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RESEARCH ARTICLE

Analytical Study of Mallow (*Malva Sylvestris*) Toula Plant and its Antioxidant Potential in Meat Processing

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ABSTRACT

The mallow (Malva parviflora) plant is one of the unique plants rich in mineral elements and compounds known for their antioxidant properties. The mallow herb, or what is called "Toula" in Iraq, was described as the food of the poor, especially in the countryside. The study aimed to identify these active compounds and the possibility of including them in meat mixtures when processing them as a natural preservative that delays oxidation in the fat and prolongs the preservation period. These compounds were identified from the aqueous and alcoholic extracts of the Mallow plant by gas chromatography coupled to mass spectrometry (GC-MS). The antioxidant power determined by destroying free radicals through hydrogen sacrifice was estimated for all extracts, the results showed that the mallow plant contain several active compounds, the antioxidant activity by free radicals estimated by hydrogen donation for all extracts, The results showed that mallow extracts contains many active compounds such as oxime-, methoxy-phenyl , Silanediol, dimethyl, 2,4-Di-tert-butylphenol, 9,12,15-octadecatrienoic acid, in aqueous and alcoholic extracts. Mallow extracts showed a unique ability to destroy DPPH free radicals by sacrificing hydrogen, and the results differed significantly in the percentage of destruction of the extracts, which amounted to 81% and 84% for aqueous and ethanol extract at a concentration of 125 mg/ml. The results showed that the mallow plant had an excellent percentage of potassium, calcium, zinc, and magnesium. Chemical and sensory changes showed the unique potential of mallow plant when used as a preservative in meat processing.

INTRODUCTION

Many researches have recently dealt with the great effects of plant antioxidants in the treatment of many diseases related to free radicals and also confirmed the ability of antioxidants to destroy free radicals and protect the tissues and cells of the body, and among these plants is the mallow plant (Toula) *Malva parviflora*,(El-Naggar et al., 2020).

Mallow or so-called "Al-Tula" is a perennial herb that is not cultivated, but rather grows naturally in the wild, farmers fields, water bodies, deserts and roadsides. Al-Khabaz leaves are consumed by

villagers in Egypt and added as one of the basic salad ingredients or eaten cooked as the leaves are packed with phenols and other substances such as trypsin, chromine, gum and many pigments (Abdalla et al., 2016).

Mallow plants, It is a wild botanical rich in components and trace elements that are biologically important and have been used traditionally as an anti-inflammatory agent and analgesic (Classen et al., 2001).

Mallow flowers (*M syvestris*) have distinctive virtues because they are rich in anthocyanins. (Mas et al.,1999). The leaves and stems showed the presence of anthocyanins, flavonols, ferulic acids, flavones, and hydroxycinnamic acids and sterols (Nawwar et al .,1977).

Therefore, it is important to highlight all parts of the plant (flowers, stem and leaves). Although the leaves contain the highest antioxidant activity (Beghdad et al., 2014). Antioxidants have recently been used as distinct alternatives to chemical preservatives, and the reasonable reason for using industrial antioxidant compounds is their safe natural source and being inexpensive due to the increase in health risks and potential toxicity. There are many studies that have evaluated the performance of these natural compounds as distinctive alternatives to industrial antioxidants. Diets contain natural antioxidant compounds that can stabilize highly reactive and unstable harmful molecules (free radicals). The high heat treatment can cause changes in the structural structure of the soluble components, such as carbohydrates and total phenols wich may be reflected in the antioxidant efficiency (Sandoval et al., 2021).

Carolus limaeus was able for the first time to distinguish the different types of baker, as he identified 15 species. The baker is not considered a halophyte, but it lives in saline soils in Bahrain and separate parts of the western coast of Australia (Michael et al., 2006).

Malva species have been extensively researched using modern technologies, and these studies focus on four species of this genus: *M neglec, M parviflora, M sylvestris,* and *M verticillata (*Azab, 2017).

Fakhfakh et al., (2016) were able to add mallow leaves to wheat flour at rates of 1, 2, 3, 4, and 5% and noted that the best percentage for producing high-quality bread is 3%.

Malva sylvestris is one of the most amazing and promising plants in the preparation of many medical and pharmaceutical compounds due to its multiple biological importance in addition to its nutritional importance in the presence of essential and non-essential elements, non-metals, and halogens, where the leaves of the plant were evaluated using the ICP-OES device and the presence of Zn, Mn, Mg, K, Fe, Ca, Ba and Si . (Hiçsönmez et al., 2009). also showed The plant has its ability to attract minerals such as Pb, Zn, Ni, Cd, and Cu from the soil it is stocked with, so it is a way to protect the population from this problem (Desideri et al., 2010). in addition to the availability of vital activity regulators, which are vitamins, the most important of which are C and E, to enhance immunity and prevent cancer (Barros et al., 2010).

