bacteria namely Sarcina lutea and Staphylococcus aureus (Habib and Karim, 2009). Less abundant compound 2,4-Thiazolidinediendone (19) is a heterocyclic compound with important pharmaceutical applications. Various derivatives of this compound are known to possess a number of biological properties including antifungal and antibacterial activities against Staphylococcus aureus, Escherichia coli, Candida albicans, C. parapsilosis, C. krusei and C. glabrata (Tuncbilek and Altanlar, 2006; Bozdag-Dundar et al., 2007). Ethanolic extract exhibited Frankenia hirsuta hirsuta exhibited potent antimicrobial activity against a fungus Candida sp. and many bacteria. γ-Sitosterol (32) was found the 2nd most abundant compound in the extract and was probably the cause of antimicrobial activity (Canli et al., 2017). This compound has also been identified from Sydney rock oyster Saccostrea glomerata and showed antimicrobial activity against pathogenic bacteria and fungi (Karthikeyan et al., 2014). This study concludes that inflorescence extract of C. oxyacantha contains some potent antimicrobial compounds. Further studies are needed to isolate and purify these phytochemicals.

Table 1: Compounds identified from methanolic inflorescence extract of Carthamus oxyacantha through GC-MS analysis.

<table>
<thead>
<tr>
<th>No.</th>
<th>Names of compounds</th>
<th>Formula</th>
<th>Weight</th>
<th>Retention time (min)</th>
<th>Peak area (%)</th>
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<tr>
<td>1</td>
<td>Phosphoric acid, bis(trimethylsilyl) monomethyl ester</td>
<td>C₇H₅O₂P(SSi₂)</td>
<td>256.385</td>
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<td>D-Ribofuranose, 5-deoxy-5-(methylsulfanyl)-1,2,3-tris-O-(trimethylsilyl)-</td>
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<td>13-Retinoic acid, (Z)-, TMS derivative</td>
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<td>15.26</td>
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<td>5</td>
<td>9-Octadecenoic acid, (E)-, TMS derivative</td>
<td>C₁₇H₃₂O₅Si</td>
<td>354.65</td>
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<td>4.92</td>
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<td>6</td>
<td>Bis(2-ethylhexyl) phthalate</td>
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<td>5-Amino-8-hydroxyquinoline, N,O-bis(trimethylsilyl)-</td>
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<td>2-methyliden-6,10,14-trimethylpentadecanoic acid silylated</td>
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<td>9</td>
<td>1-((Trimethylsilyl)oxy)propan-2-yl (Z)-hexadec-9-enoate</td>
<td>C₉₆H₁₈₂O₅Si</td>
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<td>19.233</td>
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<td>2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethyl)</td>
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<td>1-Isoleucine, N-trifluoroacetyl-</td>
<td>C₇H₁₃FNO₃</td>
<td>227.183</td>
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<td>C₁₉H₂₅O₂Si</td>
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<td>2,4-Thiazolidinedione</td>
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<td>2-Aminoethanol, N-acetyl- O-TMS</td>
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<td>175.303</td>
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<td>Benzoic acid, 3,4,5-tris(trimethylsiloxy)-, trimethylsilyl ester</td>
<td>C₁₃H₁₆O₄Si</td>
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<td>1,2,3,4,5,6-Hexa-O-trimethylsilyl-myo-inositol</td>
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<td>613.248</td>
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<td>Decanedioic acid, dibutyl ester</td>
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<td>3,5,5-Trimethyl-4-(3-(trimethylsilyl)oxy)butyl)cyclohex-2-ene</td>
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<td>Acetin, bis-1,3-trimethylsilyl ether</td>
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<td>1H-Indole. 1-(trimethylsilyl)-2,5-, bis(trimethylsilyl)oxy]-</td>
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<td>C₁₉H₂₅O₃Si</td>
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<td>N,N-Bis(2-hydroxyethyl)-p-toluidine</td>
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<td>4,7-Dimethyl-1,3,7-triazabicyclo[4.3.1]decalin</td>
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<td>Hexanoic acid, TMS derivative</td>
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<td>Pimelic acid, 2TMS derivative</td>
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<td>1,4-Bis(3-methoxy-4-((trimethylsilyl)oxy)phenyl)tetrahydro-1H,3H-furo[3,4-c]furan</td>
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<td>Silanol, trimethyl-, benzoate</td>
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<td>2-Deoxy-1,3,4,5-tetrakiso-</td>
<td>C₁₇H₂₃O₄Si₄</td>
<td>424.875</td>
<td>9.15</td>
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(trimethylsilyl)pentitol

