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Organic Acids of Mesembryanthemum Forskalii Herb and Flowers

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ABSTRACT

Plants are an important source of biologically active compounds that have been used for ages all over the world to treat and prevent various disorders. Samh (Mesembryanthemum forskalii Hochst) is a plant traditionally used in Saudi Arabia as a medicinal plant, and a profound study of its chemical constituents is needed. Carboxylic acids are one of the most important classes of biologically active compounds that possess antioxidant, anti-inflammatory, antitumor and other properties. So the scope of present paper was to study the composition and content of organic acids in M. forskalii herb and flowers. As the results have shown, both types of the plant material studied have revealed the presence of 26 organic acids with hexadicarboxylic acid present only in the herb and 2-hydroxy-3-methylglutaric acid detected in the flowers only. Both types of the plant material studied tend to accumulate oxalic, malic and citric acids, while flowers were also rich in levulinic, linoleic, succinic and ferulic acids.

Keywords: Organic acids, GC-MS, *Mesembryanthemum forskalii*

INTRODUCTION

Pharmaceutical science has always been focused on developing new medicines with high therapeutic activity and minor side effects. Phytochemists all over the world are in the permanent search for the new herbal sources of biologically active compounds. Therefore plants used in traditional folk medicine of different countries are being extensively studied in this objective.

Our attention was focused on samh (*Mesembryanthemum forskalii* Hochst). The samh seeds have been widely used by Bedouins of Saudi Arabia as a substitute for wheat grain. The seeds were used in a ground state and made into bread or cooked. The study of the effects of samh seeds on the progress of streptozocin-induced diabetes in rats has revealed that adding 5% of the seeds to the diet show hypoglycaemic and hypolipidaemic effects [1-7].

Carboxylic acids are organic compounds possessing a carboxyl functional group. This is a vast group of biologically active compounds which are found in all plants. It includes aliphatic acids; those possessing a long chain are traditionally called fatty acids, alicyclic and aromatic acids. Thus, different representatives of this diverse class of compounds can show various pharmacological effects, such as antioxidant [2], anti-inflammatory, antitumor [4], hepatoprotective [5], neuroprotective [8,9] etc. Our study was focused on the composition and content of organic acids in *M. forskalii* flowers and herb which will help us understand the pharmacological effects of the plant material.

MATERIALS AND METHODS

The plant material (0.05, accurate weight) was placed into a 2 ml vial where the internal standard and 0.6 ml of the solvent (methylene chloride) were added. Tridecane (50 µg per a plant material sample) was used as an internal standard. The sample was held in an ultrasound extractor at temperature 50°C for 3 h, or for 24 h at room temperature [10]. The obtained extract was placed into a 2 ml vial and then concentrated by purging (100 ml/min) with highly purified nitrogen to the residual volume of the extract of 10 µl. The sample (3 µl) was injected into a chromatographic column in a splitless mode which allows to inject the sample without losses on the split and considerably increase the sensitivity of the chromatography method (up to 10-20 times).

The Agilent Technologies 6890 chromatograph with mass-spectrometric detector 5973 was used. The chromatography parameters were the following: chromatographic column DB-5 capillary, inner diameter (0.25 mm), length (30 m); speed of the gas-carrier (helium) (1.2 ml/min); temperature of the sample injection heater (350°C), the thermostat temperature was programmed from 50°C-320°C with the speed 4°/min.

The mass-spectra libraries NIST05 and WILEY 2007 were used for the identification of components, with total number of spectra over 470000 combined with the identification software AMDIS and NIST. The internal standard method was used for quantitative calculations. The content of the components was calculated using a formula:

$$C = \frac{P_1 \cdot 50}{P_2 \cdot M}$$

Where, P_1-the peak area of the studied sample, P_2-the peak area of the standard, 50-weight of the internal standard (μg), injected into a sample, M-weighed quantity of the sample (g).