Many researches have shown the importance of *Malva sylvestris* as a functional food with multiple health benefits, as the leaves, flowers, and roots were used for their anti-free radical properties due to the presence of a high percentage of antioxidant phenolic compounds, especially flavonoids, and these compounds are free from side effects compared to industrial drugs (Marouane et al., 2011).

Numerous studies of the Malva plant and its antioxidant potential led to its extracts containing varying levels of antioxidant activity, as the dichloromethane extract showed that it was the strongest in curbing the free radicals of both DPPH and NO. Also, an in-depth study of the dichloromethane extract led to the identification of ten of Phenolic compounds and their isolation, and the study showed the ability of these compounds to resist SARS-COV2 activity, and these excellent results give promising hopes for the use of this plant extract in the development of drugs for the treatment or prevention of SARS-COV-2 disease (Irfan et al ., 2021).

There is no doubt that the plant mallow contains antioxidant and antimicrobial activity. as the researchers proved that its flowers are more active than the leaves (Barros et al ., 2010) and (Mihaylova et al ., 2014). The freshness of the baked goods and their microbiological condition during storage for three days (Alexieva et al ., 2022). In addition to protecting them from oxidation and reducing moisture evaporation (Dos Santos Caetano et al ., 2018). as well as imparting bright colors to the products (Zahedi ., 2019).

The aim of this study was to evaluate the antioxidant activity of extracts of mallow leaves and diagnose them using the GC-Mass device in order to introduce the dried extract as an alternative to the notorious industrial preservatives in order to extend the shelf life of processed meat products as well as enrich these products with natural flavor, and color and consistency to obtain high-quality products from a nutritional and sensory point of view.

MATERIALS AND METHODS

Material: Mallow leaves

Mallow leaves (*Malva sylvestris*). The mallow plant was harvested from a rural area in southern Iraq / Basra.

Figure 1: Mallow leaves (*Malva sylvestris*)

Preparation of mallow leaves extracts

Mallow, ethanolic, aqueous and hexane extracts Prepared by weighing 10 g of dried mallow powder with 100 ml of ethanol solution (400ml /500ml of distilled water) and the mixture was placed in a shaking incubator at 40 preparation of mallow leaves extracts Mallow ethanolic, aqueous and hexane extract Prepared by weighing 10 g of dried mallow powder with 100 ml of ethanol solution (400ml /500ml of distilled water) and the mixture was placed in a shaking incubator at 40° C , use high-quality filter paper, then was concentrate the extract using a rotary evaporator and was kept to dry completely while keeping it at a temperature of 4° c until the subsequent tests.

Diagnostics of active compounds using GC-MS

The active compounds in the mallow extracts were determined by a gas chromatograph connected to a mass spectrometer (GC-MS). This diagnosis was performed in the BOC laboratory using an Agilent Technologies system, 7890B GC, coupled with an Agilent Technologies 5977A MSD with EI signal detector, using HP-5ms 5% phenyl and 95% methyl siloxane (30m*250µm*0.25). The oven temperature was set at 40°C for 5 minutes and then raised to 10°C/min to 300°C for 20 minutes. The helium carrier gas flow rate was 1 mL/min, and the purge flow was 3 mL/min. The pulse was placed in injection mode with less splitting. The injection temperature is 290 °C, and the injection sample size is 1 µm. A mass spectrometer uses an ion source temperature of 230°C, with a scan speed of 1562 (N2) and mass range of 44-750 m/s. Data was run through the NIST 2014 and Wiley 9 Library

databases as an additional tool to confirm the identity of compounds. c, use high-quality filter paper, which was concentrated using a rotary evaporator and kept to dry completely while keeping it at a temperature of 4˚ c until the subsequent tests.

Metal Detection

The measurement was carried out using an AA7000 atomic adsorption spectrophotometer ,Shimadzu , japan . The method (Cresser and Persons ,1979) was used for the digestion process, where 0.2 grams of the sample were weighed and placed in the digestion tubes, 5 ml of H2SO4 acid was added and left overnight, after which it was placed at a temperature of 80 °C for an hour after that added 3 ml of an acidic mixture (96% H2SO4 and 4% HCIO4 acid was added and left at 80°C until the solution turned clear, then diluted to the required volume with deionized water. After digestion, the sample is transferred to the device, which is fueled by air and acetylene, and each element is measured using a special cell called a hallow cathode lamp. The work of the device is based on atomic absorption technology. After initializing the device, the measurement is done using special standards for each element, and the concentration is calculated through the absorbance given by the device. Concentration is calculated in micrograms/gram.

