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Original Research Article

Gas Chromatography Analysis, Mineral Contents and Anti-inflammatory Activity of *Sonchus maritimus*

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ABSTRACT

Sonchus maritimus belongs to Asteraceae family. It is a well-known medicinal plant for its phytochemicals and therapeutic values. This paper aimed to investigate the phytochemicals, Gas chromatography analysis of leaves aqueous extract of *Sonchus maritimus* and to estimate its anti-inflammatory propriety. Quantitative and qualitative phytochemical including GC analysis were carried out using studied protocols. Anti-inflammatory activity of extract was also evaluated using inhibition of protein denaturation and anti-hemolysis assays. The phytochemical screening of the leaves aqueous extract of *S. maritimus* demonstrated the presence of phenols, flavonoids, tannins, terpenoids, sponins, unsaturated steroids and derived steroids whereas the absence of alkaloids and reducing compounds. The results of quantitative analysis showed that *S. maritimus* has significant amounts of flavonoids and condensed tannins in addition to a reasonable amount of phenols. In addition to important content of phytominerals including sodium, potassium, calcium, iron and magnesium, copper, zinc and manganese. GC results showed that the leaves extract of *S. maritimus* contained a large number of different molecules, among abundant volatile compounds; 1-Hexanol, 2-ethyl-, Ethylene glycol - Adipate - Diethylene glycol, Cyclotrisiloxane, and hexamethyl. The extract of *S. mritimus* was exhibited an important activity to inhibit the albumin denaturation (IC_{50} 334.369±29 µg/mL) and to protect erythrocytes against hemolysis (IC_{50} 53.539 ± 4.64 µg/ mL). In conclusion, the abundance of volatile phytocompounds in the leaves aqueous extract of *S. maritimus* could indicate distinct biological activities while the therapeutic molecules are used as new pharmaceutical products to treat diverse diseases in the future.

Keywords: *Sonchus maritimus*, GC analysis, Phytochemical screening, Phenols, flavonoids

Introduction

Medicinal plants constitute an extensive range of economically important species with a variety of applications. They are the hidden gem of phytochemicals.[1] Leaves are an important part in plant because of abundance of secondary and volatile compounds which have been applied in many industrial fields due to their unique biological proprieties as reported from the ancient time.[2] Chinese folk medicine has utilized *sonchus* species as a potherb for treating a wide range of diseases. This traditional practice dates back thousands of years.[3] Richness of *Sonchus maritimus* in mineral and phytochemical components has made its valuable as dietary supplements, because it is considered an appropriate source for many bioactive compounds that have been identified in it.[4] Among bioactive phytochemicals that contained in *Sonchus* species are phenols, fatty acids, proanthocyanins, flavonoids, flavanols , phytate and high content of ascorbic acid (vitamin C) and different minerals contents.[5,6]

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The previously mentioned phytocompounds have been shown in previous research to have a wide range of pharmacological activities, such as antibacterial action, antitumor effect, hepatoprotective, neuroprotective, cardiovascular therapy, rheumatism and general pain, in addition to their anti-aging and general tonic properties.[6] Furthermore, the phytochemicals activate the immune system, reduce oxidation, reduce inflammation, block the formation of carcinogens and slow the growth of cancer cells.[7] Because of therapeutic properties of volatile compounds which have been employed in numerous conventional medical systems. Volatile compounds have been considered to be an effective alternative to synthetic and chemical medications, which often have unfavorable side effects. Therefore, numerous plant sources have been investigated in recent research for the synthesis of volatile chemicals.[8] This investigation focused on phytochemical screening of the leaves aqueous extract of *Sonchus maritimus* and identification of volatile components using GC analysis with evaluation of its anti-inflammatory activity.

Methodology

Collection and Identification of plant material

Sonchus maritimus was obtained in November 2021 from Djamaa region at coordinates 33° 32′ 0″ N, 6° 0′ 0″ E, situated at an altitude of 41 m (135 ft) in El-Oued state, Algeria; and its taxonomy was confirmed by a botanist (Pr. Halis Youcef) in CRSTRA Touggourt. Voucher specimen number: FSNV/DB/consult/2021/88-14-05 was deposited.

Plant extraction
the leaves aqueous extract of *Sonchus maritimus* (SmE) was prepared as following; 10 g of *Sonchus maritimus* dry leaves powder was mixed with 100 ml of distilled water. The mixture was next macerated for 24 hours at ambient temperature before being filtered through filter paper and drying in a stove.[9]

Phytochemicals analysis
The phytochemical screening was performed using standard protocols,[10–13] to identify the phytochemicals compounds found in the leaves aqueous extract of *Sonchus maritimus*.

Quantitative analysis
Total phenols
The total phenol content was estimated by adding 500 µL of distilled water to 125 µL of *S. maritimus* extract. Then, 125 µL of Folin-Ciocalteu's reagent was introduced to the mixture into tubes. After five minute, 1250 µL of 7.5 g/L sodium carbonate solution was added in order to speed up the medium and initiate the redox reaction. Subsequently, the reaction mixture was diluted to 3 mL with distilled water and agitated. The mixture was then left at ambient temperatures in a dark place for two hours. Using an UV-VIS spectrophotometer, the absorbance of each sample was detected at 765 nm. Using the same test method conditions and a variety of concentrations of Gallic acid from 10 to100 µg/mL, a typical calibration curve was created. The results of total phenols content were expressed on mg of Gallic acid per g of leaves aqueous extract of *S. maritimus*, The tests were carried out three times.[14]

Total flavonoids
Flavonoids content was determined using 1000 µL of 2% aluminum chloride which was mixed with 1000 µL of *S. maritimus* extract. Using an UV-VIS spectrophotometer, the absorbance of each sample was determined at 430 nm following ten minutes of incubation period at the ambient temperature. Using the same test method conditions and a variety of concentrations of quercetin from 10 to100 µg/mL, a typical calibration curve was created. The results of total flavonoids were expressed on mg of Quercetin per g of leaves aqueous extract of *S. maritimus*, The tests were carried out three times.[15]

Condensed tannins
Condensed tannins were performed using laboratory protocol. Briefly; 3 mL of 4% vanillin reagent (prepared in methanol) and 500 µL of S. maritimus extract were mixed. Then, 1500 µL of concentrated hydrochloric acid were introduced into the resulting mixture and thoroughly mixed. The assay stages were carried out in the dark and between 20°C and 2°C. After fifteen minutes of reaction, the absorbance of each sample was determined at 500 nm against water. Using the same test method conditions and a variety of concentrations of catechin from 10 to100 µg/mL, a typical calibration curve was created. The results of condensed tannins were expressed on mg of Catechine per g of leaves aqueous extract of *S. maritimus*. The tests were carried out three times.[16]

Determination of mineral elements
The phyto-mineral nutrients content in *S. maritimus*, including potassium (K), sodium (Na), calcium (Ca), iron (Fe), copper (Cu), zinc (Zn), magnesium (Mg) and manganese (Mn), were determined using an auto sampler of atomic absorption Spectrophotometer (Shimadzu AA-6800). The sample preparation began first with the burning process of the leaf powder of *S. maritimus* in a muffle furnace (Nabertherm, Germany) for 4 hours at 600°C., the ashes were then dissolved in 3 mL of hot and concentrated nitric acid, the mixture solutions were filtrated using Whatman's filter paper. The filtrate volumes were completed till 10 mL using distilled water.

