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GC-MS ANALYSIS AND GASTROPROTECTIVE EVALUATION IN INDOMETHACIN-INDUCED GASTRIC ULCER IN RATS OF MASTICHE OLEOGUM RESINS

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ABSTRACT

Ethno Pharmacological Relevance: Mastiche oleogum resin has been used in ancient Egypt as incense, preservative, breath sweetener. For the last 3000 year, it was used by traditional healers in Mediterranean and Middle East countries to relief the upper abdominal discomfort, gastralgia, dyspepsia and peptic ulcer. This study intends to scientifically validate the traditional uses via investigating, comparing the chemical composition and gastroprotective activity of the essential oils and fractions of different types of commonly available mastiche oleogum resins in Egyptian markets and known as Greek, Persian, Chinese and Turkish mastiche oleogum resins. **Material and Methods**: The *in vivo* gastroprotective effect of the essential oils and different fractions of mastiche oleogum resins was evaluated in indomethacin-induced gastric ulcer. Chemical composition of essential oils was determined by gas chromatography– mass spectrometry analysis (GC–MS). **Results**: The essential oil and petroleum ether fraction of Greek mastiche showed the most significant protective effect against the gastric damage caused by indomethacin in comparison to a known H2-receptor blocker "Ranitidine". The GC /MS analysis of the essential oils of Greek, Persian, Chinese, and Turkish mastiche oleogum resins showed that the major compounds are α-pinene (66.84%), longicyclene (50.88%), α- Copaene (38.16%) and α-ylangene (17.05%) respectively. **Conclusions**: The present study reinforces the use of mastiche oleogum resin as potential gastro protective agent. Moreover, the compiled obtained data from GC-MS of oil constituents may be used as markers for detection of different types of mastiches in markets.

KEYWORDS

Mastiche, GC - MS, Gastro protective, α- Pinene and Indomethacin.

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INTRODUCTION

Natural products represent a valuable source for developing new drugs for treatment of different diseases (Abdel Gawad *et al,* 2015)[1], (Alarif *et al,* 2015)[2], (Badria *et al,* 2015)[3]. Oleogum resins are amorphous products of a complex chemical nature, solids or semisolids, they are usually formed in schizogenous or in schizolysigenous ducts or cavities as end products of metabolism. Our team work is concerned in studying some of these natural

oleogum resins such as boswellia (Ayyad *et al,* 2015[4], Badria *et al,* 2004[5], Badria *et al,* 2003[6] a, 2003 b[7]) and myrrh (Badria and El-Nashar 2003[8], Badria *et al,* 2001)[9], results obtained encouraged us to continue searching on Mastiche.

Mastiche is a natural oleogum resin or more correctly an oleooleogum resin containing low percentage of oil (Trease and Evans 1992)[10] obtained as a trunk exudate from evergreen mastic tree (*Pistacia lentiscus,* family *Anacardiacea*) (Koutsoudaki *et al,* 2005)[11]. It has been used in traditional Greek medicine for various gastrointestinal disorders like gastralgia, dyspepsia, and peptic ulcer for more than 2,500 years, Ancient Greek physicians, such as Hippocrates, Dioscorides, Theophrastos, and Galenos, mentioned its properties and recommended its use (Paraschos, 2006)[12]. mastiche oleogum resin exhibits curative properties for patients with peptic ulcers (Al-Habbal *et al,* 1984)[13]. It produces a significant reduction of gastric secretions, protected cells, and reduced the intensity of gastric mucosal damage (Al-Said *et al,* 1986[14], Huwez 1998)[15]. The *in vitro* antimicrobial activity of *P. lentiscus* fractions has also been tested on bacteria and fungi (Iauk *et al,* 1996)[16]. It also prevents plaque formation or reduced it (Topitsoglou-Themeli *et al,* 1984)[17]. Multiple studies have been reported on the chemical composition of essential oil of different parts of *Pistacia lentiscus* belonging to different regions in the world (Aboutabl, *et al,* 1990[18], Benyoussef *et al,* 2005[19], Koutsoudaki C., *et al,* 2005[11], Calabro *et al,* 1974[20], Kivcak *et al,* 2004[21], Lo Presti *et al*, 2008[22], Wagne I.B., 1999)[23]. The essential oil of mastiche oleogum resin is used in perfumery and in cosmetic industry creams and facial products (Doukas 2003)[24]. The purpose of this study was to examine the chemical composition of oil isolated from different types of mastiche oleogum resins (Greek, Persian, Chinese and Turkish) in Egyptian markets, and to evaluate their in vivo Gastro-protective and antiulcer activity in experimental model of gastric ulcer induced by Indomethacin.

MATERIAL AND METHODS

Preparation of the essential oil

One hundred and fifty grams from Greek, Persian, Chinese and Turkish mastiche oleogum resins were subjected separately to steam distillation for 8 hours using clevenger´s cohobation apparatus according to the Egyptian Pharmacopoeia (1984)[25] method. The oils were collected, dried in a desiccators containing anhydrous calcium chloride and kept in refrigerator (-10˚C) till analysis. The yield of the obtained oils were (1.3, 1.1, 0.7, 1.2 % v/w) of Greek, Persian, Chinese and Turkish respectively.

Gas chromatography- mass spectrometry analysis (GC/MS)

GC/MS analysis was executed on GC/MS Fenningan Mat SSQ 7000 chromatograph with Digital DEC 3000 work station fitted with a fused silica DB-5 (30 m x 0.25 mm ID, 5% phenyl methyl polysiloxane) capillary column, with helium as carrier gas, at flow rate of 1.6 ml/min and column head pressure is 20.03 psi. The gas chromatograph is coupled to a mass selective detector (MS) at 70 eV in EI ionization mode. The sample was injected in 1 µl size in splitless mode. The temperature was programmed initially at 50º C for 1 min and then increased with a rate of 4º C/ min up to 250º C.

Antiulcer assay (indomethacin induced ulcer) (Dengiz *et al,* 2007)[26]

A total of 90 Female Wister albino rats (180-200 g), were maintained on standard pellet diet and water under standard conditions of 12 h dark-12 h light, humidity (60 ± 1.0%) and temperature (21 ± 1 °C). They were acclimatized to laboratory condition for seven days before commencement of the experiments. Fasting for 24 h was used prior to all assays because tested drugs were always administered orally by gavage (Sakat *et al,* 2012)[27]. The experimental protocols were approved by the Institutional Animal Care and Use Committee; Faculty of Pharmacy, Mansoura University, Egypt.

The animals were divided into fifteen groups, each consisting of six rats: The First group served as negative control and received (DMSO/ Carboxy methyl cellulose), second group served as positive control and received indomethacin (30 mg / Kg),

third group served as standard group and received rantidine (30 mg/kg) as antiulcer drug. Groups (4-15) served as test groups and administered the oils (100µl) and differents fractions (500mg/ kg) of tested mastiche oleogum resins by gastric gavage. After 1 h of administration of tested fractions or rantidine, Indomethacin (30 mg/Kg) was given for animal groups (2- 15) by oral gavage.

