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Analisys of component composition of volatile compounds of field sow thistle (*Sonchus Arvensis* L.) leaves using the method of gas chromatography with mass-detection

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Abstract
Gas chromatography mass spectrometry (GC-MS) analysis revealed the presence of 26 compounds in leaves of field sow thistle Nutt. In GC-MS analysis, some of the phytocomponents screened were phytol, pentacosane, 1, 2-benzenedicarboxylic acid, bis (2-methylpropyl) ester. The compounds were identified by comparing their retention time and peak area with that of literature and by interpretation of mass spectra. Many of them have antioxidant, anti-inflammatory, antimicrobial and anticancer actions.

Keywords: Field sow thistle Nutt, gas chromatography-mass spectrometry (GC-MS)

1. Introduction
Field sow thistle (*Sonchus arvensis* L) is the perennial plant, family Compositae. The Sonchus Genus has about 30 species of plants. The most common species using of some countries are Sow thistle and Field sow thistle because of their high biological activity [1-4]. Extracts from some species of sow thistle genus are able to detect anti-cancer, anti-hyperglycemic, anti-oxidant and other medicinal properties [1-4]. The chemical composition of Sonchus Genus arvensis is insufficiently researched though the aerial part of Field sow thistle contains a significant amount of BAS especially hydroxycinnamic acids, flavonoids and polyphenols and essential oils, organic acids, alcohol, steroids, esters, amino and nitro derivatives of aromatic hydrocarbons according to the literature. Phytochemical plant's research of native flora, exploring of the possibilities of complex using of raw materials, creation of a new drugs have recently obtained significant relevance. It is due to the high efficiency of biologically active substances (BAS) of plant materials and their low toxicity.
It had been paid an attantion to the presence of a controversial scientific sources and solitary data as to content of volatile compounds into the raw leaves of Field sow thistle and it was researched the component composition of the group mentioned above BAS of raw materials using the modern highly selective method of gas chromatography with mass-detection (GC-MS).

2. The Aim of the Study
The aim of the present study is to identify the phytocomponents of *Sonchus arvensis* L. with the use of Gas chromatography – Mass Spectrum analysis. In the present study, volatile organic matter of the leaf sample of plant was analyzed for the first time. This work will help to identify compounds, which may be used in therapeutic value.

3. Materials and Methods
The objects of the study were leaves of Field sow thistle (*Sonchus arvensis* L). Row materials of Field sow thistle (*Sonchus arvensis* L) were gathered during the blossom period in the Kyiv region in 2014.
GC-MS analyses were performed on a Agilent Technologies 6890 capillary gas chromatograph directly coupled to a mass spectrometer system (model 5973). A fused silica capillary column 5% phenyl-poly-dimethylsiloxane (DB-5 capillary column (30 m * 0.25 mm inner diameter, with 0.25 mm film thickness) was used under the following conditions: oven temperature program from 50 °C (3 min hold) to 320 °C at 4 °C/min; injector temperature 250 °C; carrier gas He, flow rate 1,2 mL/min; the volume of injected sample was 1.5µl; splitless injection

technique. Individual components were identified by comparison of their mass spectra using both "NIST-MS Library 05" and "Wiley GC-MS Library 2007". Relative percentage amounts of separated compounds were calculated automatically from peak areas of the total ion chromatograms (TIC). This is done in order to determine whether these plant species contains any individual compound or group of compounds, which may substantiate its current commercial and traditional use as the herbal medicine. Further it helps to determine the most appropriate methods of extracting these compounds. These results will consequently be discussed in the light of their putative biological or therapeutic relevance.

The above-mentioned research range is using for the identification of individual compounds or groups of substances, their presence gives a possibility to predict the pharmacological effect of Sow thistle leaves extracts.

4. Results and Discussion

Compounds of *Sonchus arvensis* L leaves was identified using the GC-MS method and they is given in Table 1. Analisys of *Sonchus arvensis* L by the the GC-MS method was found out the 42 compounds. In particular, it was found out the highest quantity of Pentakozan 75 mg / kg, 1,2-Benzenedicarboxylic acid, Di-n-butyl ester 55 mg / kg, 2 -Pentadecanone, 6,10,14-trimethyl 38 mg / kg 38 mg / kg, n -Trykozan 24 mg / kg. Identified compounds have a wide range of biological properties. Especially higher hydrocarbons namely pentadecane, hexadecane, heneykozan, trykozan, Tetracosane, pentakozan, heksakozan have antibacterial properties [6, 7, 9]. Fitola is diterpene acyclic alcohol and it is a precursor of vitamin E, K1 and it is preventive measure against the epoxide -induced breast cancer [8]. Also it were identified into the Field sow thistle leaves the aldehydes namely Dekanal and v 2,4-dekadiyenal. According to data [12] the aldehydes can exhibit antidiarrheal pharmacological properties. Some sources indicate the presence of higher fatty acids of a wide range of pharmacological properties namely anti-inflammatory, antibacterial, hepatoprotective, anti-ischemic [5]. The representatives of the class of fatty acids namely tetradecanoic acid into the analyzed objects of leaves Field sow thistle has 0.62 mg / kg. Thus we can predict the presence of hepatoprotective, anti-ischemic and other pharmacological properties characteristic of higher fatty acids [5] into the Field sow thistle leaves. Also ethyl esters that can inhibit phagocytosis present into sow thistle leaves [13].