52 n-Tetrosanol-1  C_{16}H_{39}O 354.663  14.23  0.36

53 Xylitol, STMS derivative  C_{26}H_{37}O_{35}  512.056  10.07  0.35

54 (3R,4R)-2,5-dimethoxy-2,5-dimethyl-
   hexane-3,4-diol  C_{10}H_{25}O_{4}  206.282  7.91  0.34

55 Ferulic acid, methyl ester, O-TMS  C_{9}H_{16}O_{5}Si  280.395  11.65  0.32

56 5-Propyl-10,11-dihydro-5H-
   dibenz[a,d]cyclohepten-5,10-imine
   hydrochloride  C_{16}H_{14}N  249.357  12.85  0.32

57 L-Valine, TMS derivative  C_{9}H_{15}NO_{3}Si  189.33  4.53  0.30

58 Levoglucosone  C_{9}H_{18}O_{3}  126.111  4.87  0.30

59 Pentan-3-ol, trimethylsilyl ether  C_{9}H_{16}OSi  160.332  5.06  0.30

60 Benzenacetic acid, trimethylsilyl ester  C_{13}H_{18}O_{3}Si  208.552  6.52  0.30

61 Benzaldehyde, 3-methoxy-4-
   [(trimethylsilyloxy)-, O-methyloxime  C_{16}H_{18}NO_{3}Si  253.373  9.47  0.30

62 7,12-Dithia-14-
   azadispiro[4.0.5.3]tetradeca-9,13-diene,  C_{13}H_{23}NS_{2}  329.52  15.58  0.26
   9,10-dimethyl-13-phenyl-

63 Heptadecanoic acid, TMS derivative  C_{23}H_{43}OSi  384.72  12.79  0.26

64 Phloretic acid, 2TMS derivative  C_{25}H_{43}OSi_{3}  310.54  10.32  0.26

65 2-Hydroxy-6'-methoxyacetophenone,  C_{12}H_{14}O_{3}Si  238.358  8.23  0.26
   TMS derivative

66 3-(4-Hydroxyphenyl)-1-propanol,  C_{18}H_{27}OSi_{2}  296.557  9.73  0.25
   TMS derivative

67 Olean-18-en-3-ol, O-TMS, (3.beta.)  C_{16}H_{30}O  498.911  19.52  0.25

68 2-Monooleoylglycerol trimethylsilyl ether  C_{26}H_{43}OSi  500.911  15.97  0.25

69 Phenol, 4-ethenyl-2,6-dimethoxy-
   C_{10}H_{12}O_{2}  180.203  8.85  0.24

70 Pantothenic acid tritms  C_{14}H_{23}NO_{3}Si  435.783  11.97  0.23

71 Isoquinoline, 1-[3,4-
   diethoxyphenyl)methyl]-6,7-diethoxy-

72 Dodecanoic acid, trimethylsilyl ester  C_{16}H_{29}O_{2}Si  272.504  9.44  0.21

73 Pentanedioic acid, 3-methyl-3-
   [(trimethylsilyloxy)-, bis(trimethylsilyl)  C_{13}H_{29}O_{3}Si_{3}  378.687  9.146  0.20
   ester

74 Galactinol, nonakis(trimethylsilyl) ether  C_{26}H_{38}O_{3}Si_{9}  991.935  17.27  0.19

75 Salicylic acid  C_{7}H_{6}O_{3}  138.122  6.60  0.19

76 Androst-4-ene-3,17-dione, 15-hydroxy-
   (15.alpha.-)  C_{19}H_{20}O_{3}  302.414  14.55  0.19

77 9,12,15-Octadecatrienoic acid, (Z,Z,Z)-
   C_{18}H_{30}O  264.453  12.81  0.19

78 7,9,12-Ter-butyl-1-oxaspiro(4,5)deca-6,9-
   diene-2,8-dione  C_{17}H_{26}O_{2}  276.376  11.47  0.19