At 6 h after the indomethacin administration, all of the animals were sacrificed using sodium thiopental (50 mg/kg). The rat's stomachs were removed and opened along the greater curvature and then washed with serum physiological solution (0.9% NaCl). Any macroscopically visible lesions were measured to calculate the gastric damage score. For this purpose, the ulcerous stomach was ingrained on a planar surface with small pins. Then the total areas of the stomach and ulcerous areas were drawn on a cellophane sheet. The cellophane sheet was fixed on a millimeter paper and the sum of ulcerous areas and total stomach area calculated was expressed as mm^2. The indomethacin group was compared with the healthy group. The protective effect of tested fractions was compared with the results obtained from the indomethacin and ranitidine groups. Ulcer index (UI) and % inhibition in ulcer index in relation to the indomethacin group were estimated as following:

UI = [Ulcerated area (mm^2) / total stomach area (mm^2)] × 100

% Inhibition = UIcontrol (indomethacin) - UI (treatment)/UI control (indomethacin)]

RESULTS AND DISCUSSION

Chemical composition of volatile oil of four different verities of Mastiche

Identification of the components was based on the comparison of their mass spectra with those of NIST libraries (Adams, 1995)[28], as well as on comparison of their retention times and of the standard components analyzed, the percentage composition of the compounds in the oil was determined by peak area measurements, GC-MS analysis (Table No.1) led to identification of the major constituents in Greek mastiche as α-pinene (66.84%), β- pinene (8.94%), caryophyllene (3.40%), D-Limonene (2.49%), as shown in Figure No.1.

The GC/MS of Persian Mastiche (Table 2) showed that longicyclene (50.88 %) is the major compound and identified for the first time followed by trans caryophyllene (6.73 %) and caryophyllene oxide (4.63%), followed by Humulene (1.58 %) , β-Fenchol (1.56%) as shown in Figure No.2.

The GC/ MS of Chinese mastiche (Table No.3) showed that Copaene (38.16%) is the major component followed by Longicyclene (17.71%). This is the first report on analysis of Chinese Mastiche indicate separation of volatile oil from Chinese mastiche oleogum oleogum resin, this illustrated in Figure No.3.

The GC/MS of Turkish Mastiche (Table No.4) showed that α-ylangene (17.05%) is the major component followed by α-bourbonene (8.82%), caryophyllene oxide (6.51%), spathulenol (5.91%) and Trans caryophyllene (5.89%) as shown in Figure No.4.

The gastro protective effect of Greek oil and petroleum ether fraction of Greek mastiche afforded the highest protection against the incidence of gastric ulcer (100%), comparing to rantidine. Followed by chloroform and the total methanolic fractions of Persain mastiche (93.66%, 89.16%) respectively. Meanwhile total methanolic fraction of Greek, petroleum ether fraction of Persian mastiche and Persian oil showed good prophylactic effect (81.29%, 77.09%, 72.21 %) respectively. However the chloroform fraction and total methanolic fraction of Chinese mastiche retained the moderate antiulcer activity (61.06%, 20.33%).

Remarkable hyperemias were observed in the stomachs of indomethacin-administrated rats. In the groups from (2-15) exhibited very slight hyperemias compared to indomethacin-administrated rats.

Ulcer index and Percent inhibition effects of different types of mastiche fractions and their oils are shown in Table No.6.

Investigation of Rat Stomach (Yusif *et al,* 2015)[29]

Macroscopical Examination of rat stomach

Rats stomach of positive control group which received indomethacin orally (+ ve control) showed red patches and erosions of mucosa. [(Indomethacin exhibited a higher ulcerogenic potential than other non-steroidal anti-inflammatory drugs (NSAIDs) possibly by inhibiting the release of protective factors; e.g. cyclooxygenase-1 (COX-1), prostaglandin E2 (PEG2), bicarbonate, mucus, and anti-oxidant parameters as well as stimulating aggressive factors; e.g. acid, and oxidant parameters (Suleyman, H *et al* 2010)][30]. The mucosa of rats stomach in (group 2) which received total fractions of Chinese mastiche showed extensive damage to the gastric mucosa. At the same time, rat stomach in (group 3) which received chloroform fraction of Chinese mastiche showed severe disruption to the surface epithelium. This finding was manifested by the presence of deep ulcer, low % of inhibition of rat ulcer (0 %, 20.33%, 61.06 %), and hence, the highest ulcerative index, (13.16, 10.43, 5.10) respectively (Table No.6).

On the other hand, rat received chloroform fraction of Greek showed reduction of ulcer area and leucocytes infiltration of the submucosal layer (group 4). After administration of Chinese oil to (group 5), gastric mucosa showed necrosis, desquamation and Mild lymphocyte infiltration.

Furthermore, a moderate value of ulcerative index was obtained, better protection of the gastric mucosa as seen by the reduction in ulcer area (group 6) which received petroleum ether fraction of Chinese mastiche. While in (group 7) received Persian oil showed mild esinophilic infiltrate in lamina propria. It was noticed that Group 8 which administrated petroleum ether fraction of Persian mastiche oleogum oleogum resin showed mild esinophilic infiltrate in lamina propria with reduction in ulcer area. Meanwhile, group 9 which received rantidine showed desquamation of superficial layer of gastric mucosa. Stomach of Group 10 which administrated total fraction of Greek mastiche oleogum oleogum resin showed normal lining epithelium of gastric mucosa with mild congestion. Normal lining epithelium of mucosa with mild desquamation of superficial layer in (group 11) which received total fraction of persian. While in (group 12) which received chloroform fraction of Persian showed comparatively normal lining epithelium of gastric mucosa. Normal gastric mucosa and normal submucosa was found in (groups 13 and 14) because rats administrated both Greek oil and petroleum ether fraction from mastiche oleogum oleogum resin.

It was noted that (groups 13, 14) showed the highest % of inhibition 100% so lowest ulcer index zero, as indicated in Figure No.5, Table No.6.

Microscopical Examination of Rat Stomach

Histopathological investigation of gastric mucosal lesions

Rat Stomach of group 1which treated with indomethacin reaveled superficial mucosal ulceration and exhibited complete loss of the gastric mucosa (Figure No.6, A and B).While, group 2 showed comparatively extensive damage to the gastric mucosa (Figure No.6, C and D). However, in group 3 exhibited severe disruptions of the surface epithelium and necrotic lesions penetrating deeply into mucosa (Figure No.6, E and F). Moreover, group 4 which treated with rantidine only showed reduction of ulcer area and necrosis of superficial layer of gastric epithelium (Figure No.8, A and B). Meanwhile, in group 5 treated with Chinese oil showed mild lymphocyte infilteration.