Recently, the method of chemical analysis namely gas chromatography with mass-detection becomes more widely used. This method allows the identification and quantitative determination of volatile compounds of extremely low concentrations in contrast to other methods. GC-MS allows the identification of such compounds as alkanes, higher aldehydes, fatty acids, amines, steroids, alkaloids and others.

Phytochemical analysis of plants, exploring the possibilities of complex using of raw materials, creation a new drugs, it had recently got a significant relevance. It is due to the high efficiency of biologically active substances (BAS) of plant materials and their low toxicity. One of these plants is Field sow thistle (*Sonchus arvensis* L.). Genus of thistles spread throughout Ukraine. Four species of thistles: garden thistle, Field sow thistle, sow-thistle hard, marsh thistle have the largest area in Ukraine. Plants of this genus have a wide range of pharmacological properties. It was determined that Field sow thistle has the antioxidant pharmacological properties [14]. This study shows that the antioxidant properties of methanol extracts of leaves of Field sow thistle are the most predominant. Raw material of the genus of thistles is part of dietary supplement. As part of dietary supplements thistles garden is used as a diuretic. Diuretic effect is inherent to every species of Genus of thistles. Species of the Genus thistle is widely used as a herbal nefroprotektora. Prolit, and Holit Kedzhybelinh extra are the official dietary supplements that contain raw thistle GARDEN. It is known also the dietary supplements that include other species of thistles, that are less known namely Vivital and Golden horse. One of the component of these dietary supplements is Sonchus brachyotus.

Chromatogram of the analized Field sow thistle extract of leaves is shown in Fig. 1.

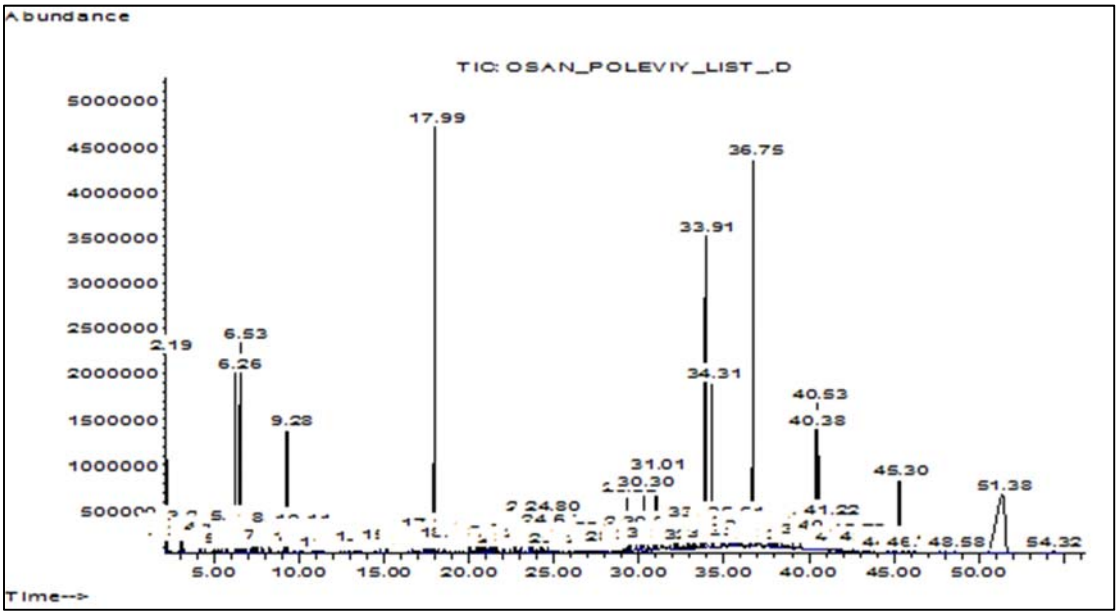

Fig 1: Chromatogram of volatile compounds of Field sow thistle leaves.

Qualitative and quantitative composition of volatile compounds of the analized object is given in following Table 1.

Table 1: The chemical composition of volatile compounds of *Sonchus arvensis* L leaves.