DPPH radical suppression assay

The ability of Mallow leaves (*Malva parviflora*) to suppress free radical DPPH (2,2 Diphenyl-1-picryl-hydrazyl) was measured by reacting 0.5 ml of Mallow extract (25, 50, 75, 125 mg/ml) with 0.3 ml of ethanol with 0.3 ml (0.5 mM DPPH), and the mixture was incubated for 45 minutes at room temperature, after which the absorbance was read at 517nm using a spectrophotometer [18]. Then it was calculated by the following relationship: {1- [Abs sample / Abs control]} × 100

Manufacture of meat patties

Meat pasties were prepared, to which 15% fat was added by chopping them well with an electric machine and then dividing them into three treatments with three replications:

The first treatment A: the control sample without adding the powder of Tula squid.

The second treatment B: adding the powder of Tula at a concentration of 50% of the weight of the meat.

The third treatment C: adding the powder at a concentration of 25% of the weight of the meat.

The patties were placed in vacuum polyethylene bags, a piece of wax paper was separated from each other, and they were closed tightly. They were then stored in refrigeration at a temperature of 4°C for two weeks to monitor changes in chemical indicators, which included peroxide number PV and thiobarbituric acid TBA. These indicators were calculated before storage and followed up each four days during the storage period, in addition to that, the sensory evaluation of the meat patties was conducted through the acceptance form, which consists of five sensory characteristics: appearance, smell, taste, color, texture, and the participation of 120 tasters, depending on their taste sense and personal preference.

Chemical indications

Peroxide Value PV: The peroxide value of meat patties cryopreserved during periods 0, 4, 10, and 14 was estimated according to the method mentioned in (Egan et al., 1981).

Thiobarbituric acid TBA: The value of thiobarbituric acid was estimated based on the method of (Pearson, 1970).

Statistical Analysis

The Statistical Package of Social Sciences (SPSS) software package (version 26.0) was used to analyze all scientific experiment data in three replicates. The data were evaluated using a one-way ANOVA, and the results were considered statistically significant at ($p < 0.05$).

RESULTS AND DISCUSSION

Diagnostics of Active Compounds Using Mass Spectrometry and Gas Chromatography

The GC-MS device showed that the aqueous and alcoholic extracts of Tola plant contained several biologically active compounds in different proportions depending on the solvent used. The results showed that there are 30 peaks that form the active compounds in the aqueous extract of Toula plant, where the anethole compound appeared at 23.70% at peak 8 and a retention time of 14.707, It is one of the important aromatic compounds with molecular formula C10H12O,This compound is responsible for the antioxidant properties (Bruits and Bucar 2008). followed by 1H-Pyrrole-2,5-dione, 3-ethynyl-4-methyl- in percentage 9,626 in peak 19, with a retention time of 18,439. The results also showed the dominance of strong antioxidant compounds such as silanediol and dimethyl at peak 2, which are known for their emollient and moisture-retaining properties, in addition to the appearance of oxime- and methoxy-phenyl- at peak 4. It is well known that oximes have anti-toxic potential, and their antioxidant activity is comparable to that of ascorbic acid (Potaniec et al ., 2014).

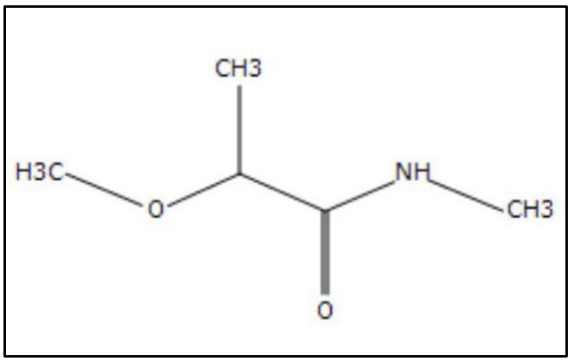

Figure 2: Oxime-, methoxy-phenyl

On the other hand, the alcoholic extract contained many unique biological compounds, which consisted of 55 peaks, the most important of those was 2,4-di-tert-butylphenol. by 13.1295 at a peak of 18 and a retention time of 18.8475 It is followed by 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-with a percentage of 9.8182 at peak 42 and a retention time of 25.0723 then, compound 1-octadeceneat a peak of 28 and a percentage of 5.5938 and a retention time of 21.9894. The compound 1,4-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester at peak 55 with a percentage of 5.5133.and the compound 5-Eicosene, (E)- at the peak 38 with a percentage of 5.2789, other compounds also contributed in small proportions, such as phytol 2.1106%, with a retention time of 25.1755, and the compound silane, triethoxymethyl-by 0.96 has a retention time of 8.979 at peak 2.