On the other hand, the tissue of the stomach of rats receiving oil and petroleum ether fraction from Greek mastiche oleogum oleogum resin group (13, 14) showed no ulceration, no necrosis, no congestion and preserved gastric mucosal architecture showed normal gastric mucosa and normal submucosa, also, glandular epithelium was protected as displayed in (Fig. 9, A, B, C, D). In addition, Stomach of group 15 (healthy) showed a normal histological structure of rat gastric mucosa where normal gastric mucosal architecture (Figure No.9, E, F). Greek mastich oil and petrolum ether fraction showed a potent curative effect for damage caused by indomethacin more over than ranitidine.

A and B: Treated rat with Indomethacin (+ ve control) showed necrosis of superficial layer of gastric mucosa and marked extensive damage with a complete loss of the mucosa (group 1).

C and D: Rat received total fraction of Chinese showed comparatively extensive damage to the gastric mucosa and necrotic lesions penetrate deeply into mucosa (group 2).

E and F: Rat received chloroform fraction of Chinese showed severe disruption to the surface epithelium and necrotic lesions penetrating deeply into mucosa (group 3).

G and H: Rat received chloroform fraction of Greek showed reduction of ulcer area and leucocytes infiltration of the submucosal layer (group 4).

(Abbreviations: White arrows: ulcer margins and white arrow head ulcer base)

(H and E, A, C, E and G, X100 and B, D, F and H X400)

A and B: Stomach rat received Chinese oil showed necrosis and desquamation of superficial layer of gastric mucosa, mild lymphocyte infiltration (group 5).

C and D: Stomach rat received petroleum ether fraction of Chinese showed comparatively better protection of the gastric mucosa as seen by the reduction in ulcer area (group 6).

E and F: Stomach rat received Persian oil showed comparatively better protection of the gastric mucosa as seen by the reduction in ulcer area showed mild esinophilic infiltrate in lamina propria (group 7).

G and H: Stomach rat received petroleum ether fraction of Persian showed mild esinophilic infiltrate in lamina propria with reduction in ulcer area (group 8).

(Abbreviations: White arrows: ulcer margins, black arrow head normal mucosa and **asterisks**, lymphocyte infiltration).

(H and E, A, C, E and G, X100 and B, D, F and H X400

A and B: Rat Stomach received Ranitidine showed desquamation of superficial layer of gastric mucosa (group 9).

C and D: Rat Stomach received total fraction of Greek showed normal lining epithelium of gastric mucosa with mild congestion (group 10).

E and F: Rat Stomach received total fraction of Persain showed normal lining epithelium of mucosa with mild desquamation of superficial layer (group 11)**.**

G and H: Rat Stomach received chloroform fraction of Persian showed comparatively normal lining epithelium of gastric mucosa (group 12).

(Abbreviations: **white arrows**: ulcer margins, **black arrow head**: normal mucosa)

(H and E, A, C, E and G, X100 and B, D, F and H X400)

A and B: Rat Stomach which received Greek oil revealed no significant ulcerations and the tissues were almost intact. Normal gastric gland and normal acid were also seen (black head arrows) (group 13).

C and D: Rat Stomach received petroleum ether fraction of Greek showed normal gastric mucosa and submucosa. Also, normal lining epithelium of gastric mucosa and normal acid producing cells were seen (black head arrows) (group 14).

E and F: Control Rat Stomach showed a normal histological structure of rat gastric mucosa where normal gastric architecture formed of outer serosa, muscularis layer composed of outer longitudinal and inner circular muscle, Submucosa with blood vessels and mucosa composed of muscularis mucosa and gastric glands with connective tissue. The gastric glands are simple tubular, lined by secreting cells of two types, the granular (peptic) cells of polygonal outline and secretory granules with affinity to basic dyes, oxyntic (acidic) cells with rounded outline and affinity to acidic dye.

(H and E, A and C, X100 and B and D, X400).

Table No.1: Chemical Composition of Greek Mastiche oleogum oleogum resin as determined by GC- MS

S.No	Compounds	Base peak	M+ peak	Relative % composition	Retention time (TR) (min)	Fragmentation peaks (m/z)
1	α- pinene	93	136	66.84	4.96	53, 67, 79.105.121
2	Camphene	93	136	0.95	5.36	67, 79, 91, 107, 121
3	β- pinene	93	136	8.94	6.47	41, 69, 79, 121
4	Anisole (p-methyl)	122	136	1.18	7.32	65, 77, 91, 107, 121
5	D-limonene	68	136	2.49	7.71	53, 79, 93, 107, 121
6	α-Linalool	71	154	1.31	10.49	41, 55, 69, 93, 107, 121
7	α- campholenal	108	152	0.54	11.43	41, 67, 77, 93, 109, 119
8	Trans pinocarveol	92	152	0.50	12.09	55, 70, 83, 91, 119, 134
9	Cis-verbenol	94	152	0.70	12.48	59, 79, 109, 119, 137
10	Myrtenal	79	150	0.60	14.12	41, 53, 91, 107, 121, 135
11	L- verbenone	107	150	0.71	14.73	67, 79, 91, 107, 122
12	Caryophyllene	93	204	3.40	21.89	69, 79, 105, 120, 133, 147
13	α- caryophyllene	93	204	0.32	23.19	67, 80, 107, 121, 136, 147
14	Caryophyllene oxide	41	220	0.44	27.75	55, 69, 79, 109, 121, 149
15	Kaurene	41	272	0.77	38.08	69, 79, 93, 105, 119, 229, 257

Table No.2: Chemical Composition of Persian mastiche as determined by GC- MS

S. No	Compounds	Base Peak	M+ peak	Relative % Composition	Retention time (TR) (min.)	Fragmentation peaks (m/z)
1	α –Myrcene	41	136	0.74	11.73	55, 69, 107, 121
2	α –linalool	71	154	0.77	15.14	41, 55, 69, 93, 121
3	β- Fenchol	81	154	1.56	17.87	43, 55, 67, 93, 121
4	α-bourbonene	81	204	0.70	23.25	41, 67, 91, 105, 123, 161
5	Longicyclene	41	204	50.88	23.83	55, 79, 91, 105, 119, 133
6	Trans caryophyllene	41	204	6.73	24.15	55, 69, 79, 93, 105, 119, 189
7	α-Humulene	93	204	1.58	25.01	41,67,79,105,121,147
8	α-Muurolene	105	204	0.64	26.13	41,81,91,119,133,161
9	Caryophyllene oxide	41	220	4.63	28.17	55,67,79,93,135,161

