Mycopath (2018) 16(1):43-46 **Research Article**

Pesticidal constituents in *n*-hexane inflorescence extract of *Chenopodium quinoa*

[*]Iqra Haider Khan[1], Arshad Javaid[1], Dildar Ahmed[2] and Uzman Khan[3]

[1]Institute of Agricultural Sciences, University of the Punjab, Lahore, Pakistan
[2]Department of Chemistry, Forman Christian College (A Chartered University), Lahore, Pakistan
[3]Department of Chemistry, GC University, Lahore, Pakistan
[*]Corresponding author's email: iqrahaider_khan@yahoo.com

Abstract

The present study was aimed to identify pesticidal compounds present in *n*-hexane fraction of methanolic inflorescence extract of quinoa (*Chenopodium quinoa* Willd.). A total of 14 compounds were identified in this fraction through GC-MS analysis. Among these, 9,12-octadecadienoic acid(z,z) followed by *n*-hexadecanoic acid and 9,12-octadecadienoic acid (z,z)-, methyl ester were the predominant compounds with peak areas of 18.76, 18.19 and 18%, respectively. Compounds namely pentadecanoic acid, methyl ester; hexadecanoic acid, methyl ester; 9,12-octadecadienoic acid(z,z) and/or E,Z-1,3,12-nonadecatriene known to possess either antifungal or antibacterial or both the activities. Likewise, methyl tetradecanoate is known for its nematicidal activity. The present study concludes that *n*-hexane fraction of methanolic inflorescence extract of *C. quinoa* is a rich source of compounds with pesticidal activities.

Keywords: *Chenopodium quinoa,* GC-MS analysis, Inflorescence, *n*-Hexane extract, Pesticidal compounds.

Introduction

Plants respond to a number of stresses particularly biotic stresses induced by a diverse range of fungi, nematode, bacteria, pests and weeds. To tailor the stress responses induce by living organisms, a wide range of synthetic agro-chemicals are being introduce to control these. However, the use of these chemicals has disadvantages effects on the environmental causing pollution and degradation of eco-friendly microorganisms. So, to combat this issue, scientists are working on natural products obtained from plants which possess a narrow host range against a specific pathogen. These products are gaining importance worldwide especially in developing countries as they provide a cheap alternate to the farmers, also of their specificity, non toxicity, less residual threats and shorter life. Plant based pesticides constitute an integral part of the pest management and when applied under field conditions protect plants from pathogen attack (Shafique *et al*., 2016).

Chenopodium quinoa a traditional food belongs to family chenopodiaceae, is considered as an excellent pseudocereal crop native to Andean regions recently being introduced in Pakistan. Quinoa is considered as a high nutritional crop with less nutrients and water inputs. It is extremely tolerant to abiotic stresses such as heat, cold, frost and drought. Work on it is going on in several countries of Europe, South America and North America (Vilcacundo and Hernandez-Ledesma, 2017). It is an excellent source of protein ranges between 14-16% higher than rice, barley, corn and wheat. It is also a rich source of amino acids, fibers, lipids and vitamins. Chemical compounds present in quinoa as weel as various quinoa products are known to exhibit various biological activities (Jarvis *et al.*, 2017). Therefore, the present study was carried out to investigate the pesticidal potential of *n*-hexane fraction of methanolic inflorescence extract.

Materials and Methods

Quinoa inflorescence (2 kg) was thoroughly washed to remove any associated debris or physical contaminant. The cleaned fresh material was then shade dried and homogenized into a coarse powder using a mixer grinder. The powder was exhaustively macerated with methanol (6 L) for 10 days and filtered through Whatman No. 1 filter paper to obtained plant methanolic extract which underwent the rotary evaporator at 45 °C and the filtrate was concentrated till dry residue remained (250 g) which was mixed in 200 mL of distilled water. Then the resultant was suspended with *n*-hexane (5 × 500 mL) in a separating funnel to successively separate the non-polar compounds from the methanol extract and obtain viscous semi solid mass (42.9 g). Then the *n*-hexane fraction was subjected to analyses of different organic compounds using GC-MS (Akhtar and Javaid, 2018).

Results and Discussion

GC-MS chromatogram of *n*-hexane fraction of methanolic inflorescence extract of quinoa is shown in Fig. 1 which indicates the presence of 14 constituents belonging to a diverse group of natural compounds. Detail of identified compounds is presented in Table 1 and structures of these compounds are given in Fig. 2. The most prevailing major compounds were 9,12-octadecadienoic acid(z,z) (**8**); *n*-hexadecanoic acid (**5**) and 9,12-octadecadienoic acid (z,z)-, methyl ester (**6**) with peak areas of 18.76, 18.19 and 18%, respectively.