2,4-di-tert-butylphenol is one of the alkylated organic compounds, and it is one of the safest antioxidants. There is little information about its toxicity, and it is widely used commercially in several fields.

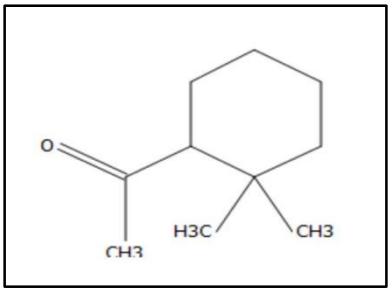

Figure 3: 2,4-di-tert-butylphenol

Table 1: Active compounds present in the aqueous extract.

Peak	R. Time	Area	Area Pct.	Compound
1	5.024	42170	2.0756	Propane, 2-chloro-2-nitro-
2	5.068	42911	2.1121	Silanediol, dimethyl-
3	5.355	28749	1.415	Oxime-, methoxy-phenyl-_
4	5.378	41500	2.0426	Oxime-, methoxy-phenyl-_
5	8.247	24564	1.209	4-Ethylbenzoic acid, octyl ester
6	10.068	65225	3.2104	Octanal
7	14.302	46681	2.2976	1,5-Heptadien-3-yne
8	14.707	481584	23.7036	Anethole
9	15.12	156402	7.6981	4-Acetylanisole
10	15.533	21046	1.0359	1-Cyclohexene-1-methanol
11	16.072	58959	2.902	2-Propanone, 1-(4-methoxyphenyl)-
12	16.33	15356	0.7558	1-Trifluoroacetoxy-10-undecene
13	17.075	21401	1.0534	Hept-3-yn-2-one
14	17.134	134776	6.6337	1-Decen-3-yne
15	17.377	23661	1.1646	.beta.-D-Glucopyranose, 1,6-anhydro-
16	17.532	22762	1.1203	3-Methoxy-4,5-methylenedioxy-N-methylamphetamine
17	17.613	33978	1.6724	Benzenamine, 4-butoxy-

18	18.034	20253	0.9969	2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-4a-methyl-, (S)-
19	18.439	195579	9.6264	1H-Pyrrole-2,5-dione, 3-ethenyl-4-methyl-
20	18.528	92778	4.5665	1-(4-Methoxyphenyl)propane-1,2-diol
21	19.074	14953	0.736	(4Z)-5-Chloro-3,4-dimethyl-2,4-heptadiene
22	19.295	18508	0.911	4(1H)-Pyridinone, 1,2,6-trimethyl-
23	19.516	112492	5.5369	5-Hexyl-2-furaldehyde
24	20.217	21912	1.0785	5-Hexyl-2-furaldehyde
25	20.394	17511	0.8619	2,4-Hexadiyne-1,6-diol
26	20.903	160135	7.8819	2-Cyclohexen-1-one, 4-hydroxy-3,5,6-trimethyl-4-(3-oxo-1-butenyl)-
27	23.1	58055	2.8575	N-Benzylformamide
28	23.204	23615	1.1623	Methanamine, N-(phenylmethylene)-, N-oxide
29	24.561	15152	0.7458	Dodecanamide
30	26.936	19020	0.9362	Trimethylsilyl-di(timethylsiloxy)-silane