Table No.3: Chemical Composition of Chinese Mastiche as determined by GC- MS

S.No	Compounds	Base Peak	M+ Peak	Relative% composition	Retention time (TR) (min)	Fragmentation peaks (m/z)
1	Camphene	93	136	0.03	10.29	67, 79, 91, 107, 121
2	5-hepten-2-one, 6-methyl	43	126	0.14	11.62	41, 55 ,69, 83, 93, 108
3	1,8-cineol	43	154	0.24	12.99	55, 69, 84, 93, 108
4	Longicyclene	41	204	17.71	22.55	55, 79, 105, 119, 133
5	α – Copaene	105	204	38.16	23.81	41, 67, 81, 119, 161
6	Aromadendrene	119	204	0.88	25.10	55, 67, 79, 91, 105, 161
7	γ – Muurolene	161	204	0.42	25.17	41, 55, 79, 93, 105, 119
8	Globulol	43	222	0.98	29.71	67, 93, 109, 161, 204
9	Epialphacadinol	161	222	0.32	29.98	43, 79, 91, 105, 119, 204

Table No.4: Chemical Composition of Turkish mastiche as determined by GC- MS

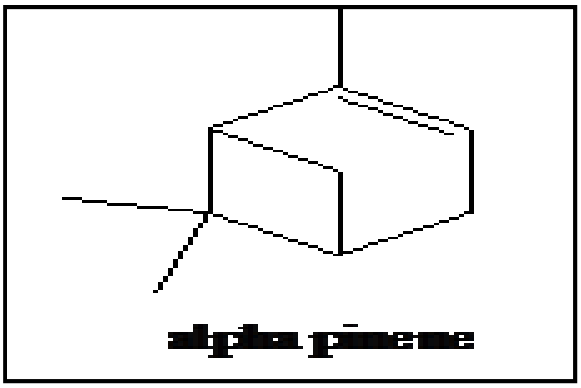
S.No	Compounds	Base Peak	M+ Peak	Relative % Composition	Retention time (TR) (min)	Fragmentation peaks (m/z)
1	(E)β- Ocimene	93	136	4.91	9.85	41, 53, 67, 105, 121
2	α –cubebene	105	204	1.68	22.28	41, 55, 81, 91, 119, 161
3	α –ylangene	41	204	17.05	23.00	53, 67, 91, 119, 133, 161
4	α-bourbonene	81	204	8.82	23.25	41, 67, 91, 105, 123, 161
5	Trans caryophyllene	41	204	5.89	24.15	55, 69, 79, 93, 105, 119, 189
6	α- Humulene	93	204	2.42	25.03	41, 67, 79, 105, 121, 147
7	γ- Murrolene	161	204	1.80	25.56	41, 55, 79, 93, 105, 119
8	Germacrene D	161	204	1.06	25.69	55, 79, 91, 105, 119, 133, 147
9	Delta-cadinene	119	204	1.00	26.69	41, 55, 65, 81, 105, 176
10	Spathulenol	43	220	5.91	28.03	55, 79, 91, 105, 119, 159
11	Caryophyllene oxide	41	220	6.51	28.17	55, 67, 79, 93, 135, 161

Table No.5: % Composition of major compound of the studied mastiche type

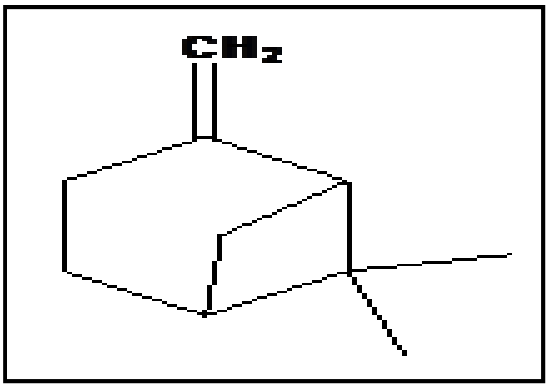
S.No	Components	Greek	Persian	Chinese	Turkish
1	α- pinene	66.84%	-------	------	-------
2	longicyclene	-------	50.88%	------	
3	α-Copaene	------	------	38.16%	-------
4	α-ylangene	-----	------	-----	17.05%

Table No.6: Gastro protective Effects of different mastiche fractions 500 mg /kg and their oils 100 µl on indomethacin (IND) - induced gastric damage in rats

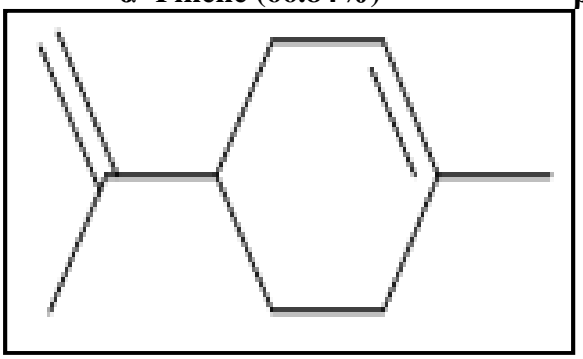
S.No	Treatment	Ulcer index	% inhibition
1	Ranitidine+(IND)	2.97±0.26	77.32
2	Greek oil+(IND)	0	100
3	Persian oil+(IND)	3.64±0.37	72.21
4	Chinese oil+(IND)	4.18±0.53	68.09
5	Total fraction of Greek+(IND)	2.45±0.35	81.29
6	Petrolum ether fraction of Greek+(IND)	0	100
7	Chloroform fraction of Greek+(IND)	4.96±0.72	62.13
8	Total fraction of Persian+(IND)	1.42±0.18	89.16
9	Petrolum ether fraction of Persian+(IND)	3.00±0.46	77.09
10	Chloroform fraction of Persian+(IND)	0.83±0.22	93.66
11	Total fraction of Chinese+(IND)	10.43±0.81	20.33
12	Petrolum ether fraction of Chinese+(IND)	3.96±0.40	69.77
13	Chloroform fraction of Chinese+(IND)	5.10±0.64	61.06
14	Control (healthy)	0	------
15	Indomethacin (IND)	13.16±0.89	------



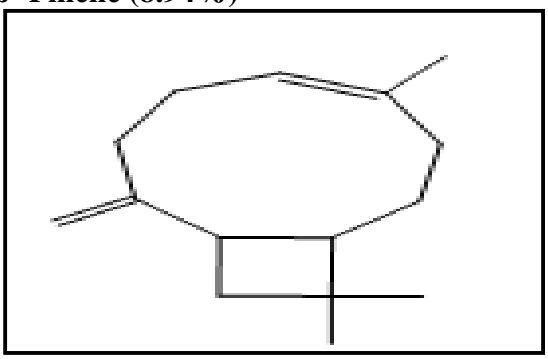
α -Pinene (66.84%)



β- Pinene (8.94%)