The compounds namely 8,11-octadecadienoic acid, methyl ester (**7**) representing (10.91%) and hexadecanoic acid, methyl ester (**4**) showing peak areas of 10.91 and 10.51%, respectively, were recorded as moderately abundant ones. Compounds present in less concentrations were docosanoic acid, methyl ester (**14**); E,Z-1,3,12-nonadecatriene (**11**); cyclopropaneoctanoic acid, 2-octyl-,methyl ester (**13**); 11- hexadecanoic acid, methyl ester (**3**); methyl tetradecanoate (**1**); 11-eicosenoic acid, methyl ester (**9**); ethanamine,2,2'-oxybis[N,N-dimethyl] (**12**); eicosanoic acid, methyl ester (**10**); ad pentadecanoic acid, methyl ester (**2**) with peak areas ranging from 1.03 to 4.38%.

The most abundant compound **8** was previouslyidentified instem extract of*Cenchrus biflorus* and isknown to exhibit antibacterial activity (Arora and Kumar, 2018). This compound was also reported from *Mantidis ootheca* with antibacterial activity against the gentamycin resistant bacterium *Pseudomonas aeruginosa* (Wang *et al.,* 2018). Likewise, compound **4** was previously isolated fromleaf and stem extract of*Origanum vulgare* and found to be highly effective against various bacterial species such as *Bacillus subtilis, Escherichia coli, Staphylococcus epidermidis, Pseudomonas aeruginosa* (Rahbar *et al*., 2012). Compound **2** and **5** were found to possess antibacterial activity against various gram positive as well gram negative bacteria (McGaw *et al*., 2002). Compound **4,** previously isolated from *Murraya koenigii,* is also known to exhibit antioxidant, nematicidal and antimicrobial (Hema *et al*., 2011) as well as antifungal activities against *Aspergillus niger, Candida albicans* and *Saccharomyces cerevisiae* (Rahbar *et al*., 2012). Likewise, one of the predominant compound **5** was previously isolated from *Indoneesiella echioides* leaves, and possess a variety of activities such as nematicidal (Hema *et al.,* 2011; Elaiyaraja and Chandramohan, 2016), and insectividal (Rahuman *et al*., 2000). Similarly, compound **11** and **2** are known to exhibit both antibacterial and antifungal properties (Chandrasekaran *et al*., 2011). It is concluded that *n*-hexane fraction of inflorescence extract of *C. quinoa* has a good profile of pesticidal components.

Table 1: Compounds identified from *n*-hexane inflorescence extract of *Chenopodium quinoa* through GC-MS analysis.

	Names of compounds	Formula	Weight	Retention time (min)	Peak area (%)
1	Methyl tetradecanoate	$C_{15}H_{30}O_2$	242	6.004	2.28
2	Pentadecanoic acid, methyl ester	$C_{16}H_{32}O_2$	256	6.466	1.03
3	11- Hexadecanoic acid, methyl ester	$C_{17}H_{32}O_2$	268	6.833	2.36
4	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	6.967	10.51
5	*n*-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	7.304	18.19
6	9,12-Octadecadienoic acid (z,z)-, methyl ester	$C_{19}H_{34}O_2$	294	7.692	18.00
7	8,11-Octadecadienoic acid, methyl ester	$C_{19}H_{34}O_2$	294	7.824	10.91
8	9,12-Octadecadienoic acid (z,z)	$C_{18}H_{32}O_2$	280	8.088	18.76
9	11-Eicosenoic acid, methyl ester	$C_{21}H_{40}O_2$	324	8.550	2.23
10	Eicosanoic acid, methyl ester	$C_{21}H_{42}O_2$	326	8.641	1.13
11	E,Z-1,3,12-Nonadecatriene	$C_{19}H_{34}$	262	8.800	3.94
12	Ethanamine,2,2'-oxybis[N,N-dimethyl]	$C_8H_{20}N_2O$	160	9.319	1.36
13	Cyclopropaneoctanoic acid,2-octyl- ,methyl ester	$C_{20}H_{38}O_2$	310	9.594	3.50
14	Docosanoic acid, methyl ester	$C_{23}H_{46}O_2$	354	9.714	4.38