RESULTS AND DISCUSSION

As the results have shown, both types of the plant material studied have revealed the presence of 26 organic acids with hexadicarboxylic acid present only in the herb and 2-hydroxy-3-methylglutaric acid detected in the flowers only (Table 1).

Table 1: Results of the organic acids' determination in *Mesembryanthemum forskalii* Hochst herb and flowers

S. No.	Compound	Flowers		Herb	
		Retention time	Content (mg/kg)	Retention time	Content (mg/kg)
1	Oxalic acid	11.403	8713.16	12.195	10505.03
2	Malonic acid	13.299	540.86	13.494	377.82
3	Fumaric acid	14.052	29.46	14.175	20.50
4	Levulinic acid	14.777	3588.42	14.694	152.56
5	Succinic acid	15.24	948.20	15.262	304.78
6	Benzoic acid	15.764	5.68	15.837	39.26
7	Phenylacetic acid	18.815	4.46	18.82	7.58
8	Salicylic acid	19.122	3.65	19.127	2.28
9	Lauric acid	19.869	259.97	19.858	59.78
10	2-Hydroxy-3-methylglutaric acid	22.384	620.82	-	-
11	Myristic acid	23.985	15.33	23.957	49.80
12	Malic acid	24.303	3863.62	24.213	1649.79
13	Azelaic acid	26.344	80.94	26.36	32.92
14	Palmitic acid	27.889	543.68	27.894	470.06
15	Citric acid	31.419	5107.10	31.681	7956.09
16	Stearic acid	31.424	331.69	31.748	771.07
17	Oleic acid	31.837	705.42	31.909	59.78
18	Linoleic acid	32.668	1915.21	32.568	111.73
19	Linolenic acid	34.068	756.93	33.649	230.58
20	Vanillic acid	34.313	60.78	34.313	50.30
21	Arachidic acid	34.715	36.32	34.748	28.05
22	Behenic acid	37.81	18.82	37.843	58.00
23	Hexadicarboxylic acid	-	-	38.412	6.40
24	*p*-Hydroxybenzoic acid	39.489	67.78	39.522	6.69
25	Gentisic acid	40.303	4.55	40.587	4.25
26	Lignoceric acid	40.721	24.42	40.76	19.97
27	Ferulic acid	42.645	684.89	42.634	42.03

Oxalic (8713.16 mg/kg in the flowers and 10505.03 mg/kg in the herb), malic (3863.62 mg/kg in the flowers and 1649.79 mg/kg in the herb) and citric (5107.10 mg/kg in the flowers and 7956.09 mg/kg in the herb) acids dominated in both types of *M. forskalii* plant material. Unlike the herb, *M. forskalii* flowers tend to accumulate levulinic (3588.42 mg/kg), linoleic (1915.21 mg/kg), succinic (948.20 mg/kg) and ferulic (684.89 mg/kg) acids.

Among the total number of organic acids found in the *M. forskalii* plant material, there were detected 10 compounds which are traditionally called the fatty acids. Out of those 10 fatty acids 3 were unsaturated-oleic, linoleic and linolenic acids, which dominated over the rest of fatty acids in *M. forskalii* flowers. Unlike the flowers, the herb was rich in stearic, palmitic and linolenic acids.

Even though some authors do not implicate the intake of dietary oxalates as a major risk factor for the kidney stone formation, the products containing high concentration of oxalic acid should be avoided in people with calcium oxalate kidney stones in anamnesis [3,8,11,12]. Thus, dietary supplements based on samh herb or flower extracts should be administered with caution in people with nephrolithiasis. Relatively high content of ferulic acid in *Mesembryanthemum forskalii* flowers can contribute to the hypoglycemic effect of the plant since ferulic acid has shown synergic effect with Hypoglycaemic agents [6].

CONCLUSION

Thus, the study carried out has allowed determining the organic acids present in *M. forskalii* flowers and herb. Both types of the plant material studied tend to accumulate oxalic, malic and citric acids, while flowers were also rich in levulinic, linoleic, succinic and ferulic acids [13].

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