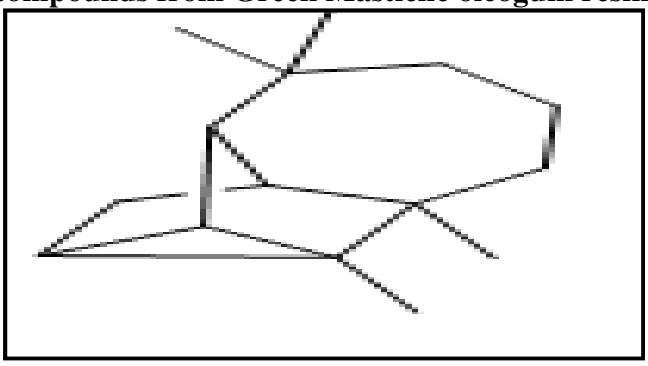


D-Limonene (2.49%)

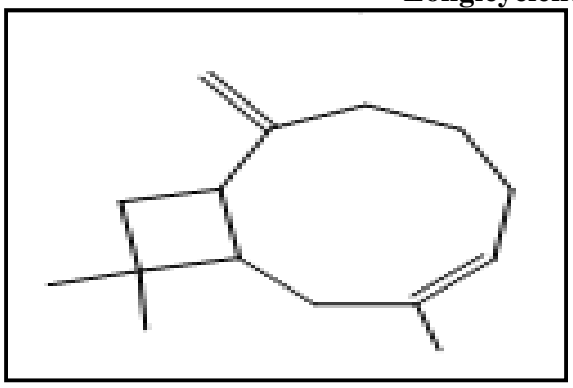


Caryophyllene (3.4%)

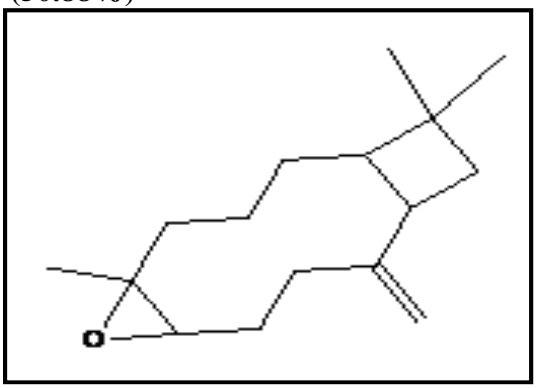
Figure No.1: Major compounds from Greek Mastiche oleogum resin detected by GC/MS



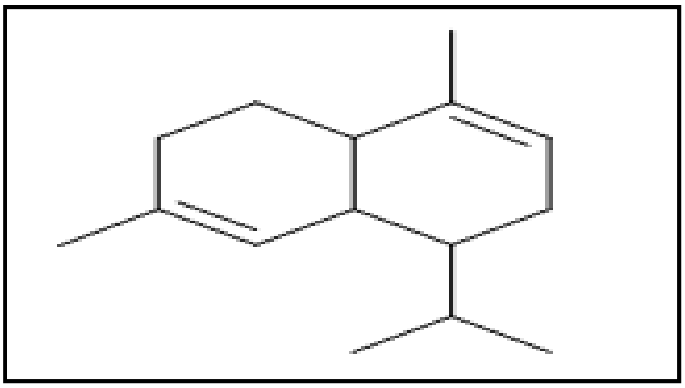
Longicyclene (50.88%)



Trans caryophyllene (6.73%)

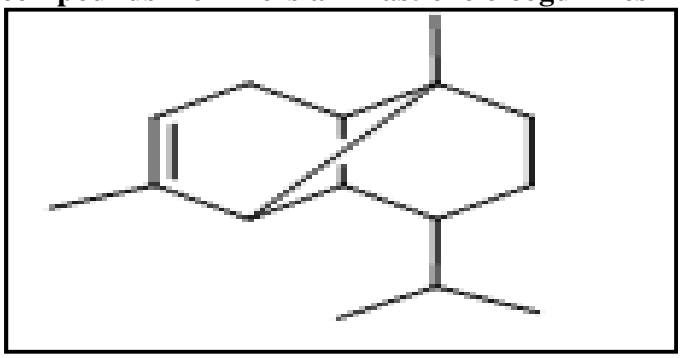


Caryophyllene oxide (4.63%)



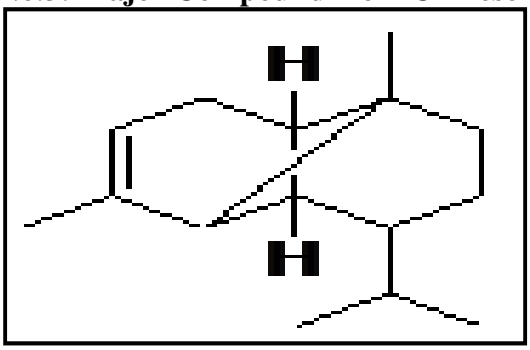
α -Muruolene (1.58%)

Figure No.2: Major compounds from Persian Mastiche oleogum resin detected by GC/MS

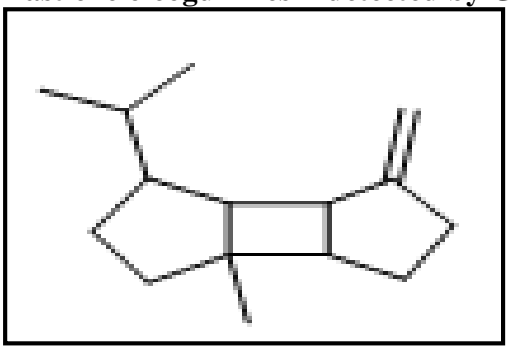


α- copaene (38.16%)

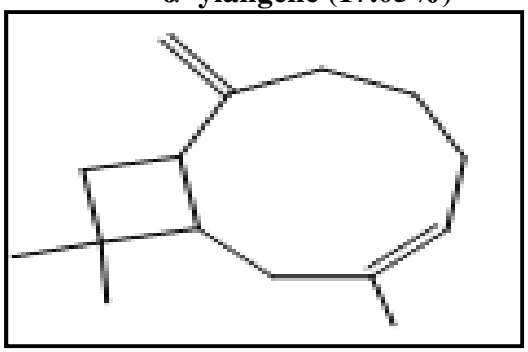
Figure No.3: Major Compound from Chinese Mastiche oleogum resin detected by GC / MS



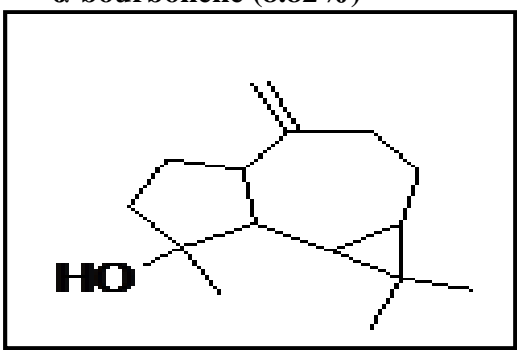
α -ylangene (17.05%)



α-bourbonene (8.82%)

