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Chemical Composition of Methanolic Extracts of Cactus Plant (Opuntia Ficus-Indica)

Hajar Nasser[1*], Nawal Ali[2], Amjad Deeb[3]

[1]Department of Chemistry, Faculty of Sciences, Tishreen University, Lattakia, Syria
[2]Department of Botany, Faculty of Sciences, Tishreen University, Lattakia, Syria
[3]Department of Environmental Chemistry at Higher Institute for Environmental Researches, Faculty of Sciences, Tishreen University, Lattakia, Syria
*Corresponding author email: mostafaisbera@gmail.com

Abstract *Opuntiaficus-indica* is an important medicinal plant widely used in traditional systems of medicine. In the present work, the chemical composition of methanolic extracts of three parts of cactus plant (cladodes, flowers and fruits) was studied by using gas chromatography system equipped with mass spectrometry detector (GC-MS). Remarkable differences were noted between the composition and the constituent ratio of the different studied organs. The cladodes extract showed 10 compounds with different ratios, the highest ratio reached 33.57 % for a compound (Hexadecamethyl), and this extract also contains other important compounds such as (Octasiloxane, Silicate anion Tetramer, Furan carbox aldehyde, Butyl Butyrate **,**Benzene acetic acid) by ratios reached (18.91, 16.13, 13.85, 8.61, 8.30 %), respectively. The flowers extracts also showed 10 compounds, but the highest ratio reached 35.19 % for a compound (Octasiloxane), this extract also contains other important compounds such as (Silicate anion Tetramer, Benzene acetic acid, Hexadeca methyl, Butyl Butyrate) by ratios reached (26.09, 11.83, 9.71, 9.42%), respectively. While the fruits extracts showed 16 compounds, but the highest ratio reached 22.02 % for a compound (4-H-pyran-4-one), this extract also contains other important compounds such as (Furan carbox aldehyde, Octasiloxane **,**Silicate anion Tetramer) by ratios reached (20.80, 17.49, 12.77%), respectively.

Keywords *Opuntiaficus-indica*, Methanolic extract, GC-MS

1. Introduction

Plants are a rich source of secondary metabolites with potential or actual use as flavours, fragrances, pesticides, pharmaceuticals and antimicrobials. About 12,000 of these aromatic substances and their derivatives have been isolated and it represents roughly 10% of the total [1].

Cactaceae family is a source of secondary metabolites like alkaloids, carotenoids, betalains, triterpenes and sterols [2-3]. The production of those chemicals, in some cases occurs in the whole plant; in some other circumstances, there may be a selective production of specific secondary metabolites in any plant organ [4]. Many phytochemicals are synthesized in roots, which can then be stored *in situ* or transported to other organ plant. In other hand inside cells, sesquiterpenes, triterpenes and sterols occur in the endoplasmic reticulum, whereas monoterpenes originate in plastids; and amines and alkaloids in mitochondria [5].

The *Cactaceae* family is unusual among tropical plants. Cactus pear, produced by perennial *Opuntia* cactus, belongs to the *cactaceae* family and is well adapted to arid and semiarid climates, where water shall be a limiting factor in cultivation [6-7].

Recent scientific reports have highlighted the presence of natural cactus molecules, which may have high potential interest in human health and medicine [8-9]. As a general rule in herbal medicine, the extraction of bioactive compounds from permeable solid plant materials using solvents constitutes a key step in the manufacture of phytochemical-rich products. *Opuntiaficus indica* is known for its high content in polyphenols exhibiting antioxidant and anti-inflammatory properties [6,10]. Interestingly, alkaloids, indicaxanthin, neobetanin, and various flavonoids have been isolated from the cactus [9] along with polysaccharides which are abundant in cladode extracts and endowed with antidiabetic and antiglycation effects [11], Akacha *et al*., [12] tested the efficacy of the ethanol extract of the cladode on rats treated with methotrexate, and found that the extract provides protection for the small intestine from the cellular toxicity caused by treatment with methotrexate.

Many species of *Opuntia cacti* produce edible highly flavored fruit known as "prickly pear". Cactus pear fruit is a many seeded berry with a thick peel, enclosing a delicately flavored seedy pulp. Cactus pear fruits are rich source of nutrients and vitamins [13] and are eaten fresh, dried or preserved in jams, syrups or processed into candy – like products [6].

The gel-like sap of prickly pears might be useful as a hair conditioner. In Mexican folk medicine, its pulp and juice have been used to treat numerous maladies, such as wounds and inflammations of the digestive and urinary tracts [14]. *Opuntia* cacti has been used in traditional folk medicine because of its role in treating a number of diseases and conditions, including anti-inflammatory effects [15], hypoglycemic properties, inhibition of peptic ulceration [16], neuroprotective effects [17], antioxidant actions and also used for treating burns and asthma [18].