Gas chromatography and mass spectroscopy (GC/MS) analysis
Solid-phase micro-extraction (SPME) using DVB/CAR/PDMS fibre was utilized to extract volatiles from headspace. First, the fibre had to be conditioned at 270°C in the GC injection point. Next, for 15 minutes at room temperature, the fiber was added to the vial containing the sample using an adaptor. Subsequently, the fiber was introduced into a gas chromatograph through its injection port to initiate desorption. Ten minutes at 260°C was desorption time in the splitless mode. The analysis was carried out using mass detector of 5975C VL Triple-Axis which was coupled with 7890A GC system from Agilent Technologies in Santa Clara, United States. The separation process was done out using helium as the carrier gas at an average flow rate of 0.6 mL/min on a DB-5MS capillary column (25 m × 0.2 mm; film thickness of 0.33 µm; manufactured by J&W, Folsom, California). The injector and transfer line had temperatures of 260°C and 280°C, respectively. In the oven, the temperature was programmed to start at 40°C and stay there for three minutes. After that, it grew at a rate of 4°C per minute to 160°C and then at a rate of 10°C per minute to 280°C, with a final temperature hold of three minutes. The mass range that was scanned was 33-333 Da. The value of ionization energy was established at 70 eV. The National Institute of Standards and Technology (NIST) 05 library was used to identify volatiles.

Anti-inflammatory activities
Haemolysis assay
From healthy chicken, 5mL of blood was obtained and placed into in tube contain 5.4 mg of EDTA to stop coagulation, then the blood centrifuged for 10 min at 1000 rpm at 4°C. With the utmost care, the pipette was used to aspirate the plasma and totally remove the white buffy layer. The erythrocytes were subsequently washed three more times for 5 minutes with 1X PBS, pH 7.4. Erythrocytes that had been washed were kept at 4°C and used for the hemolysis assay within 6 hours. 50 mL of erythrocytes suspension diluted 10% (900 µL 1XPBS: 100 µL Erythrocytes suspension) were mixed with100 µL of sample (*Sonchus maritimus* extract) (10-100 µg/mL), a negative control was 100 mL of 1XPBS, a positive control was 100 mL of different concentrations of diclofenac. Then, the reaction mixture was incubated for 60 minutes in a water bath at 37°C. With the addition of 850 µL of 1XPB, the reaction mixture's volume was raised to 1 mL. the reaction mixture was then centrifuged at 300 rpm for 3 minutes. The resulting amount of hemoglobin in the supernatant was subsequently measured using a spectrophotometer at 540 nm. The hemolysis percentage equation as following: % Hemolysis inhibition= 100-[Sample / Control] x 100. The results were expressed by IC_{50}.[17]

Protein denaturation assay
The anti-inflammatory activity of the *Sonchus maritimus* extract were studied using *in vitro* assay of protein denaturation inhibition. 1% of serum albumin solution was mixed different concentrations (10–100 µg/mL) of sample. Then the mixture was incubated for 30 min at room temperature. Drop-wise of concentrated HCl, the reaction solution's pH was adjusted to 2. The mixture was heated for 30 minutes at 72 °C following incubation. After that, the tubes were cooled for 10 min. Finally, the turbidity was measured at 660 nm. The used standard was Diclofenac. The formula that used for calculating the percentage inhibition as following: %Inhibition = (A0-A1)/A0 ×100. The results were expressed by IC_{50}.[18]

Statistical analysis
The obtained results were expressed on mean of measurements and their standard error values (means ± SD). The data calculated using MINITAB 19. The graphis of this paper were obtained using EXCEL 2016.

Results and discussion

The obtained results demonstrated presence of different phytocompounds in *Sonchus maritimus* aqueous extract including phenols, flavonoids, tannins, terpenoids, saponins, unsaturated steroids and derived steroids. However, absence of alkaloids and reducing compounds was noticed (Table 1). The phytochemical screening is beneficial for identify the components of plant extracts and to determine the predominate compounds over the others as well as to detect the bioactive compounds that can be used for producing new medications.[1] Several studies have demonstrated the presence of phenols, flavonoids, terpenoids, and tannins in medicinal plants. Phytochemical screening

involves qualitative characterization reactions to detect all secondary metabolite families present in the plant part under study. These reactions rely on precipitation or coloration phenomena using specific reagents for each compound family. The advancement of scientific knowledge of herbal medicines as significant alternatives or supplemental therapies for disease treatment has led to the utilization of these bioactive components as therapeutic agents.[19]

The quantitative phytochemical analysis revealed that there was a reasonable content of phenols in *Sonchus maritimus*, in addition to important contents of flavonoids and condensed tannins as presented in (Table 2). The presence of hydroxyl groups (-OH) in phenolic compounds facilitates their capacity to act as antioxidants and free radical scavengers. Polyphenolic compounds from plants have various biological activities, such as antibacterial, anti-inflammatory, antiviral, anti-allergic, and antioxidant.[20] Flavonoids are a ubiquitous type of polyphenolic compounds which are widely present in most plants, they have an anti-inflammatory, vasodilatory, antibacterial, antithrombotic, antineoplastic and a potent antioxidant activities have been considered to be responsible for repair the oxidative damage which implicated in most diseases.[21] Condensed tannins are one of the plant's secondary metabolites that are well-known for their beneficial effects on animal health and the nutritional value of food, including their antioxidant activity.[22]

Results in Table 3 showed a richness of dry leaves of *Sonchus maritimus* with different mineral nutrients, including major elements such as sodium, potassium, calcium, iron and magnesium and minor elements such as copper, zinc and manganese. The existence of these dietary minerals in leaves of *S.maritimus*, are supported by another study that found some of these minerals in *S.maritimus*.[5] These phytomineral contribute to increase the nutritional value profile of this plant.[23] For human health, it is suggested that consumption of calcium prevents osteoporosis and could be responsible to the lack of adverse effects with regard to gastric lesions. Two macronutrients, sodium and potassium, must be present for a number of metabolic processes that occur in human body cells. These responses improve heart health, increase metabolism, lower the risk of sudden cardiac death, and control the amount of water in the body. Iron is a vital component; the body needs iron for functioning properly. Copper and zinc are two elements enhanced the antioxidant defense system.[24]