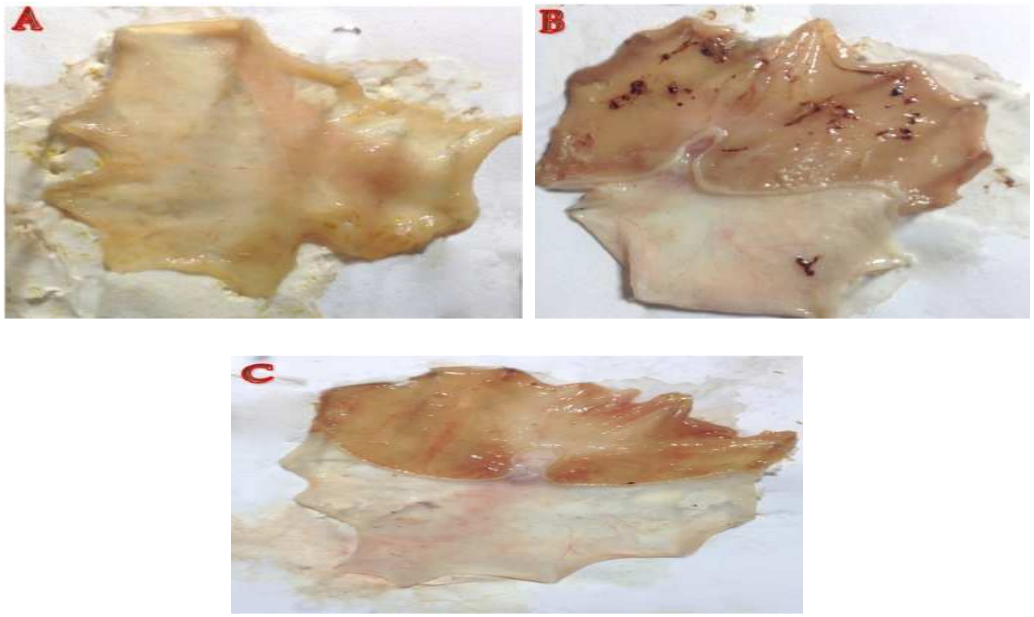


Trans caryophyllene (5.89%)

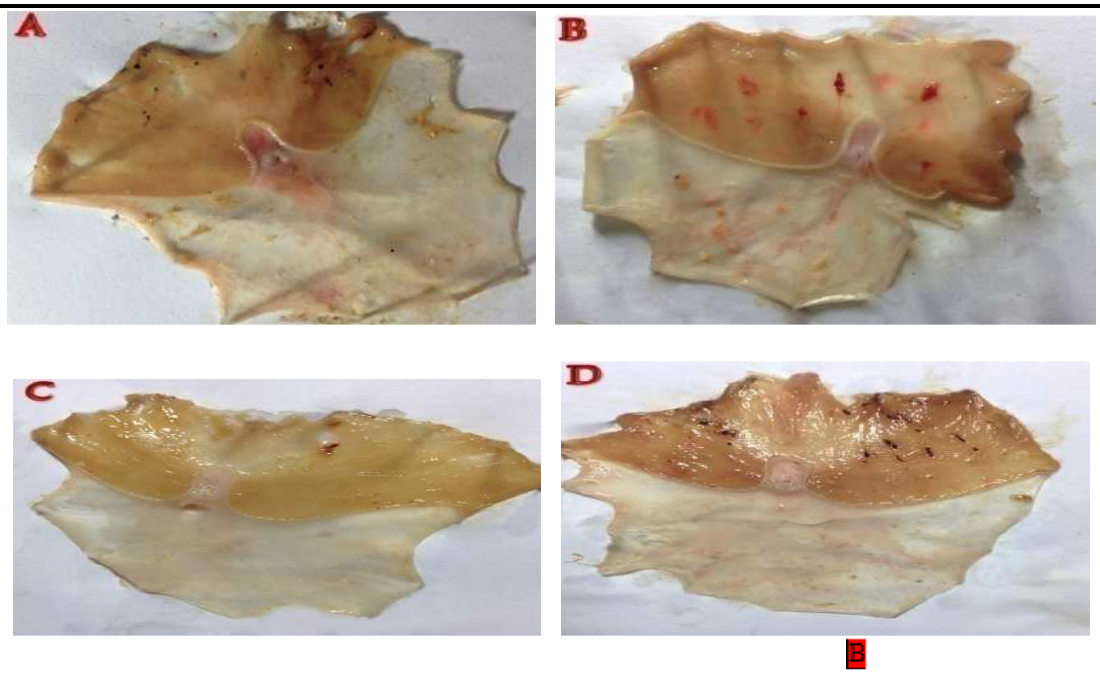


Spathulenol (5.91%)

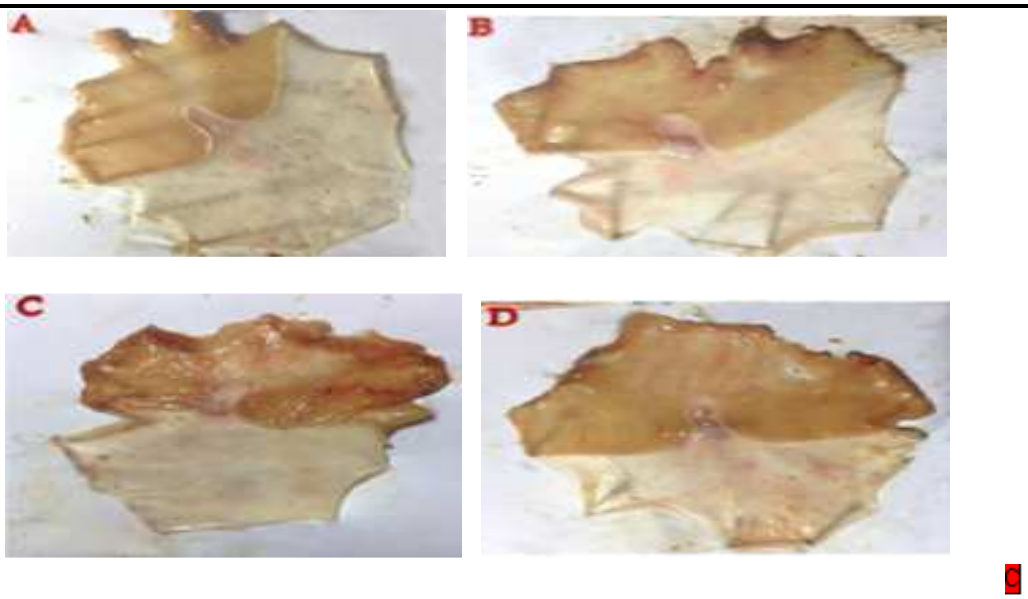
Figure No.4: Major compounds from Turkish Mastiche oleogum resin detected by GC- MS



