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Chemical Composition and Antioxidant Properties of *Malva sylvestris* L.

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ABSTRACT

The leaves and petioles of *Malva sylvestris* L. were analyzed for their proximate composition, fatty acid composition, mineral content, total flavonoids and mucilage. The antioxidant capacities of samples were estimated using Folin-Ciocalteu (FC), Trolox equivalent antioxidant capacity (TEAC), 2,2'-diphenyl-1-picrylhydrazyl (DPPH), ferric-reducing/antioxidant power (FRAP) radical scavenging assays. The anti-nutritive compounds, tannin and nitrate were also quantified. The results showed that linolenic, linoleic, palmitic and oleic acids were measured more than 82% of total fatty acids in leaves and petioles. GC-MS analysis of methanolic extract revealed that 2-methoxy-4-vinylphenol was the major compound in the extract. Analysis of variance was showed that genotype and plant part were important sources of variability in the measured properties. Finally, antioxidant capacities of the *Malva sylvestris* L. were compared with spinach.

Keywords: *Malva sylvestris*, Antioxidant activity, Proximate composition, Fatty acids

INTRODUCTION

Humans have developed a broad knowledge of useful plants over time through continuous contact with their environment. Cultivated plants are widely used today although edible plants have the significant medical properties**.** Edible plants may have different uses in different areas of the same country. Additionally, people use them for some medicinal purposes (Dogan *et al*., 2004).

The *Malva sylvestris* L. is a biennial–perennial herbaceous plant that originated in southern Europe and Asia, but is found as a weed in most parts of the world. *Malva sylvestris* L. is a member of the Malvaceae family. This plant has a perennial root, and a juicy, annual stem two to three feet high. Leaves are large, broadly heart-shaped, soft, plaited and slightly seven-lobed. Flowers of the plant closely resemble that of honeysuckle (Lust, 1974). *Malva sylvestris* L.or common mallow is known by different synonyms and vernacular names such as Panirak, Khabazi, Tole in Iran, Malva, Marva in Italy (Scherrer *et al*., 2005), Malva in Portugal (Ferreira *et al*., 2006) and Ebegumeci, Gomecotu in Turkey (Kültür *et al*., 2007).

Many local wild plants such as *Malva sylvestris* L.are used in both food and medicine. Traditional phytotherapy uses include the treatment of cough, inflammatory diseases of mucous

membranes, non specific dermatitis, stomach ache, and sore throat (Kültür *et al*., 2007; Scherrer *et al*., 2005). The most typical preparations are aqueous extractions. These plants are very demulcent, with slight nervine tonic properties (Lust, 1974).

Antioxidants are important components because they protect against free radicals, such as reactive oxygen species in the human body. Free radicals are known to be the major contributors to degenerative diseases of aging and are recognized as major factors causing cancer. The human can use antioxidants either as dietary, food supplements or as a medicine. At present, there is an increasing interest both in industry and scientific research in vegetables, fruits, medicinal plants and spices because of their antioxidative phytochemicals and antimicrobial properties. These properties are due to many substances, including flavonoids, vitamins, terpenoides, minerals, phytochemicals, etc.

The branches with leaves and the other aboveground parts of *Malva sylvestris* L. are consumed as vegetable in the West of Iran. The objective of this research is to study of nutritional composition and antioxidant properties of leaf and petiole of *Malva sylvestris* L. and compare it with other vegetables.

MATERIALS AND METHODS

Samples collection

Plant samples were collected from different local supermarkets between July to September of 2009 from Ilam, Dehloran and Dezful. Specialists of plant taxonomy botanically identified them. Tissues were washed with distilled water, differentiated into leaves and petioles, stored at -18°C and protected from light until analyzed.

Proximate composition analysis

Moisture, ash, fat, fiber and protein contents were determined by using the standard methods (AOAC, 2000). Moisture content was determined after attaining constant weight at 105 °C. Ash content was heated after obtaining constant weight at 550 °C, and then the residue was determined gravimetrically. Total fat content was obtained by the Soxhelt extraction method. Protein was determined by Kjeldal procedure; the factor N×6.25 was used to convert nitrogen into crude protein. Data were expressed as percent of dry weight (DW).