The GC results of leaves aqueous extract of *Sonchus maritimus* were demonstrated in Figure 1 and it has detected 283 different metabolites. The assessment of volatile biocompound identification was conducted by comparison of NIST standards 05 library. The majority of phytochemicals were identified by specific retention time like 1-Hexanol, 2-ethyl, Ethylene glycol - Adipate - Diethylene glycol, Cyclotrisiloxane, hexamethyl, Cyclopentasiloxane, decamethyl, 1-[2,4-Bis(trimethylsiloxy)phenyl]-2-[(4-trimethylsiloxy)phenyl]propan-1-one, Cyclopentasiloxane, decamethyl, Cyclotetrasiloxane, octamethyl, 6-Chloro-2,3-quinoxalinediol, O, O', di-TMS, 1,1,3,3,5,5,7,7-Octamethyl-7-(2-methylpropoxy)tetrasiloxan-1-ol, Dibutyl phthalate (1.384), Pentanoic acid, 2,2,4-trimethyl-3-carboxyisopropyl, isobutyl ester, Phloroglucinaldehyde, tris(tert-butyldimethylsilyl) ether, ,3,5-Triethoxy-1,1,1,7,7,7-hexamethyl-5-(trimethylsilyloxy)tetrasiloxane, Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl, Pentadecane, Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl, Hexadecane, Oxime-, methoxy-phenyl, Eicosane, Methyl Alcohol and the remaining volatile substances, according to the elution on an individual retention time, showed less than 0.7 % of the area as presented in in Table 4. Numerous investigations have reported on the pharmacological benefits of volatile compounds in various plants, however, other literatures have confirmed that a lot of volatile elements found in the plant have demonstrated strong cytotoxic activities. For this reason, these volatile substances are listed with different characters to help understand their biological activity.[25] A previous study identified the chemical compounds of aerial part extract of *Sonchus oleraceus* using GC chromatograms, which are a fingerprint of the plant based on the chemical components present in it.[26]

Table 1: Phytochemical screening of leave extract of *S. maritimus*

Phytochemical	*Sonchus maritimus*
Phenols	+
Flavonoids	+
Alkaloids	-
Tannins	+
Terpenoids	+
Reducing compounds	-
Saponins	+
Unsaturated steroids	+
Derived steroids	+

(+) presence; (-) absence

Table 2: Contents of total phenols, flavonoids and condensed tannins in leaves aqueous extract of *S. maritimus*

Parameters	Aqueous extract of *Sonchus maritimus*
Total phenols (mg EGA/g of extract)	23.190 ± 0.781
Total Flavonoids (mg EQer/g of extract)	12.906 ± 0.154
Condensed Tannins (mg ECat/g of extract)	2.890 ± 0.474

Table 3: Mineral elements content in dried leaves of *S. maritimus*

Mineral Elements		*Sonchus maritimus* (µg/g of dry leaves)
Major Elements	Na	13188 ± 659.4
	K	35716 ± 1785.8
	Ca	10508 ± 525.4
	Mg	3992 ± 199.6
Minor Elements	Fe	154 ± 7.7
	Cu	0.52 ± 0.026
	Zn	0.41 ± 0.0205
	Mn	0.45 ± 0.0225

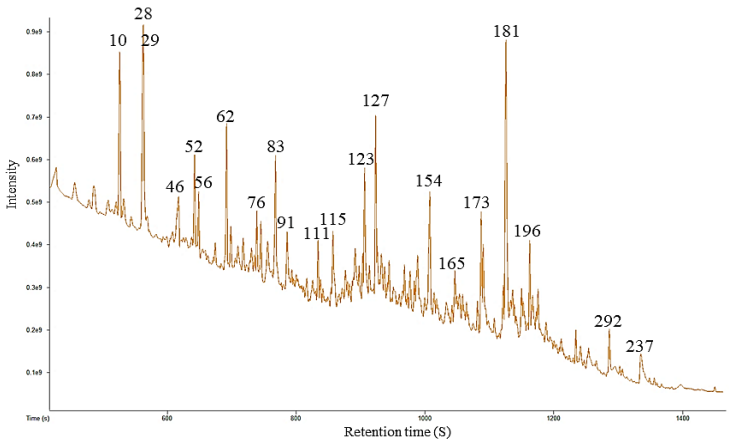

Figure 1: GC chromatogram of *S. maritimus* leaves aqueous extract

Table 4: Different phytocompounds detected by GC analysis of leaves aqueous extract of *S. maritimus*