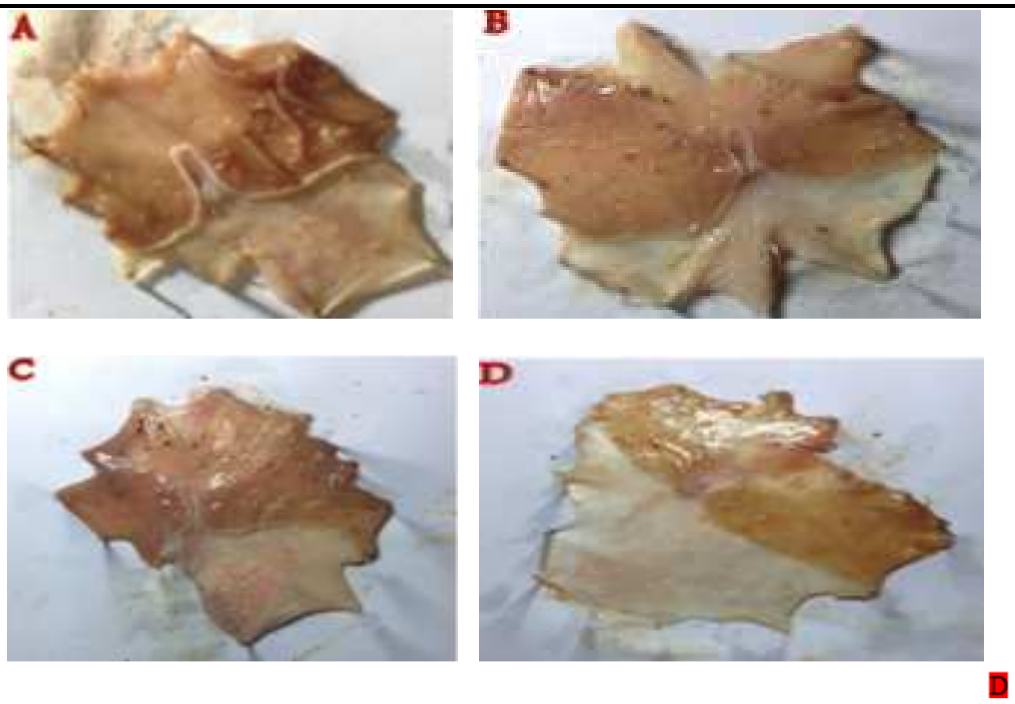
A: -Ve (carboxy methyl cellulose/distilled water)
B: +Ve (Indomethacin)
C: Standard (Rantidine)



A: Chinese oil
B: total fraction of Chinese
C: petrolum ether fraction of Chinese
D: methylene chloride fraction of Chinese



A: Greek oiL
B: total fraction of Greek
C: petrolum ether fraction of Greek
D: methylene chloride fraction of Greek



A: persian oil
B: total fraction of Persian
C: petrolum ether fraction of Persian
D: methylene chloride fraction of Persian

Figure No.5: Macroscopical examination of rat stomach for different oleogum resin fractions and oils

Figure No.6: Photomicrograph of transverse histological sections in the stomach of experimental rat groups

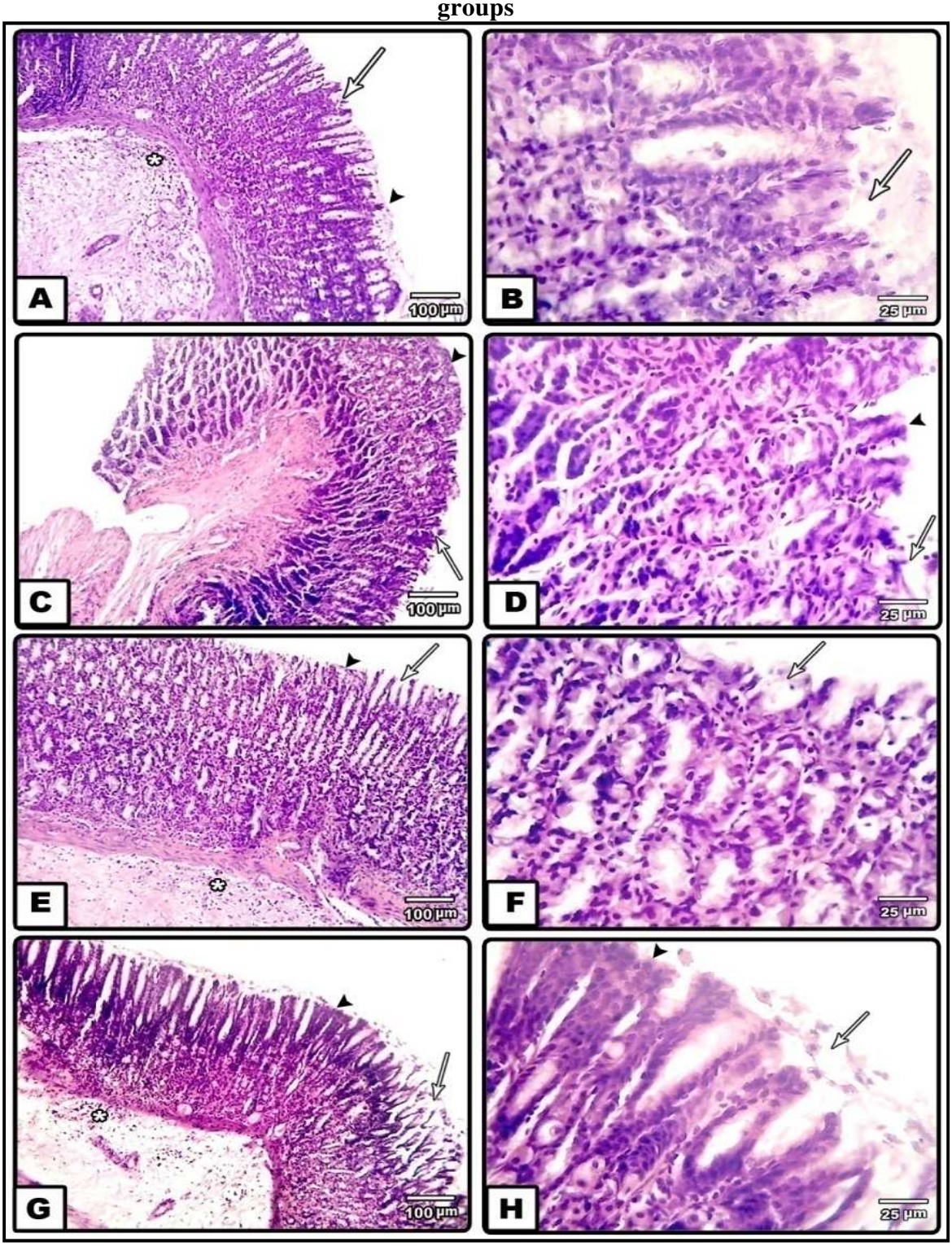


Figure No.7: Photomicrograph of transverse histological sections in the stomach of experimental rat groups