Mineral element analysis

Na, K, Ca, Mg, Fe, Cu and Zn were determined by atomic absorption spectrometer (Chemtech CTA-2000, England). Samples were digested by dry-ashing and dissolved in 1M HCl. Phosphorus content was determined colorimetrically according to the molybdovanadate method (AOAC, 2000).

Fatty acids analysis

The fatty acid methyl esters (FAMEs) were prepared according to the procedure described by Metcalf *et al.* (1966). Fifty mg of extracted oil was saponified with 5 mL of methanolic NaOH (2%) solution by refluxing for 10 min at 90 °C. After addition of 2.2 mL BF_3-methanol, the sample was boiled for 5 min. The FAMEs were extracted from a saturated salt mixture with hexane. The FAMEs were then analyzed using a gas chromatograph (UNICAM model 4600, Cambridge, UK) coupled with a FID detector. The column used for fatty acid separation was a fused silica BPX70 column (30 m × 0.22 mm i.d. × 25 μm film thickness) from SGE, Grieheim, Germany). The oven temperature was held at 180 °C during separation. The injector and detector temperatures were 240 and 280 °C,

respectively. The carrier gas (helium) flow rate was 1mL.min^{-1}. One µL of methyl esters of free fatty acids was injected into the split injector. The split ratio was adjusted to 1:10. The internal standards C15:0 was used in the quantitative analysis.

Gas chromatography/mass spectrometry (GC/MS) analysis

The methanolic fraction was analyzed by GC–MS (HP6890, USA) equipped with a capillary silica HP5 column (30m×0.25mm i.d.; film thickness 0.25 µm). The carrier gas was helium (1 ml.min^{-1}) and the injector temperature was of 280 ˚C. The temperature program was set as follows: 50 ˚C hold for 2 min, raised at 5 ˚C.min^{-1} to 300 ˚C, and hold for 5 min. Mass spectrometer (HP 5973) was an electron impact (EI) type (70 eV), programmed from *m*/*z* 10 to *m*/*z* 400. The ion source and interface temperatures were set at 230 and 280 ˚C, respectively.

Extraction and determination of total phenolic content

Sample materials were extracted with 70% aqueous ethanol in the ratio of 1 to 10 w:v using an orbital shaker at room temperature for 2 hr. Extracts were centrifuged at 1000 g for 15 min. The supernant was recovered and used for antioxidant assay and total phenolic analysis (Amin *et al.*, 2006). Total phenolics were estimated by the FC method. Fifty-µL of supernant extracts were mixed with 2.5 mL of 0.2 N FC reagent diluted 1:10 (v:v). After 5 min, 2 mL of Na_2CO_3 (7.5% w:v) were added. The mixture was incubated in a water bath (45ºC) for 15 min. The absorbance of samples was measured at 765 nm using a UV-Vis spectrophotometer (3000 series, Cecil, Cambridge, England).Triplicate measurements were taken and results expressed as gallic acid equivalents (GAE).g^{-1} dry weight of plant material.

ABTS assay

Antioxidant activity was measured using the improved method as described by Re *et al.* (1999). The 2, 2′-Azino-bis-3-ethylbenzo-thiazoline-6-sulfonic acid radical cation ($ABTS^{\cdot+}$) was produced by mixing ABTS (7 mM) and potassium persulfate (2.45 mM). The mixed solution was kept at room temperature for 12-16 hr. The $ABTS^{\cdot+}$ solution was diluted with ethanol to obtain an absorbance of 0.700±0.050 at 734 nm. The solution was equilibrated at 30ºC. All samples were diluted to provide 20-80% inhibition of the blank absorbance. Fifty-µL of the diluted extracts or Trolox standard solution was added to 1.9 mL of diluted $ABTS^{\cdot+}$ solution. The reaction mixture was allowed to stand at 23ºC for 6 min. The absorbance was recorded at 734 nm (Li *et al.,* 2008). The result was expressed as µmol Trolox .g^{-1} dry weight of plant material. The percentage of inhibition was calculated using the equation below:

$$\text{Inhibition (\%)} = \left(\frac{A_{734}^{control} - A_{734}^{extract}}{A_{734}^{control}}\right) \times 100$$