Opuntia flowers are also useful in numerous fields; such as traditional medicines thanks to its effect which are defined as depurative and in particularly diuretic and relaxant of renal excretory tract [19].

In the present work, we studied the chemical composition of methanolic extracts of three parts of cactus plant (cladodes, flowers and fruits) by using gas chromatography system equipped with mass spectrometry detector (GC-MS).

Materials and Methods

Plant Material

The three plant parts of *Opuntiaficus-indica* collected from several areas of east of Lattakia city, the samples of cladodes collected during April 2017, while flowers collected during June, whereas fruits collected during August at the same year.

The samples were brought to the Graduate Laboratory at the Faculty of Science, Department of Plant Biology in Tishreen University, cleaned well from the thorns and the soil, washed with distilled water several times, cut the samples of the cladodes and fruits into slices by using a sterile sharp knife, Leave to dry in the shade for several days, then put in oven at Temperature 35 °C until the weight stability, then grind by using the electric mixer to get a fine powder, kept in the refrigerator in sealed and sterile glass containers until use.

Preparation of Crude Extract

20 g of dried powder was soaked in 200 ml of methanol 95%, the flask was covered with aluminum foil and then placed on a magnetic stirrer for half hour, left for 7 days into dark, stirring occasionally, then filtered with Whatman No.1., concentrated in a rotary vacuum evaporator at 40 °C. The crude extract kept in the refrigerator in sealed and sterile glass containers until use.

Chemical analysis of *Opuntiaficus indica* extracts

-Methanol extracts from the parts of *Opuntia* were analyzed using gas chromatography system equipped with mass spectrometry detector (GCMS-QP2010, SHIMADZU, Kyoto, Japan) (Figure 1).

-The device has the following specifications:

• Column: OPTIMA 5, film thickness 0.25 μm, column length 30 meters, diameter 0.25 mm.

• Gas carrier: helium with pressure of 54kPa.

• Injector: automatic, injector temperature 250 °C, injection pattern: Split less, injected sample size: 1 μl.

• Thermal program:
Oven temperature (35 - 250) °C, raising at a rate of 3 degrees / min.
Total Program Time: 53 minutes.
• Mass spectrometer: Ion source temperature: 200 °C.
-The extracts were prepared for analysis with pure methanol to obtain 5% concentration.
- The components of the extract were identified using the Wiley and Nist electronic offices.

Figure 1: Gas Chromatography system equipped with Mass Spectrometry detect

Results and Discussion

Table (1) shows the GC-MS results of the methanolic extracts of cactus plants, type of chemical compound and their medicinal properties after referring with references [20-26].

Most of the compounds obtained from the chemical analysis of the extracts belong to different functional groups (aromatic compounds, carboxylic acids, aldehydes, ketones, esters, hydrocarbons and alcohols), and this is consistent with the study [27], which showed presence some of that compounds in *Opuntia* extracts.

The cladodes extract showed 10 compounds with different ratios, the highest ratio reached 33.57 % for a compound (Hexadecamethyl), and this extract also contains other important compounds such as (Octasiloxane, Silicate anion Tetramer, Furan carbox aldehyde, Butyl Butyrate, Benzene acetic acid) by ratios reached (18.91, 16.13, 13.85, 8.61, 8.30)%, respectively. The flowers extracts also showed 10 compounds, but the highest ratio reached 35.19 % for a compound (Octasiloxane), this extract also contains other important compounds such as (Silicate anion Tetramer **,**Benzene acetic acid, Hexadecamethyl, Butyl Butyrate) by ratios reached (26.09, 11.83, 9.71, 9.42) %, respectively. While the fruits extracts showed 16 compounds, but the highest ratio reached 22.02 % for a compound (4-H-pyran-4-one), this extract also contains other important compounds such as (Furan carbox aldehyde, Octasiloxane, Silicate anion Tetramer) by ratios reached (20.80, 17.49, 12.77) %, respectively.