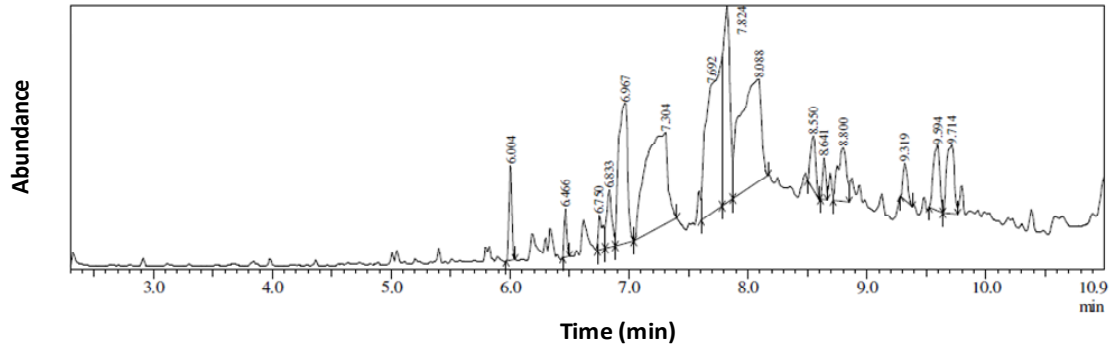

Fig. 1: GC-MS chromatograms of *n*-hexane inflorescence extract of *Chenopodium quinoa*.

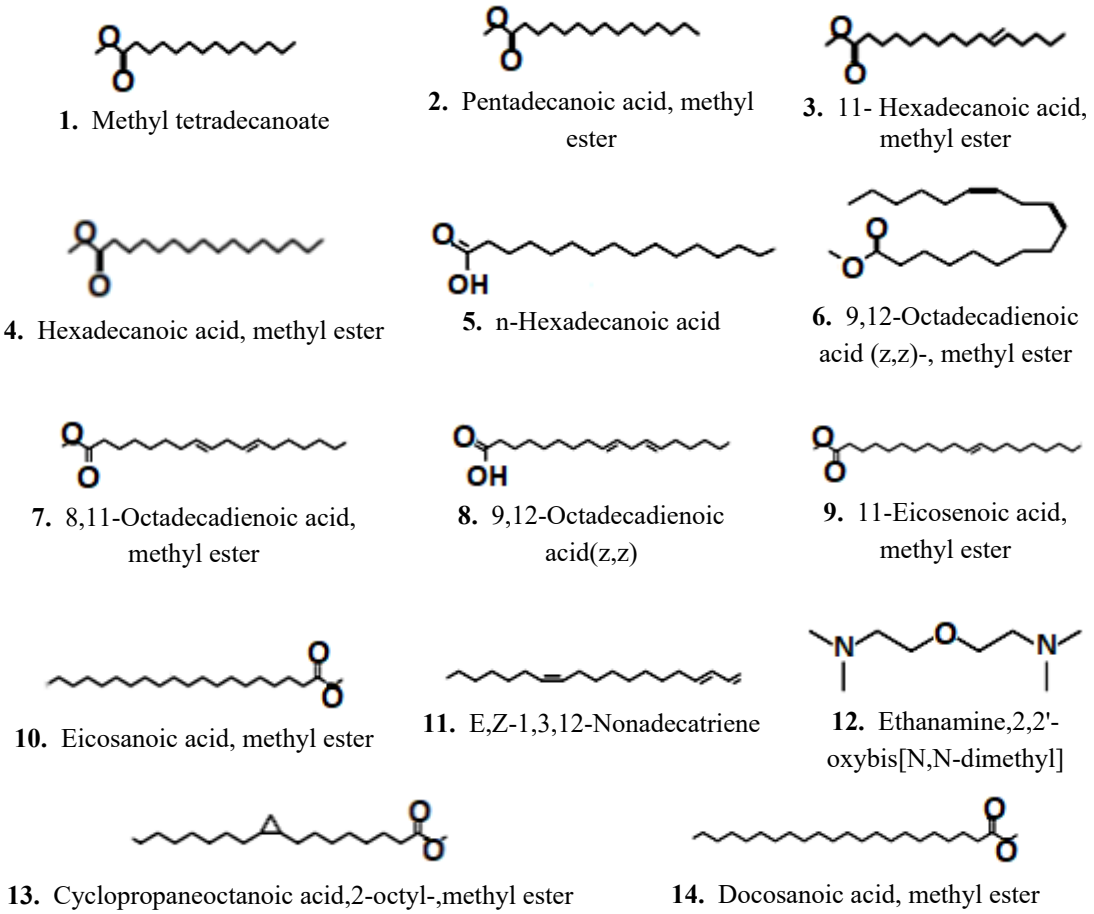

Fig. 2: Structures of compounds in *n*-hexaneinflorescence extract of *Chenopodium quinoa*.