DDPH assay

One milliliter of various concentrations of the extract was added to 1 ml of a 0.004% methanol solution of DPPH. The mixture was shaken vigorously and left to stand at room temperature for 30 min in the dark. Then the absorbance was measured at 517 nm against a blank. Inhibition of free radical (I%) was calculated according to:

$$I\,\% = (A_{blank} - A_{sample})/A_{blank} \times 100$$

Where A_{blank} is the absorbance of the control reaction (containing all reagents except the test compound), and A_{sample} is the absorbance of the test compound. Extract concentration providing 50% inhibition (IC_{50}) was calculated from the graph plotting inhibition percentage against extract concentration. Butylated hydroxytoluene (BHT) was used as

positive control. IC_{50} for BHT was 0.184±0.011 $mg.ml^{-1}$.

FRAP assay

The FRAP reagent included 10mM 2,4,6-Tri (2-pyridyl)1,3,5-triazine (TPTZ) solution in 40mM HCl, 20 mM $FeCl_3$ solution and 0.3 M acetate buffer (pH=3.6) in proportions of 1:1:10 (v/v). 50 µl of each diluted ethanolic extracts were mixed with 3 ml of freshly prepared FRAP reagent and the reaction mixtures incubated at 37°C for 30 min. Absorbance at 593 nm was determined against distilled water blank. FRAP values were expressed as mmol of Fe (II).g^{-1} dry weight of plant powder (Liu *et al.,* 2009).

Total flavonoid contents

An aliquot (250µl) of each extract or standard solution was mixed with 1.25 ml of doubly distilled H_2O and 75µl of 5% $NaNO_2$ solution. After 6 min, 150 µl of 10% $AlCl_3$. H_2O solution was added. After 5 min, 0.5 ml of 1M NaOH solution was added and then the total volume was made up to 2.5 ml with water. The absorbance against blank was determined at 510 nm. Catechin was utilized for constructing the standard curve (Liu *et al.,* 2009).

Nitrate, tannin and mucilage content

The measurement method for nitrate was based on AOAC official method 968.07 [6]. Nitrate was extracted with cadmium and barium chloride solutions. Bulks of soluble proteins were precipitated in alkaline solution and the clarified solution passed through metallic cadmium column. Absorbance was measured at 540 nm.

For determination of condensed tannin contents, 50 µl of each extract or standard solution was mixed with 1.5 ml of 4% vanillin (prepared with MeOH). After that, 750 µl of concentrate HCl were added. The well-mixed solution was incubated at ambient temperature in the dark for 20 min. The absorbance against blank was read at 500 nm. The results were expressed as mg catechin equivalents (CE). g^{-1} dry weight (Liu *et al.,* 2009).

Plant samples were pulverized and raw mucilage extracted by hot extraction method (Brautigam and Franz, 1985). After extracting, the raw mucilage were dried and weighted.

RESULTS AND DISCUSSION

Proximate composition

The moisture, ash, fat, fiber and crude protein content of *Malva sylvestris* L. samples are shown in Table 1. Leaves of different samples contained 82.80-86.23 % moisture; 13.10-14.85 % ash; 0.16-0.30% fat; 2.95-5.0% fiber; and 2.49-3.22% protein (percentage as fresh weight basis). Petioles of different samples contained 82.65-83.53 % moisture; 13.96-15.56 % ash; 0.1-0.2% fat; 3.50-5.48% fiber; and 2.88-2.92% protein. Fat and fiber were higher in leaves and petioles, respectively.

Mineral content

Table 1 shows some of mineral contents in the leaves and petioles of *Malva sylvestris* L. Content of calcium and potassium in samples were very high (414.17-823.05 and 304.78-709.63 mg/100gfw, respectively). Calcium was the most abundant element in *Malva sylvestris* L. The other elements, in descending order by quantity, were Na, Mg, Fe, P, Zn and Cu. Variations in mineral contents may have some relation with growing environment. Results showed that, *Malva sylvestris* L. is good source of Ca and K. Sodium and magnesium were present in moderate amount (168.08-251.98, 65.55-177.48 mg/100gfw, respectively), while Fe, P, Zn and Cu levels were low (2.99-4.39, 0.52-1.04, 0.11-0.34 and 0.17-0.30 mg/100gfw, respectively). Mineral content of the