79 (+)-a-ar-cumene  C_{16}H_{22}  202.341  8.18  0.18

80 Ethyl alpha-D-glucopyranoside, 4TMS  C_{26}H_{50}O_{3}Si_{4}  496.938  13.49  0.15
   derivative

81 Diethylene glycol, 2TMS derivative  C_{26}H_{48}O_{3}Si_{2}  250.485  5.99  0.15

82 2-O-Glycerol-alpha-d-galactopyranoside,  C_{26}H_{48}O_{3}Si_{6}  687.327  13.99  0.15
   hexa-TMS

83 5-O-Coumaroyl-D-quinic acid, 5TMS  C_{25}H_{48}O_{3}Si  699.222  17.32  0.15

84 Eicosanoic acid, methyl ester  C_{22}H_{40}O_{2}  326.565  13.86  0.14

85 Octahydro-1H-cyclopenta[b]pyridin-4-ol  C_{15}H_{13}NO  141.214  4.26  0.14

86 Acetic acid, 2-[(6-methoxy-4-methyl-2-
   quinolinyl)thio]-, hydrazide  C_{17}H_{22}N_{2}O_{2}S  277.342  11.28  0.13

87 (E)-methoxy-[2,3,4,5-
   tetraakis(trimethylsilyloxy)-1-
   (trimethylsilyloxy)methyl]pentylidene]amin e

88 Phosphoric acid, bis(trimethylsilyl) 2,3-
   bis[(trimethylsilyloxy)propyl ester  C_{12}H_{18}O_{3}PSi_{4}  460.801  10.41  0.11

89 Propanetriol, 2-methyl-., tris-O-
   (trimethylsilyl)-  C_{13}H_{29}O_{3}Si  322.667  7.88  0.10

90 3-[(Trimethylsilyloxy)lidenede  C_{12}H_{18}OSi  204.344  7.51  0.09

91 L-Proline, 5-oxo-1-(trimethylsilyl)-, trimethylsilyl ester  C_{12}H_{18}NO_{3}Si_{2}  273.479  8.52  0.08
3-Vanilpropanol, bis(trimethylsilyl)-
100 326.583 10.75 0.08
1-Pentanol, 5-chloro-, acetate
C₃H₁₂ClO₂ 164.629 4.35 0.07
Triethylene glycol, 2TMS derivative
C₂H₅O₇Si₂ 294.538 8.30 0.07
2-O-(2-(4-hydroxyphenyl)-ethyl)-d- β- 
glucopyranose, 5TMS
C₂H₂O₆Si₃ 661.217 16.31 0.07
Bis(2-ethylhexyl) phthalate
C₃H₁₂O₆Si₂ 220.415 4.39 0.07
2,5-Dimethyl-4-hydroxy-3(2H)-furanone
C₅H₈O₄ 128.127 4.30 0.07
Butanoic acid, 2-methyl-3- 
[(trimethylsilyl)oxy]-, trimethylsilyl ester
C₅H₁₂O₂Si 262.496 5.57 0.07
3-Octadecenoic acid, 2TMS derivative
C₂₀H₃₆O₂Si 442.831 14.82 0.07
4-Coumaric acid, 2TMS derivative
C₂₀H₃₆O₂Si 308.524 11.57 0.06
Hexadecanoic acid, 4-
[[trimethylsilyl]oxy]butyl ester
C₂₀H₃₆O₂Si 400.719 15.88 0.06
cis-13-Octadecenoic acid
C₁₈H₃₆O₂ 282.468 12.78 0.06
Methanone, (2-methoxyphenyl)(5,6,7,8- 
tetrahydro-1,4-dimethoxy-2-naphthalenyl)-
C₂₇H₂₆O₄ 326.392 15.43 0.05

Table 2: Possible antibacterial and antifungal compounds in methanolic inflorescence extract of Carthamus oxyca thana.

Fig. 1: Structures of antibacterial and/or antifungal compounds identified in methanolic inflorescence extracts of Carthamus oxyca thana.

References


Marwat SK, Khan IU, 2012. Tracing the uUseful eEthnophytomedicinal rRecipes of aAngiosperms uUsed aAgainst jJaudice and hHepatitis in Indo-Pak Subcontinent University Wensam College, Gomal University, Dera Ismail Khan, KPK, Pakistan Faculty of Pharmacy , Gomal University , Dera Ismail Khan. World Appl. Sci. J., 18: 1243-1252.


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