Peak	Name	Formula	R.T. (s)
1	Pentanoic acid	$C_5H_{10}O_2$	303.431
2	Isocrotonic acid	$C_4H_6O_2$	306.021
3	Silane, ethoxytriethyl-	$C_8H_{20}OSi$	339.988
4	Dimethyl Sulfoxide	C_2H_6OS	348.768
5	Butanoic acid, 2-methyl-	$C_5H_{10}O_2$	367.487
6	Benzeneethanol, *α,β*-dimethyl-	$C_{10}H_{14}O$	380.592
7	Cyclobutane, 1,1,2,3,3-pentamethyl-	C_9H_{18}	388.367
8	2-Butanone, 3-chloro-	$C_4H_7C_lO$	399.417
9	Heptanal	$C_7H_{14}O$	415.563
10	Oxime-, methoxy-phenyl-_	$C_8H_9NO_2$	428.032
11	1,3,5,7-Tetroxane	$C_4H_8O_4$	432.062
12	Dimethyl sulfone	$C_2H_6O_2S$	436.428
13	Hexanoic acid, methyl ester	$C_7H_{14}O_2$	443.312
14	1-Methoxy-2-propyl acetate	$C_6H_{12}O_3$	455.864
15	*α*-Pinene	$C_{10}H_{16}$	456.918
16	2-Propanol, 1-butoxy-	$C_7H_{16}O_2$	463.176
17	1-Pentanone, 1-(2-thienyl)-	$C_9H_{12}OS$	477.443
18	p-Aminotoluene	C_7H_9N	484.372
19	Cyclopropane, butyl-	C_7H_{14}	495.389
20	Benzene, 1-methyl-3-(1-methylethyl)-	$C_{10}H_{14}$	499.065
21	*β*-Phellandrene	$C_{10}H_{16}$	502.242
22	*β*-Pinene	$C_{10}H_{16}$	507.091
23	Benzene, 1,1'-(1-ethenyl-1,3-propanediyl)bis-	$C_{17}H_{18}$	510.877
24	5-Hepten-2-one, 6-methyl-	$C_8H_{14}O$	514.91
25	2-Octanone	$C_8H_{16}O$	519.123
26	Furan, 2-pentyl-	$C_9H_{14}O$	520.74
27	2-(2-tert-Butyldimethylsilyloxy-5-methylphenyl)benzotriazole	$C_{19}H_{25}N_3OSi$	525.212
28	1-[2,4-Bis(trimethylsiloxy)phenyl]-2-[(4-trimethylsiloxy)phenyl]propan-1-one	$C_{24}H_{38}O_4Si_3$	525.986
29	Cyclotetrasiloxane, octamethyl-	$C_8H_{24}O_4Si_4$	526.236
30	5-Hydroxy-7-methoxy-2-methyl-3-phenyl-4-chromenone	$C_{17}H_{14}O_4$	527.309
31	Octanal	$C_8H_{16}O$	532.469
32	2-Propanol, 1-(2-ethoxypropoxy)-	$C_8H_{18}O_3$	535.324
33	2-Propanone, 1-hydroxy-	$C_3H_6O_2$	535.705
34	3-Carene	$C_{10}H_{16}$	544.039
35	Propane-1,2,3-triamine	$C_3H_{11}N_3$	547.372
36	Oxirane, [[(2-ethylhexyl)oxy]methyl]-	$C_{11}H_{22}O_2$	556.323
37	1-Hexanol, 2-ethyl-	$C_8H_{18}O$	561.763
38	Butanedioic acid, dimethyl ester	$C_6H_{10}O_4$	565.005
39	Benzyl alcohol	C_7H_8O	569.147
40	2(3H)-Furanone, 5-ethenyldihydro-5-methyl-	$C_7H_{10}O_2$	575.793
41	2(3H)-Furanone, 5-ethyldihydro-	$C_6H_{10}O_2$	589.535
42	Undecane, 2,2-dimethyl-	$C_{13}H_{28}$	590.839
43	Phenylglyoxal	$C_8H_6O_2$	603.872

44	Acetophenone	C_8H_8O	604.578
45	2-Hexene, 3,5-dimethyl-	C_8H_{16}	611.733
46	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	618.049
47	Benzenemethanol, *α,α*-dimethyl-	$C_9H_{12}O$	624.96
48	1-[4-(2-Hydroxy-3-morpholin-4-ylpropoxy)phenoxy]-3-morpholin-4-ylpropan-2-ol	$C_{20}H_{32}N_2O_6$	631.295
49	Undecane, 2-methyl-	$C_{12}H_{26}$	633.22
50	Octane, 6-ethyl-2-methyl-	$C_{11}H_{24}$	633.957
51	Undecane	$C_{11}H_{24}$	637.62
52	Nonanal	$C_9H_{18}O$	642.495
53	Benzeneacetic acid, 10-undecenyl ester	$C_{19}H_{28}O_2$	654.744
54	Triethyl phosphate	$C_6H_{15}O_4P$	667.3
55	Methyl Alcohol	CH_4O	673.197
56	Pentanedioic acid, dimethyl ester	$C_7H_{12}O_4$	674.851
57	Cyclopentanone	C_5H_8O	677.151
58	Bicyclo[3.1.1]heptan-2-one, 6,6-dimethyl-	$C_9H_{14}O$	683.021
59	(6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl ethyl carbonate	$C_{13}H_{20}O_3$	685.067
60	1-Heptene, 6-methyl-	C_8H_{16}	689.576
61	(+)-2-Bornanone	$C_{10}H_{16}O$	690.859
62	Cyclopentasiloxane, decamethyl-	$C_{10}H_{30}O_5Si_5$	692.043
63	Cyclohexanone, 5-methyl-2-(1-methylethyl)-	$C_{10}H_{18}O$	698.618
64	Octane, 3-ethyl-2,7-dimethyl-	$C_{12}H_{26}$	699.297
65	Acetic acid, phenylmethyl ester	$C_9H_{10}O_2$	705.371
66	Decane, 1,1'-oxybis-	$C_{20}H_{42}O$	710.088
67	endo-Borneol	$C_{10}H_{18}O$	713.844
68	Cyclohexanol, 1-methyl-4-(1-methylethyl)-	$C_{10}H_{20}O$	717.525
69	1-(1-Methoxypropan-2-yloxy)propan-2-yl acetate	$C_9H_{18}O_4$	718.842
70	Benzeneethanol, *α,α*-dimethyl-, acetate	$C_{12}H_{16}O_2$	724.549
71	Cyclohexane, (1,3-dimethylbutyl)-	$C_{12}H_{24}$	727.801
72	3-Cyclohexen-1-ol, 5-methylene-6-(1-methylethenyl)-, acetate	$C_{12}H_{16}O_2$	728.323
73	Ethanol, 2-(2-butoxyethoxy)-	$C_8H_{18}O_3$	729.914
74	Naphthalene	$C_{10}H_8$	730.904
75	1,5,5-Trimethyl-6-methylene-cyclohexene	$C_{10}H_{16}$	735.553
76	Dodecane	$C_{12}H_{26}$	739.046
77	Decanal	$C_{10}H_{20}O$	745.303
78	Undecane, 2,5-dimethyl-	$C_{13}H_{28}$	752.875
79	Bicyclo[3.1.1]hept-2-en-6-one, 2,7,7-trimethyl-	$C_{10}H_{14}O$	756.042
80	2-ethenyl-3-ethylpyrazine	$C_8H_{10}N_2$	760.039
81	Nonane, 3-methyl-5-propyl-	$C_{13}H_{28}$	760.577
82	Benzaldehyde, 4-(1-methylethyl)-	$C_{10}H_{12}O$	765.985
83	1,1,3,3,5,5,7,7-Octamethyl-7-(2-methylpropoxy)tetrasiloxan-1-ol	$C_{12}H_{34}O_5Si_4$	768.21
84	1-Methyl-4-isopropyl-cyclohexyl 2-hydroperfluorobutanoate	$C_{14}H_{20}F_6O_2$	769.023
85	1,2-Benzisothiazole	C_7H_5NS	770.734
86	Carbonic acid, propargyl 2-ethylhexyl ester	$C_{12}H_{20}O_3$	777.058
87	Hexanedioic acid, dimethyl ester	$C_8H_{14}O_4$	780.042
88	Piperazine, 1,4-dinitro-	$C_4H_8N_4O_4$	782.373