Malva sylvestris L. was comparable with spinach. These values for *Spinacia oleracea* L. (Spinach) and *Malva sylvestris* L. were Cu (0.05, 0.18 mg/100gfw), Zn (0.3, 0.27 mg/100gfw), Fe (1, 4 mg/100gfw), K (537, 544 mg/100gfw), Na (94, 194 mg/100gfw), Ca (64, 643 mg/100gfw), Mg (55, 131 mg/100gfw) (Kawashima and Valente Soares, 2003).

Table 1. Proximate compositions[a], mineral elements[b], antinutrient contents[c], mucilage and antioxidant activity[d] of *Malva sylvestris* samples[e]

	Leaf			Petiole		
	Ilam	Dehloran	Dezful	Ilam	Dehloran	Dezful
Ash	13.53±0.64dc	13.1±0.54e	14.85±0.26ab	14.57±0.17bc	15.56±0.4a	13.96±0.37dc
Moisture	83.85±0.31b	86.23±0.49a	82.8±0.6bc	82.65±0.4c	83.13±0.37bc	83.53±0.34b
Fat	0.24±0.03b	0.16±0.01d	0.30±0.02a	0.12±0.02e	0.10±0.01e	0.20±0.02c
Fiber	3.76±0.07d	2.95±0.05f	5.00±0.10b	4.76±0.09c	3.50±0.08e	5.48±0.07a
Protein	2.81±0.04c	2.49±0.02d	3.22±0.03a	2.92±0.03b	2.92±0.05b	2.88±0.04b
Na	209.60±2.86c	221.0±4.13b	251.98±4.1a	171.18±5.74e	168.08±4.36e	195±3.4d
K	539.94±5.48c	447.3±6.55d	643.3±6.34b	304.78±5.6f	431.5±5.95e	709.63±4.28a
Ca	689.74±7.28c	417.6±7.99d	823.05±5.46a	771.10±6.85b	414.2±7.05d	769.82±4.66b
Mg	149.47±1.54b	65.55±1.31e	177.48±4.43a	128.47±2.61c	73.93±2.78d	145.26±4.92b
Fe	4.39±0.16a	3.6±0.16bc	4.34±0.2a	3.87±0.2b	2.99±0.06d	3.44±0.25c
Cu	0.17±0.02c	0.20±0.04bc	0.18±0.01bc	0.30±0.03a	0.28±0.01a	0.22±0.03b
Zn	0.34±0.02a	0.24±0.01b	0.24±0.01b	0.25±0.04b	0.16±0.01c	0.11±0.02d
P	0.80±0.02b	0.87±0.01b	1.04±0.01a	0.54±0.04d	0.52±0.04d	0.69±0.11c
Tannin	1.87±0.03b	2.18±0.03a	1.86±0.05b	0.86±0.05e	1.18±0.04c	0.95±0.06d
Nitrate	2.95±0.12f	4.73±0.10e	9.24±0.13d	19.20±0.08c	59.29±0.06b	66.89±0.09a
mocilage	12.73±0.15a	6.9±0.2d	8.26±0.15b	7.46±0.15c	6.3±0.26e	5.96±0.11f
Total Phenolics	15.11±0.28a	12.35±0.16b	11.82±0.14c	1.68±0.01e	1.97±0.01d	1.40±0.02f
Total flavonoids	27.18±0.47a	25.58±0.30b	21.85±0.40c	4.31±0.20e	4.95±0.12d	3.50±0.09f
TEAC	28.70±0.69a	24.07±0.37c	25.70±0.28b	25.76±0.54b	21.91±0.25d	25.56±0.05b
FRAP	0.149±0.001a	0.134±0.001b	0.129±0.003c	0.051±0.001d	0.046±0.003e	0.046±0.002e
DPPH	0.077±0.002a	0.076±0.001a	0.071±0.002b	0.075±0.002ab	0.074±0.001ab	0.071±0.005b