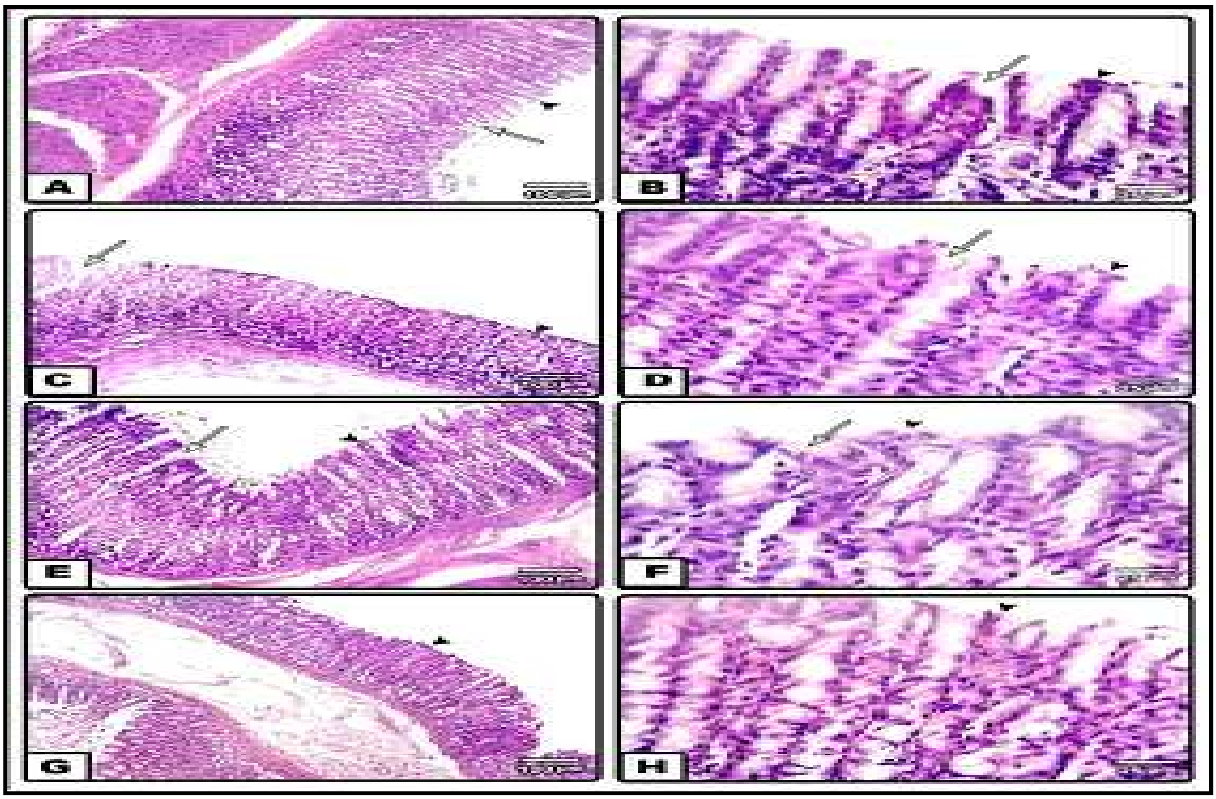


Figure No.8: Photomicrograph of transverse histological sections in the stomach of experimental rat groups

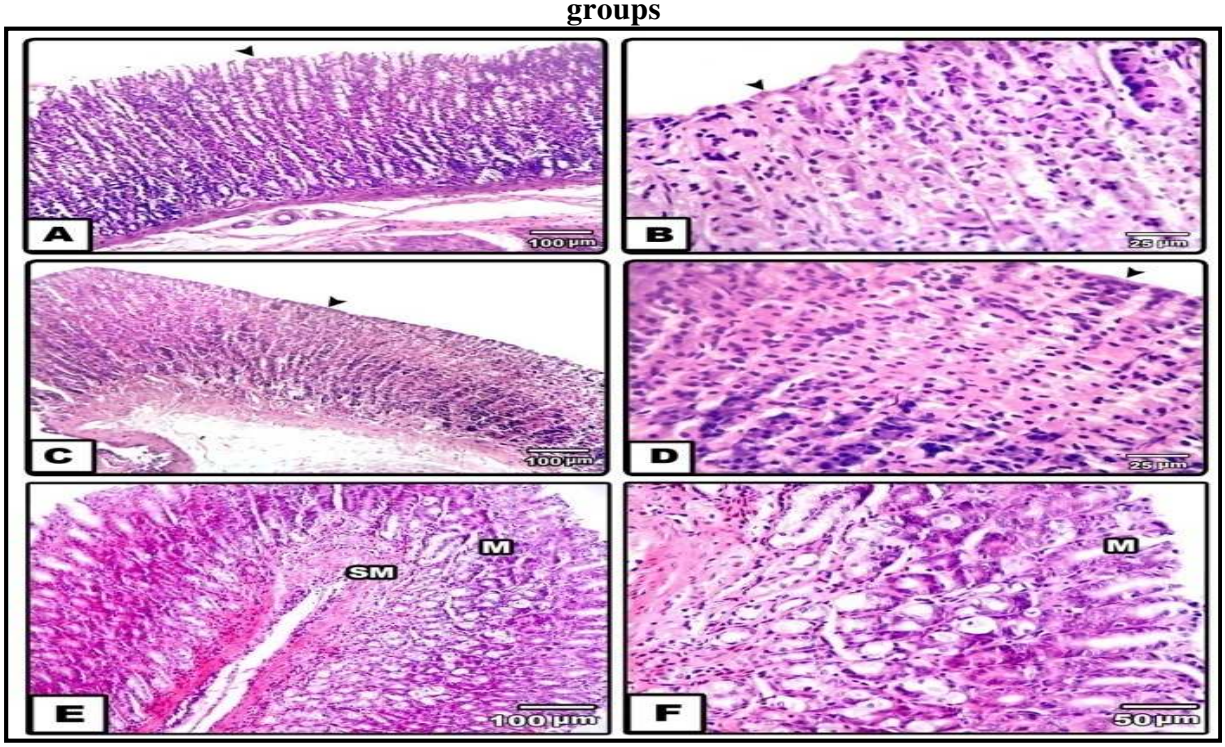


Figure No.9: Photomicrograph of transverse histological sections in the stomach of experimental rat groups

CONCLUSION

GC/MS of four types of Mastiche revealed that α-pinene (66.84%), longicyclene (50.88 %), α-Copaene (38.16 %), α-ylangene (17.05 %) are the major compounds of Greek, Persian, Chinese and Turkish. This could be used as a marker for detection of several oils for different types of mastiche. However oil and petroleum ether fraction of Greek mastiche showed the most significant protective effect against the gastric damage caused by indomethacin. The gastroprotective effect of those was also stronger than that of ranitidine, which is an H2-receptor blocker. So, they are capable of providing protection from ulceration.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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