89	2,4,6-Tris(trimethylsilyl)cyclohexane-1,3,5-trione	$C_{15}H_{30}O_3Si_3$	783.594
90	HEX-5-EN-3-OL	$C_6H_{12}O$	785.063
91	Phloroglucinaldehyde, tris(tert-butyldimethylsilyl) ether	$C_{25}H_{48}O_4Si_3$	785.987
92	(-)-Carvone	$C_{10}H_{14}O$	787.461
93	Dodecane, 5-methyl-	$C_{13}H_{28}$	791.487
94	3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl-	$C_{10}H_{16}O$	793.356
95	3,3,5-Triethoxy-1,1,1,7,7,7-hexamethyl-5-(trimethylsilyloxy)tetrasiloxane	$C_{15}H_{42}O_7Si_5$	799.349
96	Benzene, hexyl-	$C_{12}H_{18}$	800.539
97	1,2-Hydrazinedicarboxaldehyde	$C_2H_4N_2O_2$	801.92
98	Nonanoic acid	$C_9H_{18}O_2$	803.047
99	Tetradecane, 2,5-dimethyl-	$C_{16}H_{34}$	806.778
100	2,6-Dimethyldecane	$C_{12}H_{26}$	809.003
101	2-Bromo dodecane	$C_{12}H_{25}Br$	811.751
102	1H-Indol-3-amine	$C_8H_8N_2$	812.029
103	Heptadecane, 2,6,10,15-tetramethyl-	$C_{21}H_{44}$	816.697
104	Butanenitrile, 2,3-bis(benzoyloxyimino)-	$C_{18}H_{13}N_3O_4$	823.456
105	Dodecane, 2,6,10-trimethyl-	$C_{15}H_{32}$	824.478
106	Anethole	$C_{10}H_{12}O$	825.795
107	1H-Pyrazole, 1-methyl-	$C_4H_6N_2$	827.232
108	3-Aminopyrazine 1-oxide	$C_4H_5N_3O$	834.369
109	Decan-2-ol, dimethylpentafluorophenylsilyl ether	$C_{18}H_{27}F_5OSi$	836.85
110	Dodecane, 2,7,10-trimethyl-	$C_{15}H_{32}$	837.313
111	Naphthalene, 1-methyl-	$C_{11}H_{10}$	837.933
112	Oxirane, dodecyl-	$C_{14}H_{28}O$	841.676
113	Dodecane, 2,5-dimethyl-	$C_{14}H_{30}$	850.963
114	Benzene, (2-methyl-1-propenyl)-	$C_{10}H_{12}$	856.793
115	6-Chloro-2,3-quinoxalinediol, O, O', di-TMS	$C_{14}H_{21}ClN_2O_2Si_2$	857.169
116	Dodecane, 2,6,11-trimethyl-	$C_{15}H_{32}$	867.006
117	2,6,10-Trimethyltridecane	$C_{16}H_{34}$	873.8
118	Glycerol 1,2-diacetate	$C_7H_{12}O_5$	876.002
120	Tridecane, 6-methyl-	$C_{14}H_{30}$	879.865
121	Cyclohexene, 1-methyl-5-(1-methylethenyl)-, (R)-	$C_{10}H_{16}$	884.01
122	Tridecane, 4-methyl-	$C_{14}H_{30}$	887.032
123	Tridecane, 2-methyl-	$C_{14}H_{30}$	891.458
124	Ethanol, 2-(2-butoxyethoxy)-, acetate	$C_{10}H_{20}O_4$	892.152
125	Perhydrophenalene, (3aα, 6aα, 9aα, 9bβ)-	$C_{13}H_{22}$	895.964
126	Tridecane, 3-methyl-	$C_{14}H_{30}$	897.849
127	Hexadecane, 2,6,10,14-tetramethyl-	$C_{20}H_{42}$	903.359
128	1,2,4-Metheno-1H-indene, octahydro-1,7a-dimethyl-5-(1-methylethyl)-, [1S-(1α,2α,3aβ,4α,5α,7aβ,8S*)]-	$C_{15}H_{24}$	912.973
129	Nonane, 4,5-dimethyl-	$C_{11}H_{24}$	916.766
130	Ethanone, 1-(1-methylcyclohexyl)-	$C_9H_{16}O$	920.409
131	Tridecane, 4,8-dimethyl-	$C_{15}H_{32}$	927.099
132	Novaluron, N,N'-dimethyl-	$C_{19}H_{13}ClF_8N_2O_4$	927.52
133	Naphthalene, 1-ethyl-	$C_{12}H_{12}$	927.784