[a] % of fresh weight basis
[b] mg/100g fresh weight
[c] Tannin (mg CE/gdw), Nitrate (mg/100gdw)
[d] Total phenolics (mg GAE/gdw), total flavonoids (mg CE/gdw), TEAC (µmolTrolox/gdw), FRAP (mmol Fe(II)/gdw), DPPH (IC_{50} (mg/ml))
[e] Values are the means ± SD of three determinations

Table 2. Fatty acid composition of *Malva sylvestris* oil (relative content %)

Fatty acid	Leaf			Petiole		
	Ilam	Dehloran	Dezful	Ilam	Dehloran	Dezful
Pentadecenoic acid	7.71±0.42a	6.71±0.14b	7.21±0.46ab	1.65±0.27c	1.07±0.3d	1.70±0.21c
Palmitic acid	17.92±0.22e	17.45±0.42e	18.57±0.25d	25.97±0.13a	23.81±0.37b	22.95±0.15c
Palmitoleic acid	2.07±0.06a	1.81±0.03b	1.56±0.1c	0.00[a]e	0.96±0.08d	0.00[a]e
Stearic acid	4.19±0.14c	4.84±0.17b	4.76±0.19b	4.77±0.22b	7.92±0.26a	4.32±0.23c
Oleic acid	4.46±0.21e	12.33±0.85ab	7.55±0.57d	10.22±0.73c	13.04±0.62a	11.46±0.33b
Linoleic acid	10.67±0.36e	12.46±0.67d	9.14±0.71f	24.10±0.51a	22.52±0.48b	19.27±0.83c
Linolenic acid	50.15±0.92a	43.07±0.89c	48.15±0.73b	23.86±0.68d	23.10±0.51d	20.78±0.94e
Arachidic acid	0.80±0.46ab	0.00b	1.07±0.86a	0.00b	0.00b	1.32±0.91a
Arachidonic acid	1.15±0.88d	0.43±0.01d	0.85±0.11d	7.13±0.55b	4.50±0.66c	14.64±0.84a
Behenic acid	0.88±0.06b	0.90±0.03b	1.15±0.12ab	1.08±0.16ab	1.31±0.34a	0.00b
Lignoceric acid	0.00b	0.00b	0.00b	0.00b	0.00b	0.45±0.06a
Nervonic acid	0.00d	0.00d	0.00d	1.21±0.08c	1.77±0.06b	3.11±0.09a
Total saturates	23.79	23.19	25.55	31.83	33.04	29.04
Total unsaturates	76.21	76.81	74.45	68.17	66.96	70.96
Monounsaturates	14.24	20.85	16.32	13.08	16.84	16.27
Polyunsaturates	61.97	55.96	58.13	55.09	50.12	54.70

[a]: not detected

In each row, means with a similar letter are not statistically significant from each other

Mucilage and antinutritional factors

The genera of Malvaceae have different amount of mucilage that stored in different type in the tissue. In some species, mucilage stored in idioblasts and others stored in the cavities between cells. Mucilage contents ranged 6.9-12.73% and 5.96-7.46% in leaves and petioles, respectively (Table 1).

The effects of tannins are mainly related to their interaction with proteins and tannin-protein complexes are insoluble, consequently, protein digestibility is decrease. As shown in Table 1, tannin and nitrate contents in these samples ranged between 1.86-2.18 and 0.86-1.18 mg CE/gdw and 2.95-9.24 and 19.2-66.89 mg nitrate/100gdw for leaves and petioles, respectively.

Fatty acid composition

The results showed that four major acids (linolenic, linoleic, palmitic and oleic acids) accounted for more than 82% of total fatty acids (Table 2). Linolenic and palmitic acids were the dominant fatty acids with contents of 43.07-50.15% and 22.95-25.97% in leaves and petioles, respectively. Unsaturated fatty acids were the main fatty acids in both leaves and petioles with contents of 66.96-76.81%. Poly-unsaturated and mono-unsaturated fatty acids contributed 50.12-61.97% and 13.08-20.85%, respectively. Saturated fatty acids determined 23.19-33.04% of total fatty acids.