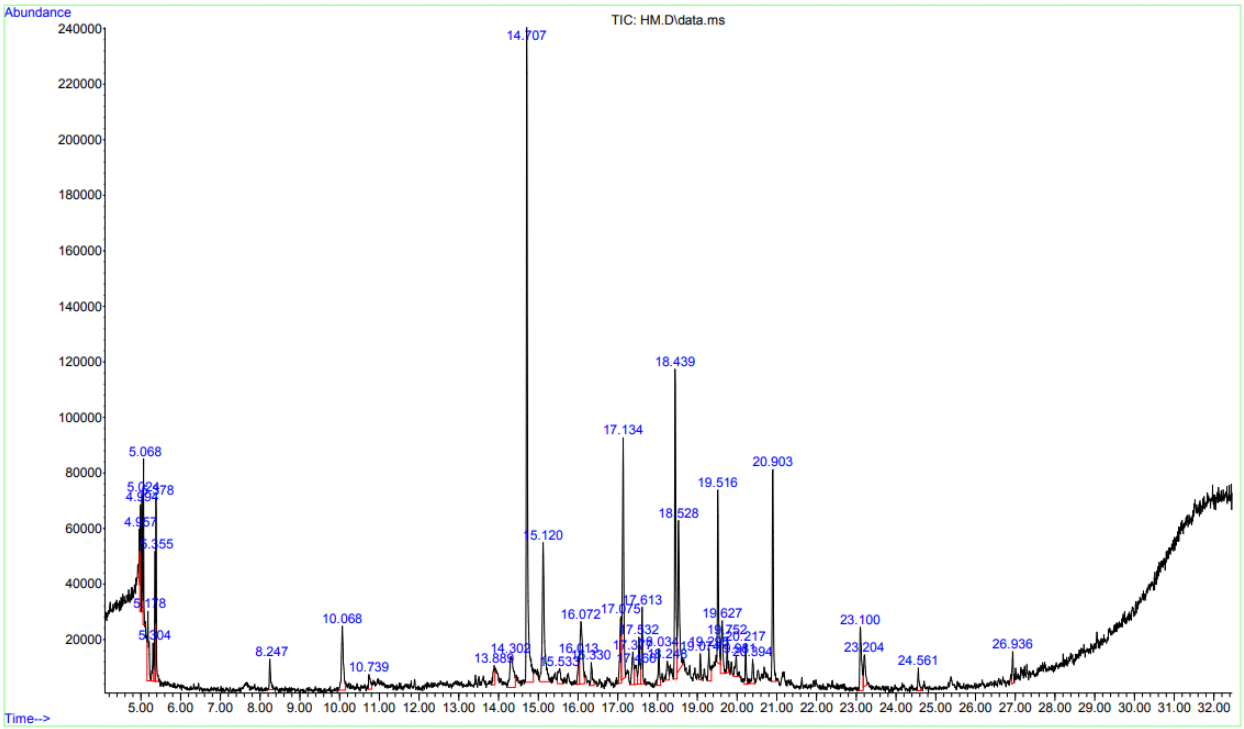

Figure 4: Active compounds present in the aqueous extract

Table 2: Active compounds present in the ethanolic extract.

Peak	R. Time	Area	Area Pct.	Compound
1	8.765	156360	0.897	3-Methylsalicylhydrazide
2	8.979	167392	0.96	Silane, triethoxymethyl-
3	9.51	70389	0.404	Undecanal, 2-methyl-
4	9.864	73664	0.422	5-Nitrobenzofuran-2-one
6	10.853	90379	0.518	Butanoic acid, 2-amino-, (R)-
7	11.015	102814	0.59	Tetraethyl silicate
8	11.207	649902	3.727	Episulfide isomer 1
11	14.415	215910	1.238	1-Decene
12	16.001	77166	0.443	Tridecane
14	17.254	535847	3.073	2-Tetradecene, (E)-
15	17.844	115193	0.661	1H-2-Benzothiopyran, octahydro-, cis-
18	18.848	2289428	13.129	2,4-Di-tert-butylphenol
19	19.755	839270	4.813	2-Tetradecene, (E)-
20	19.895	198131	1.136	1-Tetradecene
21	20.389	194190	1.114	Benzophenone
22	20.603	111779	0.641	2,5-Dihydroxybenzoic acid, 3TMS derivative
23	20.713	86109	0.494	Isovaleric acid, pentadecyl ester
24	21.112	107713	0.618	Pyroquilon
25	21.259	103501	0.594	Methyl tetradecanoate
26	21.392	124484	0.714	1,4-Benzenediol, 2,5-bis(1,1-dimethylethyl)-
27	21.635	140604	0.806	Tetradecanoic acid
28	21.989	975402	5.594	1-Octadecene
29	22.144	195760	1.123	Phenanthrene

30	**22.248**	**114388**	**0.656**	**Anthracene**
31	**22.484**	**151970**	**0.872**	**Neophytadiene**
32	**22.867**	**191963**	**1.101**	**Phthalic acid, isobutyl octyl ester**
33	**23.081**	**81182**	**0.466**	**Ethanone, 1,1'-(9H-fluorene-2,7-diyl)bis-**
34	**23.361**	**225579**	**1.294**	**Hexadecanoic acid, methyl ester**
35	**23.435**	**77816**	**0.446**	**7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione**
36	**23.693**	**148071**	**0.849**	**n-Hexadecanoic acid**
37	**23.804**	**117008**	**0.671**	**Dibutyl phthalate**
38	**24.01**	**920506**	**5.279**	**5-Eicosene, (E)-**
39	**24.224**	**150160**	**0.861**	**Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, ethyl ester**
40	**24.881**	**660675**	**3.789**	**1-Octadecene**
41	**24.984**	**325542**	**1.867**	**Fluoranthene**
42	**25.072**	**1712034**	**9.818**	**9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-**
43	**25.176**	**368027**	**2.111**	**Phytol**
44	**25.412**	**97443**	**0.559**	**9,12,15-Octadecatrienoic acid, (Z,Z,Z)-**
45	**25.507**	**136093**	**0.78**	**Pyrene**
46	**25.677**	**494437**	**2.836**	**9,12,15-Octadecatrienoic acid, ethyl ester, (Z,Z,Z)-**
47	**25.854**	**414013**	**2.374**	**5-Eicosene, (E)-**
48	**26.783**	**114016**	**0.654**	**Trifluoroacetic acid,n-tridecyl ester**
49	**27.373**	**230339**	**1.321**	**9-Octadecenamide, (Z)-**
51	**28.399**	**91168**	**0.523**	**2-Ethylacridine**
52	**28.848**	**192510**	**1.104**	**Bis(2-ethylhexyl) phthalate**
55	**30.301**	**961379**	**5.513**	**1,4-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester**