134	3-Amino-N-(4-fluoro-2-methylphenyl)propanamide	$C_{10}H_{13}FN_2O$	930.333
135	Diphenyl ether	$C_{12}H_{10}O$	933.289
136	Tetrasiloxane, 3,5-diethoxy-1,1,1,7,7,7-hexamethyl-3,5-bis(trimethylsiloxy)-	$C_{16}H_{46}O_7Si_6$	934.879
137	2-Thiopheneacetic acid, 3-tetradecyl ester	$C_{20}H_{34}O_2S$	940.293
138	1H-2-Indenone,2,4,5,6,7,7a-hexahydro-3-(1-methylethyl)-7a-methyl	$C_{13}H_{20}O$	941.794
139	Longifolene	$C_{15}H_{24}$	944.356
140	Tetracontane, 3,5,24-trimethyl-	$C_{43}H_{88}$	948.071
141	Tetracyclo[5.2.1.0(2,6).0(3,5)]non-8-ene, 4-methyl-4-phenyl-, endo-	$C_{17}H_{18}$	950.852
142	5,5-Dibutylnonane	$C_{17}H_{36}$	952.328
143	Pentadecane, 4-methyl-	$C_{16}H_{34}$	956.12
144	2(1H)-Naphthalenone, 3,4,4a,5,6,7-hexahydro-1,1,4a-trimethyl-	$C_{13}H_{20}O$	960.078
145	Tetradecane, 5-methyl-	$C_{15}H_{32}$	968.318
146	5,9-Undecadien-2-one, 6,10-dimethyl-	$C_{13}H_{22}O$	970.596
147	Tetradecane, 3-methyl-	$C_{15}H_{32}$	983.51
148	1-Dodecanol	$C_{12}H_{26}O$	986.695
149	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-	$C_{14}H_{20}O_2$	988.698
150	Anthracene, tetradecahydro-	$C_{14}H_{24}$	996.455
151	(2R,3R,3aR,6R,8aS)-3,7,7-Trimethyl-8-methyleneoctahydro-1H-3a,6-methanoazulen-2-ol	$C_{15}H_{24}O$	999.562
152	3-Buten-2-one, 4-(2,6,6-trimethyl-1-cyclohexen-1-yl)-	$C_{13}H_{20}O$	1003.65
153	Cycloheptasiloxane, tetradecamethyl-	$C_{14}H_{42}O_7Si_7$	1005.93
154	Pentadecane	$C_{15}H_{32}$	1007.54
155	Hordenine	$C_{10}H_{15}NO$	1011.59
155	Decyl octyl ether	$C_{18}H_{38}O$	1014.12
156	Naphthalene, 1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-, (1α,4aα,8aα)-	$C_{15}H_{24}$	1018.22
157	Nonane, 5-methyl-5-propyl-	$C_{13}H_{28}$	1018.82
158	Carbonic acid, octadecyl prop-1-en-2-yl ester	$C_{22}H_{42}O_3$	1029.05
159	Dibenzofuran	$C_{12}H_8O$	1033.1
160	Dichlorophen, O,O'-(2-trifluoromethylbenzoyl)-	$C_{29}H_{16}Cl_2F_6O_4$	1035.19
161	Bis(tert-butyldimethylsilyl) 2,3-bis((tert-butyldimethylsilyl)oxy)fumarate	$C_{28}H_{60}O_6Si_4$	1035.77
162	trans-Calamenene	$C_{15}H_{22}$	1037.67
163	Hexadecane, 1-chloro-	$C_{16}H_{33}Cl$	1041.97
164	Nonyl tetradecyl ether	$C_{23}H_{48}O$	1044.8
165	Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl-	$C_{14}H_{44}O_6Si_7$	1046.1
166	Benzene, (1-propylheptyl)-	$C_{16}H_{26}$	1048.77
167	Tetradecane, 4-methyl-	$C_{15}H_{32}$	1049.66
168	3-Ethoxy-1,1,1,7,7,7-hexamethyl-3,5,5-tris(trimethylsiloxy)tetrasiloxane	$C_{17}H_{50}O_7Si_7$	1058.8
169	Hexane, 3,4-bis(1,1-dimethylethyl)-2,2,5,5-tetramethyl-	$C_{18}H_{38}$	1060.9
170	7-[3,5-Dihydroxy-4-(4-hydroxyphenyl)-2-methoxyphenyl]-3-methoxy-3,4-dihydrooxepine-2,5-dione, 3TMS	$C_{29}H_{42}O_8Si_3$	1062.51
171	Pentadecane, 3-methyl-	$C_{16}H_{34}$	1064.54
172	Hexadecane	$C_{16}H_{34}$	1087.13

173	Pentanoic acid, 2,2,4-trimethyl-3-carboxyisopropyl, isobutyl ester	$C_{16}H_{30}O_4$	1090.26
174	Dodecanoic acid, 1-methylethyl ester	$C_{15}H_{30}O_2$	1107.68
175	Undecane, 5-ethyl-	$C_{13}H_{28}$	1114.82
176	Benzene, (1-pentylhexyl)-	$C_{17}H_{28}$	1115.57
177	9H-Xanthene	$C_{13}H_{10}O$	1116.32
178	Benzene, (1-butylheptyl)-	$C_{17}H_{28}$	1118.18
179	2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol	$C_{17}H_{26}O_2$	1121.34
180	Dodecane, 3-methyl-	$C_{13}H_{28}$	1121.99
181	Ethylene glycol - Adipate - Diethylene glycol	$C_{12}H_{22}O_7$	1125.71
182	1,4-Methanobenzocyclodecene, 1,2,3,4,4a,5,8,9,12,12a-decahydro-	$C_{15}H_{22}$	1127.85
183	Hexadecane, 4-methyl-	$C_{17}H_{36}$	1131.36
184	Octane, 1,1'-oxybis-	$C_{16}H_{34}O$	1136.1
185	Cyclooctasiloxane, hexadecamethyl-	$C_{16}H_{48}O_8Si_8$	1138.79
186	Hexadecane, 3-methyl-	$C_{17}H_{36}$	1141.27
187	Benzene, (1-ethylnonyl)-	$C_{17}H_{28}$	1142.15
188	Amberonne (isomer 1)	$C_{16}H_{26}O$	1149.84
189	1,1'-Biphenyl, 2,2',5,5'-tetramethyl-	$C_{16}H_{18}$	1157.97
190	2,6-Diisopropylnaphthalene	$C_{16}H_{20}$	1158.57
191	Eicosane	$C_{20}H_{42}$	1162.53
192	Pentadecane, 2,6,10,14-tetramethyl-	$C_{19}H_{40}$	1167.1
193	Benzene, (1-methyldecyl)-	$C_{17}H_{28}$	1169.64
194	3-Isopropoxy-1,1,1,7,7,7-hexamethyl-3,5,5-tris(trimethylsiloxy)tetrasiloxane	$C_{18}H_{52}O_7Si_7$	1170.26
195	Sulfurous acid, di(2-ethylhexyl) ester	$C_{16}H_{34}O_3S$	1172.2
196	2,4-Dihydroxybenzoic acid, 3TMS derivative	$C_{16}H_{30}O_4Si_3$	1175.45
197	Benzoic acid, 2-ethylhexyl ester	$C_{15}H_{22}O_2$	1176.2
198	Tetrafluoromethane	CF_4	1177.69
199	4-(2-(4-Fluorophenyl)-1-hydroxyethenyl)benzene-1,3-diol, tris(tert-butyldimethylsilyl) ether	$C_{32}H_{53}FO_3Si_3$	1178.86
200	2,4,2',4'-Tetramethyl-biphenyl	$C_{16}H_{18}$	1179.21
201	1-Cyclohexene-3,5-dione, hexakis(trimethylsilyloxy)-	$C_{24}H_{54}O_8Si_6$	1183.07
202	1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl-	$C_{18}H_{20}$	1188.74
200	Benzene, (1-butyloctyl)-	$C_{18}H_{30}$	1191.33
201	1,3-di-iso-propylnaphthalene	$C_{16}H_{20}$	1192.9
202	10-Methylnonadecane	$C_{20}H_{42}$	1194.08
203	Decane, 3,7-dimethyl-	$C_{12}H_{26}$	1203.81
204	Heptadecane, 9-hexyl-	$C_{23}H_{48}$	1208.18
205	Cyclohexane, undecyl-	$C_{17}H_{34}$	1210.25
206	Benzene, 1,1'-(1,2-cyclobutanediyl)bis-, trans-	$C_{16}H_{16}$	1211.71
207	Heptadecane, 3-methyl-	$C_{18}H_{38}$	1214.12
208	Benzene, (1-ethyldecyl)-	$C_{18}H_{30}$	1216.34
209	Octanoic acid, octyl ester	$C_{16}H_{32}O_2$	1219.73
210	Naphtho[2,1-b]furan, dodecahydro-3a,6,6,9a-tetramethyl-	$C_{16}H_{28}O$	1224.23
211	Naphthalene, 1,2,3,4-tetrahydro-1-phenyl-	$C_{16}H_{16}$	1227.49
212	2-Naphthalenol, 1,2-dihydro-, acetate	$C_{12}H_{12}O_2$	1230.17
213	Octadecane	$C_{18}H_{38}$	1234.15