S. No	R/T	Name of the Compound	Molecular Formula	MW	Content, mg / kg
1	14,78	Decanal	$C_{10}H_{20}O$	156	1,44
2	18,57	2,4-Decadienal	$C_{10}H_{16}O$	152	1,55
3	21,22	Tetradecane	$C_{14}H_{30}$	198	1,1
4	24,35	Pentadecane	$C_{15}H_{32}$	212	0,98
5	27,3	Hexadecane	$C_{16}H_{34}$	226	0,45
6	30,15	Heptadecan	$C_{17}H_{36}$	240	0,72
7	30,28	Benzoic acid, 2-ethylhexyl ester	$C_{15}H_{22}O_2$	234	7,22
8	31	3-Tetradecene	$C_{14}H_{28}$	196	8,76
9	31,87	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	0,62
10	32,85	Octadecane	$C_{18}H_{38}$	254	1,24
11	33,25	Tetradecanal	$C_{14}H_{28}O$	212	3,20
12	34,3	1,2-benzenedicarboxylic acid,bis(2-methylpropyl)ester	$C_{16}H_{22}O_4$	278	17,53
13	34,9	1-Hexadecanol	$C_{16}H_{34}O$	242	1,65
14	35,40	Nonadecan	$C_{19}H_{40}$	268	0,93
15	37,7	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	0,77
16	37,9	Eicosane	$C_{20}H_{42}$	282	0,88
17	40,05	10-Heneicosene	$C_{21}H_{42}$	294	1,75
18	40,35	Heneicosene	$C_{21}H_{44}$	296	18,56
19	40,55	Phytol	$C_{20}H_{40}O$	296	21,13
20	41,85	9,12,15-octadecatrienoic acid,ethyl ester	$C_{20}H_{34}O_2$	306	0,88
21	42,76	Dokozan	$C_{22}H_{46}$	310	2,63
22	44,7	9-Tricosene, Z	$C_{23}H_{46}$	322	0,57
23	45,2	Tricosan	$C_{23}H_{48}$	324	23,71
24	47,8	Tetracosane	$C_{24}H_{50}$	338	3,71
25	50,7	Pentacosane	$C_{25}H_{52}$	352	75,26
26	54,2	Hexacosane	$C_{26}H_{54}$	366	1,55

Table 2: GC-MS analysis showed phytochemical compounds, their nature and biological activities of leaves *Sonchus arvensis* L.

S. No	R/T	Name of the Compound	Compound Nature	Activity
1	14,78	Decanal	Aldehyde	Antidiarrhoeal [12]
2	18,57	2,4-Decadienal	Aldehyde	Antidiarrhoeal [12]
3	21,22	Tetradecane	Aliphatic hydrocarbon	Antibacterial, antioxidant [6]
4	24,35	Pentadecane	Aliphatic hydrocarbon	Antibacterial, antioxidant [6]
5	27,3	Hexadecane	Aliphatic hydrocarbon	Antibacterial, antioxidant [6]
6	30,15	Heptadecan	Aliphatic hydrocarbon	Antibacterial, antioxidant [66]
7	30,28	Benzoic acid, 2-ethylhexyl ester	Ester	Inhibits phagocytosis [13]
8	31	3-Tetradecene	Aliphatichydrocarbon	Antibacterial [6]
9	31,87	Tetradecanoic acid	Fatty acid	Anti-inflammatory, hypocholesterolemic, cancer preventive, hepatoprotective, antibacterial, antiarthritic, anticoronary [12]
10	32,85	Octadecanes	Aliphatic hydrocarbon	Antibacterial [6]
11	33,25	Tetradecanal	Aldehyde	Antidiarrhoeal [6]
12	34,3	1,2-benzenedicarboxylic acid,bis(2-methylpropyl)ester	Ester	Inhibits phagocytosis [13]
13	34,9	1-Hexadecanol	Fatty alcohols	Antibacterial [6]
14	35,40	Nonadecan	Aliphatic hydrocarbon	Antibacterial, antioxidant [6]
15	37,7	Hexadecanoic acid, ethyl ester	Ester	Inhibits phagocytosis [13]
16	37,9	Eicosane	Aliphatic hydrocarbon	Antibacterial, antioxidant [13]
17	40,05	10-Heneicosene	Aliphatic hydrocarbon	Antibacterial, antioxidant [13]
18	40,35	Heneicosene	Aliphatic hydrocarbon	Antibacterial, antioxidant [13]
19	40,55	Phytol	Diterpene	Antimicrobial, anticancer, cancer preventive, diuretic antiinflammatory [12]
20	41,85	9,12,15-octadecatrienoic acid,ethyl ester	Ester	Inhibits phagocytosis [13]
21	42,76	Dokozan	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]
22	44,7	9-Tricosene, Z	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]
23	45,2	Tricosan	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]
24	47,8	Tetracosane	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]
25	50,7	Pentacosane	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]
26	54,2	Hexacosane	Aliphatic hydrocarbon	Antibacterial, antioxidant [7]

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Development of methods for the identification and quantification of biologically active substances;
Identification and study of patterns of relationship between the structure and pharmacological activity of known and synthesized substances.