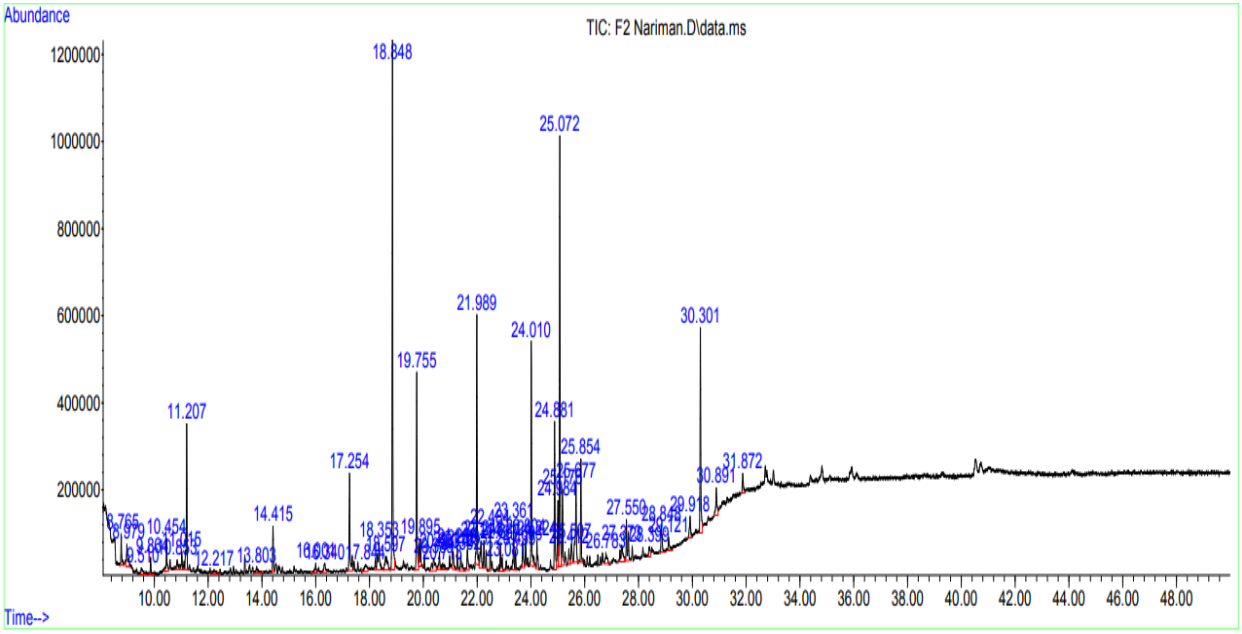

Figure 5: Active compounds present in the ethanolic extract

Metal detection

Metal detection using AA7000, atomic absorption spectrophotometer. Results indicate a high content of calcium and iron, as they reached 7702.13 and 337.435 µg/g, respectively. In addition to a good amount of zinc, magnesium and, potassium 116.9, 8743 and 27.59 µg/g, with a small amounts of sodium and phosphorus. And by comparing these results with what was reached by Abdalla et al., (2016), where it was found that the calcium content was 243 mg/100g, magnesium, zinc and, potassium were 206.5, 82.4 and, 856 mg/100 g, respectively and there is no doubt that these elements have virtues that do not count as enriching the nutritional value of this plant, and they also have distinct roles in terms of controlling oxidative reactions.