214	Phenanthrene	$C_{14}H_{10}$	1236.64
215	1-Octanol, 2-butyl-	$C_{12}H_{26}O$	1237.58
216	(6-Chloro-2-methylhexan-2-yl)benzene	$C_{13}H_{19}Cl$	1239.85
217	Benzene, (1-methylundecyl)-	$C_{18}H_{30}$	1243.46
218	Salicylic acid, 1-methylpropyl ester	$C_{11}H_{14}O_3$	1246.15
219	13-Methyltetradecanal	$C_{15}H_{30}O$	1247.04
220	Isopropyl myristate	$C_{17}H_{34}O_2$	1251.76
221	Cyclononasiloxane, octadecamethyl-	$C_{18}H_{54}O_9Si_9$	1253.61
222	Benzene, (1-pentyloctyl)-	$C_{19}H_{32}$	1257.4
223	Benzene, (1-butylnonyl)-	$C_{19}H_{32}$	1262.08
224	Heptane, 3-ethyl-5-methylene-	$C_{10}H_{20}$	1265.39
225	Undecane, 4,4-dimethyl-	$C_{13}H_{28}$	1269.64
226	Octadecane, 4-methyl-	$C_{19}H_{40}$	1273.97
227	Octadecane, 2-methyl-	$C_{19}H_{40}$	1277.55
228	Pentacos-1-ene	$C_{25}H_{50}$	1279.75
229	Phthalic acid, hex-3-yl isobutyl ester	$C_{18}H_{26}O_4$	1286.04
230	2-Amino-4-(1-ethylpropyl)-4H-benzo[h]chromene-3-carbonitrile	$C_{19}H_{20}N_{2O}$	1289.32
231	1,3,4-Oxadiazole-2(3H)-thione, 3-(4-morpholylmethyl)-5-phenoxymethyl-	$C_{14}H_{17}N_3O_3S$	1294.9
232	2-Methyltetracosane	$C_{25}H_{52}$	1297.5
233	Nonadecane	$C_{19}H_{40}$	1302.31
234	1-Pentadecanamine, N,N-dimethyl-	$C_{17}H_{37}N$	1306.23
235	Benzene, (1-methyldodecyl)-	$C_{19}H_{32}$	1313.72
234	Phthalic acid, 2-chloropropyl isobutyl ester	$C_{15}H_{19}ClO_4$	1317.24
235	Pentadecanoic acid, 14-methyl-, methyl ester	$C_{17}H_{34}O_2$	1319.79
236	1-[6,8-Dichloro-2-phenyl-4-quinolyl]hexahydro-3H-oxazolo[3,4-a]pyridine	$C_{22}H_{20}Cl_2N_2O$	1322.43
237	Dibutyl phthalate	$C_{16}H_{22}O_4$	1334.86
238	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	1340.33
239	Cyclohexane, hexyl-	$C_{12}H_{24}$	1351.3
240	Furan-3-carboxylic acid, 5-(adamantan-1-yl)-2-methyl-, (2,6-dimethylphenyl)amide	$C_{24}H_{29}NO_2$	1359.94
241	4-cyano-3-fluorophenyl 4-(4-ethylcyclohexyl)benzoate	$C_{22}H_{22}FNO_2$	1365.78
242	4b,8-Dimethyl-2-isopropylphenanthrene, 4b,5,6,7,8,8a,9,10-octahydro-	$C_{19}H_{28}$	1370.9
243	Isopropyl palmitate	$C_{19}H_{38}O_2$	1382.93
244	4,4'-(Hexafluoroisopropylidene)diphenol	$C_{15}H_{10}F_6O_2$	1398.25
245	10,18-Bisnorabieta-8,11,13-triene	$C_{18}H_{26}$	1409.86
246	1,4-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	$C_{16}H_{22}O_4$	1412.58
247	7-Isopropyl-1,1,4a-trimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthrene	$C_{20}H_{30}$	1420.12
248	Cyclodecane, methyl-	$C_{11}H_{22}$	1423.81
249	(1R,2S)-1-{3,4-Bis[(trimethylsilyl)oxy]phenyl}-N-(1-methylethyl)-1-[(trimethylsilyl)oxy]butan-2-amine	$C_{22}H_{45}NO_3Si_3$	1428.35
250	6-Octadecenoic acid, methyl ester, (Z)-	$C_{19}H_{36}O_2$	1431.92
251	Isothiazole	C_3H_3NS	1433.49
252	Fluoranthene	$C_{16}H_{10}$	1436.62

253	o-Anisic acid, tridec-2-ynyl ester	$C_{21}H_{30}O_3$	1441.28
254	1-Propene-1,2,3-tricarboxylic acid, tributyl ester	$C_{18}H_{30}O_6$	1467.4
255	2-Propenoic acid, 3-(4-methoxyphenyl)-, 2-ethylhexyl ester	$C_{18}H_{26}O_3$	1472.3
256	4-Chlorobutyric acid, pentadecyl ester	$C_{19}H_{37}ClO_2$	1494.45
257	Oxirane, hexadecyl-	$C_{18}H_{36}O$	1504.69
258	Benzene, 1,1'-sulfonylbis[4-chloro-	$C_{12}H_8Cl_2O_2S$	1520.65
259	Tributyl acetylcitrate	$C_{20}H_{34}O_8$	1526.73
260	Phthalic acid, butyl 2-pentyl ester	$C_{17}H_{24}O_4$	1528.83
261	1-Decanol, 2-ethyl-	$C_{12}H_{26}O$	1531.23
262	Tritriacontane, 2-methyl-	$C_{34}H_{70}$	1545.95
263	4,9-Decadien-2-amine, N-butyl-	$C_{14}H_{27}N$	1550
264	Benzoic acid, tridecyl ester	$C_{20}H_{32}O_2$	1553.84
265	Octanoic acid, heptadecyl ester	$C_{25}H_{50}O_2$	1588.23
266	Hexanedioic acid, bis(2-ethylhexyl) ester	$C_{22}H_{42}O_4$	1601.98
267	Benzoic acid, tetradecyl ester	$C_{21}H_{34}O_2$	1610.94
268	Hexanoic acid, 2-ethyl-, hexadecyl ester	$C_{24}H_{48}O_2$	1641.77
269	4-Hydroxybenzyl alcohol, 2TBDMS derivative	$C_{19}H_{36}O_2Si_2$	1647.39
270	9,10-Anthracenedione, 3-(1,2-dihydroxypropyl)-1,6,8-trihydroxy-, 5TMS	$C_{32}H_{54}O_7Si_5$	1652.42
271	Octan-2-yl palmitate	$C_{24}H_{48}O_2$	1656.61
272	Benzoic acid, pentadecyl ester	$C_{22}H_{36}O_2$	1665.72
273	Benzyldiethyl-(2,6-xylylcarbamoylmethyl)-ammonium benzoate	$C_{28}H_{34}N_2O_3$	1680.79
274	(*E*)-7-Benzylidene-1-azabicyclo[3.2.1]octan-5-yl methanesulfonate	$C_{15}H_{19}NO_3S$	1682.33
275	Phthalic acid, 2-ethylhexyl tetradecyl ester	$C_{30}H_{50}O_4$	1682.92
276	3-Methylheptacosane	$C_{28}H_{58}$	1704.01
277	Hexanoic acid, 2-ethyl-, anhydride	$C_{16}H_{30}O_3$	1717.43
278	Benzene, 1,4-bis(phenylthio)-	$C_{18}H_{14}S_2$	1723.03
279	2-Ethylhexyl stearate	$C_{26}H_{52}O_2$	1758.57
280	1,3-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	$C_{24}H_{38}O_4$	1785.54
281	Borane, diethyl(decyloxy)-	$C_{14}H_{31}BO$	1811.7
282	Squalene	$C_{30}H_{50}$	1835.94
283	Cholesta-4,6-dien-3-ol, (3*β*)-	$C_{27}H_{44}O$	1887.41