Chemical Composition of Methanolic Extracts of Cactus Plant (Opuntia Ficus-Indica)

Table 1: The GC-MS results of the methanolic extracts of cactus plants, type of chemical compound and their medicinal properties

Furfurylic alcohol	Antioxidant, flavour ingredient, fungicide, insecticide			0.14
2-Butenoic acid	Nf	0.15	0.19	0.07
Cyclopentandion	Nf			0.43
4-Heptanone	Nf	0.12	0.14	
Butyl Butyrate	Antioxidant	8.61	9.42	5.51
Ethanedial	Nf	0.01		
Mannitol	Antimicrobial, Anticancer			1.78
Phenyl acetaldehyde	Antioxidant		1.63	5.06
Benzene ethanol	Antimicrobial		3.37	
Acetic acid	Analgesic activity			0.91

4-H-pyran-4-one	Antimicrobial, Anti-inflammatory, Antiproliferative, Antioxidant, Automatic nerve activity			22.02
Disiloxane	Antimicrobial			1.62
Furan carbox aldehyde	Antimicrobial, Preservative Clastogenic activity, Uterotonic activity	13.85		20.80
2-Methyl-4-vinyl phenol	Antioxidant, Antimicrobial, Anti-inflammatory			0.51
Benzene methanol	Antimicrobial			2.86
Hexadecamethyl	Antimicrobial	33.57	9.71	2.33
Octasiloxane	Antimicrobial	18.91	35.19	17.49
Docosanoic acid	Antioxidant	0.35		
Hexadecanoic acid	Antitumor, Antioxidant, Anti-inflammatory		2.43	
Silicate anion Tetramer	Antimicrobial	16.13	26.09	12.77
Benzene acetic acid	Antimicrobial, Antioxidant	8.30	11.83	5.70

Nf: Not found.

The Figures (2, 3, 4) show the chromatograms of the methanolic extracts of the studied plant parts.

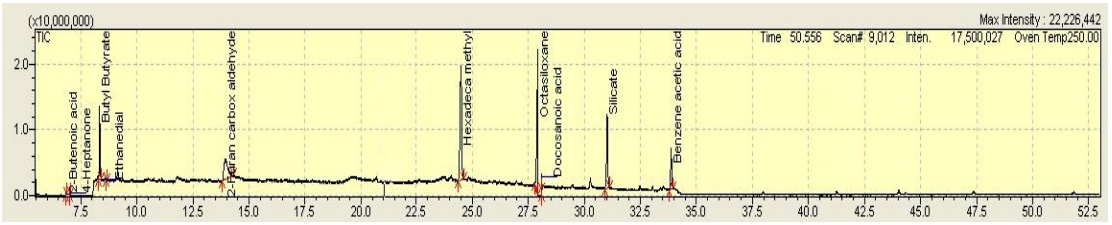

Figure 2: The chromatogram of the Cladodes extract

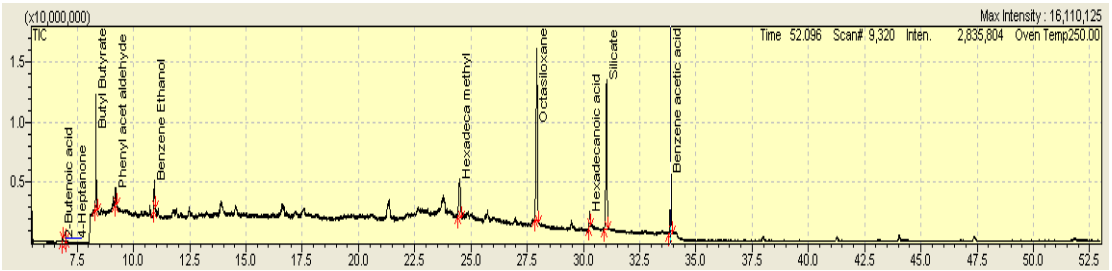

Figure 3: The chromatogram of the flowers extract

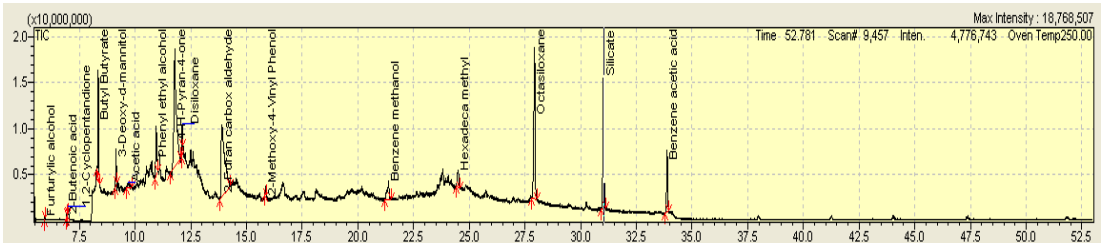

Figure 4: The chromatogram of the fruits extract

Conclusion

Cactus plant extracts are contained various phytochemicals with biological activity can be of valuable therapeutic key. The presence of such a variety of phytochemicals may be attributed to the medicinal characteristics of this plant. The presence of phyto-components reveals the importance of the plant as medicinally used. Further investigations are planned to conduct the pharmacological studies to know the potency of theseextracts. So, it is recommended as a plant of phyto - pharmaceutical importance.

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