Total phenolic content and antioxidant capacity

Naturally, occurring substances in fruits and vegetables such as phenolic compounds have antioxidant activity. These substances have the ability to scavenge free radicals by single electron transfer (Re *et al.,* 1999). Total phenolic contents of *Malva sylvestris* L. samples are given in Table 1. Results showed that, total phenolic contents decreased in the order of Ilam, Dehloran and Dezful. Phenolic compounds ranged 11.82-15.11 and 1.40-

1.97 mg GAE/gdw in leaves and petioles, respectively.

Flavonoids are typical phenolic compounds and powerful chain-breaking antioxidants. Flavonoids have multiple biological activities including potent anti-allergic and anti-inflammatory and antiviral reactions. The possible presence of flavonoid-like compounds in *Malva sylvestris* L. was tested. The flavonoid content in leaves and petiole of *Malva sylvestris* L. ranged between 21.85-27.18 and 3.50-4.95 mg CE/gdw, respectively (Table 1).

Three testes evaluated the antioxidant activity of ethanol extracts: TEAC, FRAP and DPPH (Table 1). The use of more than one method is recommended to give a comprehensive prediction of antioxidant activity. In all cases, leaves had higher antioxidant activity than petioles. In TEAC assay, radical scavenging capacity of sample antioxidant was evaluated against ABTS radical generated by the chemical method. The ABTS scavenging capacity ranged 24.07-28.70 and 21.91-25.76 µmol Trolox /gdw for leaves and petioles, respectively. FRAP assay is based on the reduction of the Fe^{3+}-TPTZ complex of the ferrous form at low pH. FRAP values were 0.129-0.149 mmol Fe (II)/gdw for leaves and 0.046-0.051 mmol Fe(II)/gdw for petiols. DPPH is a stable nitrogen-centered free radical which the color changes from violet to yellow upon reduction by either the process of hydrogen or electron donation. Antioxidants are able to perform this reaction and scavenge the radicals. IC_{50} values ranked from 0.071-0.077 $mg.ml^{-1}$ for leaves and 0.711-0.747 $mg.ml^{-1}$ for petioles.

Antioxidant activity of the *Malva sylvestris* L. was comparable with spinach. These values for *Spinacia oleracea* L. (Spinach) and *Malva sylvestris* L. were total phenolic content (9-13 mgGAE/gdw (Zhou and Yu, 2006), 13.1 mg GAE/gdw), TEAC (35-50 µmolTrolox/gdw (Zhou and Yu, 2006), 26.1 µmolTrolox/gdw), FRAP (26.94 mmol Fe(II)/kgfw (Pellegrini *et al.,* 2009), 21.6 mmol Fe(II)/kgfw).

Analysis of methanol fraction by GC-MS

Methanol fraction was analyzed by GC–MS to determine its chemical composition. The GC–MS analysis showed that extract contained a variety of compounds (Figure. 1). By comparing the MS spectral data with those of standards and MS library, 18 compounds were identified. 2-Methoxy-4-vinylphenol was the major phenolic compound.

Statistical analysis

Effects of genotype and plant parts on proximate composition, mineral content, anti-nutritive compounds, fatty acids and antioxidant activities were tested with analysis of variance (ANOVA). The ANOVA indicated that genotype as a source of variation was significant for all of properties except ash (Table 3). Plant parts (organ) as other source of variation was significant for all of properties except DPPH and arachidonic acid (Table 3). Some of genotype × organ interactions were also not significant.

CONCLUSION

This study revealed that *Malva sylvestris* L. had relatively high antioxidant capacity. The results showed that four major fatty acids (linolenic, linoleic, palmitic and oleic acids) measured more than 82% of total fatty acids in leaves and petioles. The GC–MS analysis showed that methanolic extract contained 18 compounds that 2-Methoxy-4-vinylphenol was the major phenolic compound. Genotype and plant part were important sources of variability in proximate composition, mineral content, anti-nutritive compounds, fatty acids and antioxidant activities. Mineral content and antioxidant activity of the *Malva sylvestris* L. were comparable with spinach. The

results showed that *Malva sylvestris* L. had great potential for use as food and/or feed resources.