2-ethyl-1-hexanol, is a potent volatile compound have an antifungal activity such as Fusarium,[27] Cyclotrisiloxane, hexamethyl- presented good antioxidant and antifungal activities against the mycoses, which are caused a high mortality rate of individuals with compromised immune systems.[28] According to Gaafar *et al.*, the Cyclopentasiloxane, decamethyl- is detected in other plant extracts using GC/MS analysis, it may be contributing in the cytotoxicity effect against colon cancer cells (HCT116) and breast cancer cells (MCF-7). It may be exhibit an antiviral activity against avian influenza H5N1 virus through the inhibition of their viral adsorption, replication and propagation process.[29]

The anti-inflammatory activity of *S.maritimus* expressed on IC_{50} value, our extract of plant was presented an effective inhibition of albumin denaturation (IC_{50} = 334.369±29 µg/mL) less than diclofenac (standard) as presented in Figure 02 (A). However, *S. maritimus* extract was demonstrated an important protection to RBCs membrane (IC_{50} = 53.539±4.64 µg/mL) better than standard as showed in Figure 02 (B). The resulting anti-inflammatory activity of the extract is attributed to the presence of active metabolites such as flavonoids in the extract. Flavonoids are group of secondary metabolites called polyphenols exhibit anti-inflammatory action.[30] *In vitro* anti-inflammation activity of *S.maritimus* extract to prevent protein denaturation was investigated. Protection of RBCs membrane and anti-hemolytic activity was also indexed in this study as anti-inflammatory effect of *S. maritimus* extract. The anti-inflammatory activities of the aqueous extract of *Sonchus maritimus* may be related to the presence of secondary metabolites, including phenols, flavonoids, and terpenoids, which have been confirmed in several studies to possess potent anti-inflammatory activity.[31] In addition, Hilton-Simpson informed that *Sonchus maritimus* was traditionally used in Algeria against eye inflammation in the 20th century.[32] According to these results, *S.maritimus* extract is the most effective extract and a promising source of anti-inflammatory compounds.

Conclusion

The results provided a considerable confirmation of the anti-inflammatory activities of leaves aqueous extract of *Sonchus maritimus* against denaturation of protein and hemolysis of red blood cells due to abundance of phytomineral and phytochemicals, which are the active ingredients, as demonstrated from the quantitative and qualitative analysis of the extract, in addition to 283 volatile compounds that

identified using GC characterization. The detected active volatile phytocompounds may show various biological activities and act as therapeutic molecule which may become a novel future drugs against various disease.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

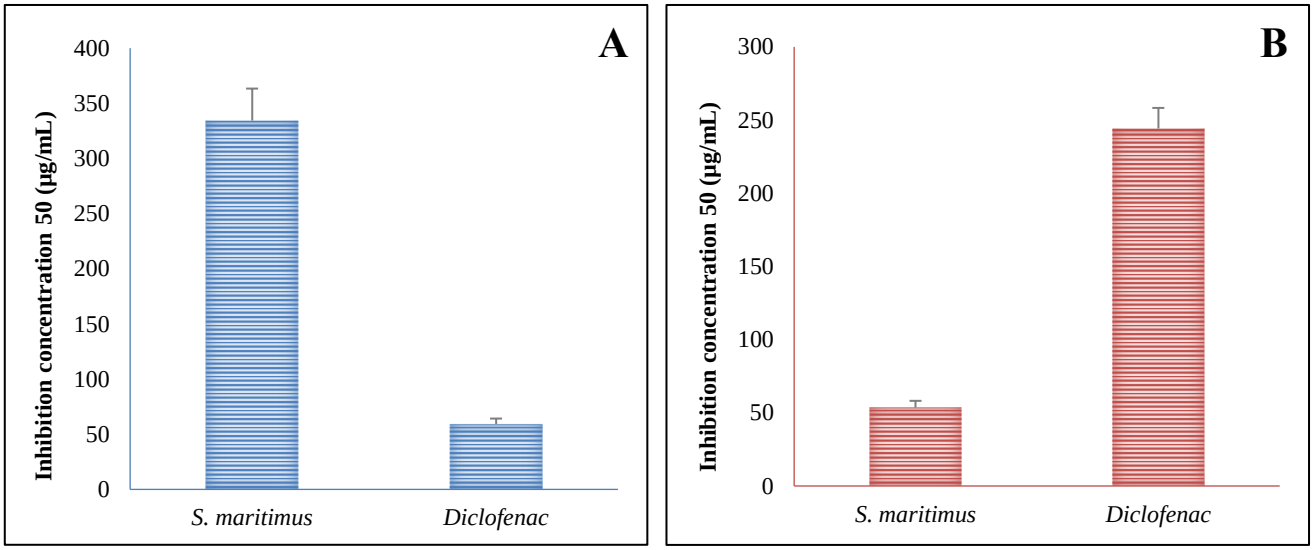

Figure 2: Inhibition of protein denaturation activity (A) and anti-hemolysis activity (B) of leaves aqueous extract of *S. maritimus* and diclofenac

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