Table 2: Potential pesticidal constituents in *n*-hexane inflorescence extract of *Chenopodium quinoa*.

Compound No.	Names of compounds	Property	Reference
1	Methyl tetradecanoate	Nematicide activity	Elaiyaraja and Chandramohan (2016)
2	Pentadecanoic acid, methyl ester	Antibacterial, Antifungal	Chandrasekaran *et al.* (2011)
4	Hexadecanoic acid, methyl ester	Antibacterial, antifungal	Rahbar *et al*. (2012) Hema *et al*. (2011)
5	*n*-Hexadecanoic acid	Nematicide, pesticide, antibacterial	Elaiyaraja and Chandramohan (2016) Rahuman *et al*. (2000) McGaw *et al*. (2002) Hema *et al*. (2011)
8	9,12-Octadecadienoic acid(z,z)	Antibacterial	Arora and Kumar (2018) Wang *et al.* (2018)
11	E,Z-1,3,12-Nonadecatriene	Antimicrobial activity	Hadi *et al.* (2016)

References

Akhtar R, Javaid A, 2018. Biological management of basal rot of onion by *Trichoderma harzianum* and *Withania somnifera*. *Planta Daninha*, **35**: e017164713.

Arora S, Kumar G, 2018. Phytochemical screening of root, stem and leaves of *Cenchrus biflorus* Roxb. *J. Pharm. Phys.*, **7**: 1445-1450.

Chandrasekaran M, Senthilkumar A, Venkatesalu V, 2011. Antibacterial and antifungal efficacy of fatty acid methyl esters from the leaves of *Sesuvium portulacastrum* L. *Eur. Rev. Med. Pharm. Sci.*, **15**: 775-780.

Elaiyaraja A, Chandramohan G, 2016. Comparative phytochemical profile of *Indoneesiella echioides* (L.) Nees leaves using GC-MS. *J. Pharm. Phys.*, **5**: 158-171.

Hadi MY, Mohammed GJ, Hameed IH, 2016. Analysis of bioactive chemical compounds of *Nigella sativa* using gas chromatography-mass spectrometry. *J. Pharmcog. Phytother.*, **8**: 8-24.

Hema R, Kumaravel S, Alagusundaram K, 2011. GC/MS determination of bioactive components of *Murraya koenigii*. *J. Am. Sci.*, **7**: 80-83.

Jarvis DE, Ho YS, Lightfoot DJ, Schmockel SM, Li B, Borm TJ, Ohyanagi H, Mineta K, Michell CT, Saber N, Kharbatia NM, 2017. The genome of *Chenopodium quinoa*. *Nature*, **542**: 307.

McGaw LJ, Jager AK, Staden JV, 2002. Isolation of antibacterial fatty acids from *Schotia brachypetala*. *Fitoterapia,* **73**: 431-433.

Rahbar N, Shafaghat A, Salimi F, 2012. Antimicrobial activity and constituents of the hexane extracts from leaf and stem extract of *Origanum vulgare* L. ssp. *Viride* (Boiss.) Hayek. growing wild in Northwest Iran. *J. Med. Plant Res.*, **6**: 2681-2685.

Rahuman AA, Gopalakrishnan G, Ghouse BS, Arumugam S, Himalayan B, 2000. Effect of *Feronia limonia* on mosquito larvae. *Fitoterapia*, **71**: 553-555.

Shafique HA, Sultana V, Ehteshamul-Haque S, Athar M, 2016. Management of soil-borne diseases of organic vegetables. *J. Plant Prot. Res.*, **56**: 221-230.

Vilcacundo R, Hernandez-Ledesma B, 2017. Nutritional and biological value of quinoa (*Chenopodium quinoa* Willd.). *Curr. Opin. Food Sci.,* **14**: 1-6.

Wang W, Zhang N, Chanda W, Liu M, Riaz ud Din S, Diao Y, Liu L, Cao J, Wang X, Li X, Ning A, Huang M, Zhong M, 2018. Antibacterial and anti-biofilm activity of the lipid extract fom *Mantidis ootheca* on *Pseudomonas aeruginosa. J. Zhejiang Uni-Sci. B,* **19**: 364-371.