Table 3. Results of ANOVA for main effects and interactions

Variables	Source of variation		
	Genotype (G)	Organ (O)	G × O
Ash	NS	***	***
Moisture	***	***	***
Fat	***	***	NS
Fiber	***	***	***
Protein	***	**	***
Na	***	***	**
K	***	***	***
Ca	***	*	***
Mg	***	***	***
Fe	***	***	NS
Cu	*	***	*
Zn	***	***	NS
P	***	***	NS
Tannin	***	***	NS
Nitrate	***	***	***
Mocilage	***	***	***
Total Phenolics	***	***	***
Total flavonoids	***	***	***
TEAC	***	***	***
FRAP	***	***	***
DPPH	*	NS	NS
Pentadecenoic acid	***	***	NS
Palmitic acid	***	***	***
Palmitoleic acid	***	***	***
Stearic acid	***	***	***
Oleic acid	***	***	***
Linoleic acid	***	***	***
Linolenic acid	***	***	***
Arachidic acid	**	NS	NS
Arachidonic acid	***	***	***
Behenic acid	***	*	***
Lignoceric acid	***	***	***
Nervonic acid	***	***	***

NS, *, **, ***: Not significant, Significant at $P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$
G: Ilam, Dehloran, Dezful
O: Leaf, Petiol

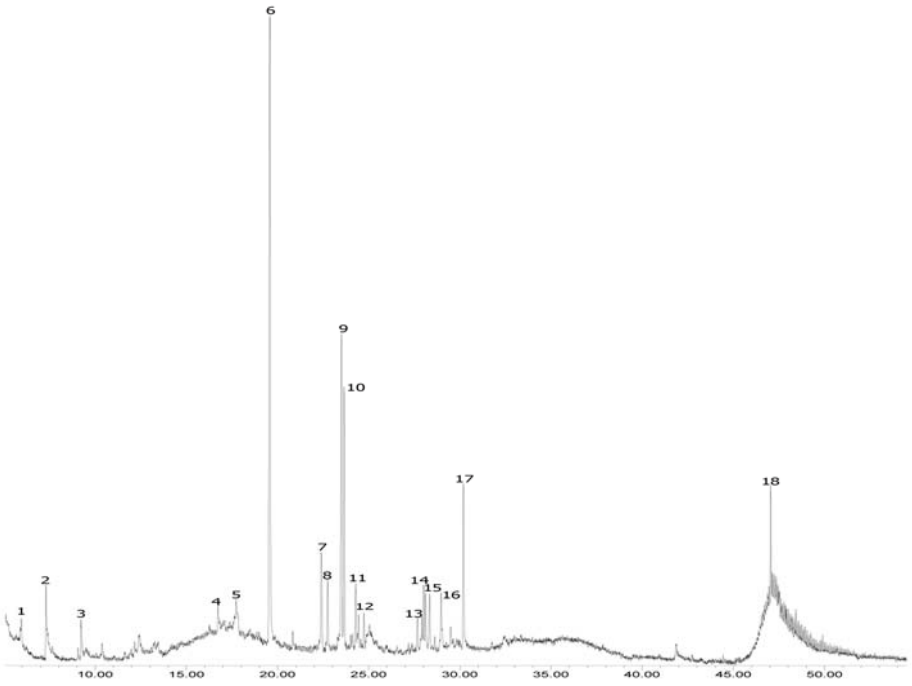

Figure 1. GC-MS chromatogram of methanolic extract from *Malva sylvestris*

(1) 2-Amino-1-butanol (2) Dihydro-2(3H)-furanone (3) 3-Hydroxy-2-butanone (4) N,N,N',N'-tetramethyl-1,2-ethanediamine (5) n-Pentanal (6) 2-Methoxy-4-vinylphenol (7) 2,2'-[Ethylidenebis(oxy)]bis-pentane (8) 5-Methoxy-thiazole (9) 2,4,6-Trimethyl-1,3-dioxane (10) 2,4-Pentaediol (11) 3-(1-Methylbutoxy)-2-butanol (12) 3-Methyl-oxirane-2-carboxylic acid (13) Succinaldehyde (14) 5-Methoxy-thiazole (15) Succinic acid dihydrazid (16) Trans-1-(2-pyrazyl)-1-octene (17) Ethyl citrate (18) Triphenylphosphine oxide

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