Table 3: Mineral elements in Toula plant

Metallic Elements	Amount µg/g
Calcium (Ca)	7702.13
Iron (Fe)	337.435
Zinc (Zn)	116.9
Magnesium (Mg)	8743
Sodium (Na)	3.01
Potassium (K)	27.59
Phosphorus (P)	1.129

DPPH radical suppression assay

The ability of the aqueous and alcoholic extract of the mallow plant to suppress the unstable free radical and convert it into a stable free radical, 2,2-di phenyl-1-picryl hydrazine, was evaluated through the ability of the extract to sacrifice hydrogen and change the color of the DPPH solution from violet to yellow, and decrease in the absorbance value to 517. Both extracts (aqueous and alcoholic) showed a strong ability to suppress free radical DPPH, and this ability increased with increasing concentration, as the highest rate of suppression was 81% and 84% for the aqueous and alcoholic extracts respectively, at a concentration of 125 mg/ml, while the concentration of 25 mg/ml gave the lowest rate of suppression of 58 and 59% for the aqueous and alcoholic extracts, respectively. This is consistent with the findings of Beghdad et al., (2014) about the mallow plant having a good ability to inhibit DPPH free radicals using EC50 equivalent.

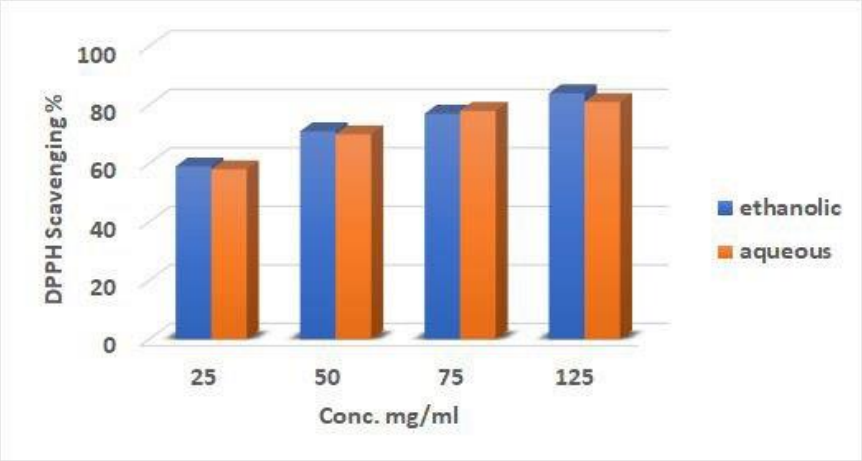

Figure 6: DPPH Scavenging by Toula extracts (aqueous and ethanolic).

Manufacture of meat patties

A part of the minced meat was replaced by the powder of mallow leaves by 50% for sample B and 25% for sample C when making meat patties compared to the sample without the powder. The sensory evaluation results revealed clear differences in color, taste, and tenderness, as samples B and C were characterized by a dark color and unique taste compared to sample A. The results of the sensory test also showed distinct characteristics of odor and freshness in samples B and C compared to A, and inclusion by 50% gave a darker color.

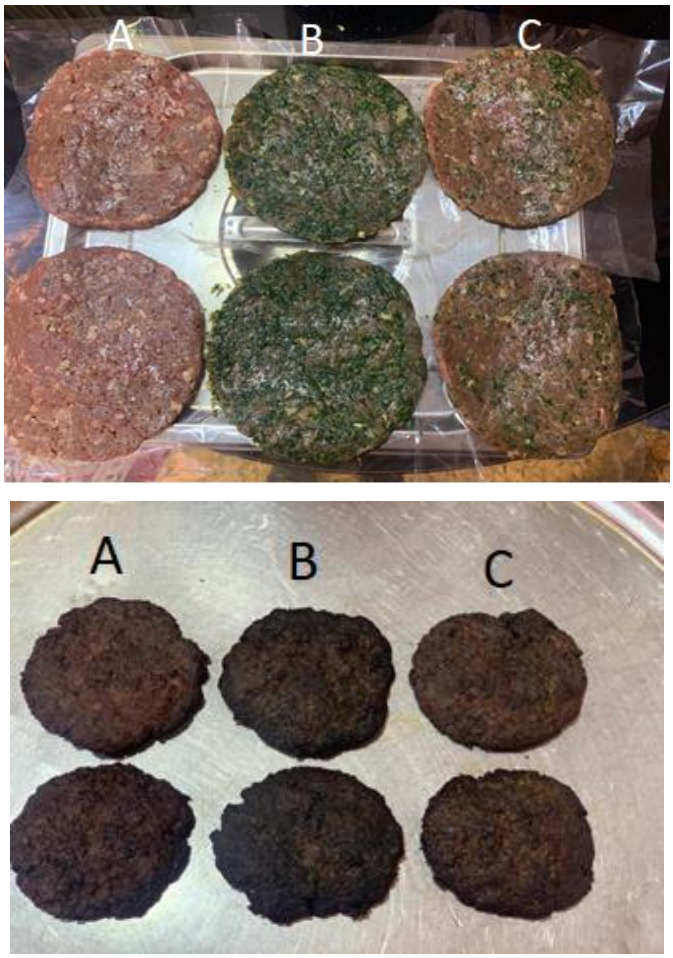

Figure 7: Manufacture of meat patties

Table 4: Sensory evaluation form

Treatment	Appearance	Color	Odor	Taste	Texture	Total
A	**15.1±0.45b**	**17.1±0.46a**	**15.3±0.25c**	**17.4±0.47c**	**16.4±0.45b**	**81.3±1.20c**
B	**18.2±0.34a**	**16.2±0.36a**	**17.3±0.27b**	**18.3±0.23b**	**18.6±0.47a**	**88.6±1.10b**
C	**19.1±0.44a**	**17.2±0.43a**	**19.1±0.29a**	**19.2±0.30a**	**17.2±0.54b**	**91.8±1.12a**

A: Control : The sample without adding the extract, B: The sample by adding 50% of the aqueous extract of Toula, C: : The sample by adding 25% of the aqueous extract of Toula.

Chemical indications:

Peroxide Value PV: The peroxide value reveals the concentrations of peroxide and hydroperoxide formed during the initial stages of oxidation, and this value expresses the extent of oxidation in lipids (Olafsdóttir et al ., 1997). The results show in Table (1) the effect of adding toula aqueous extract on the peroxide values in the cold-stored meat patties. The results showed a significant decrease ($P < 0.05$) in the peroxide values of the minced meat tablets treated with Toula extract at a concentration of 50% and 25%, compared to the control sample. The reason is due to the active compounds present in the extract and their antioxidant effectiveness, such as Anethole ; It is one of the main biologically active compounds, and it is one of the important essential oils. It possesses many virtues, the most

important of which are anti-oxidation, anti-inflammatory, and protection of the gastrointestinal tract.(Freire et al ., 2005). It has not been proven to have any toxic or harmful effects on the liver (Ritter et al ., 2013). These effective compounds have limited the oxidation of fats, thus reducing the amount of peroxides produced.

Table 5: Peroxide Value

storage time (day)	A	B	C
0	0.62	0.62	0.62
3	3.55	2.21	2.96
7	6.23	3.41	4.21
10	8.44	4.52	5.34
14	11.12	5.67	6.78

A: Control : The sample without adding the extract, B: The sample by adding 50% of the aqueous extract of Toula, C: : The sample by adding 25% of the aqueous extract of Toula.

Thiobarbituric acid TBA :

Table 6: TBA Value

storage time (day)	A	B	C
0	0.33	0.33	0.33
3	1.98	0.84	0.98
7	3.74	1.22	1.54
10	5.32	2.87	3.21
14	9.01	4.21	5.21

A: Control : The sample without adding the extract , B: The sample by adding 50% of the aqueous extract of Toula, C: The sample by adding 25% of the aqueous extract of Toula ,TBA:mg malondialdehyde /kg.

Table (2) shows the effect of adding an aqueous extract of toula leaves on TBA values in cold-stored meat patties. The results of the statistical analysis revealed that there were significant differences ($P<0.05$) between the meat tablets treated with 50% and 25% extract and the control sample. The increase was very clear in TBA in the control treatment, while the effect was clear in tula leaf extract, which limited this increase by good rates. The reason for the rise in TBA values is due to the oxidation of lipids during storage, which produces peroxides, aldehydes, and ketones. Our results were consistent with what was stated by Fakhfakh et al., (2016) that replacing the leaves of *Malva aegyptiaca* at a rate of 3% in the composition of wheat bread had a functional effect and important nutritional potential, due to its richness in biologically active compounds, the most important of which are flavonoids, and its excellent ability to inhibit the oxidation process without causing a change in the degree of sensory acceptance of these baked goods. And to obtain products rich in antioxidants, in addition to its high content of dietary fiber and flavonoids, it is an important

candidate for improving food quality (Fakhfakh et al., 2016), and Alexieva et al.,(2022) concluded that the use of edible wrappers made of polysaccharides with mallow extract is a vital factor for extending the shelf life of small bread as it maintains the freshness of the loaves during the storage period by reducing moisture loss and slowing down the freezing process, in addition to maintaining an excellent nutritional and health value (Alexieva et al ., 2022). These results agree with what we have reached in this research about mallow extract having distinctive virtues in prolonging the shelf life of minced meat patties.

CONCLUSION

The mallow plant (*Malva sylvestris*), called "Toula" in Iraq, is an important food source that contains the most important antioxidant compounds such, as anethole, Silanediol, dimethyl, oxime, methoxy-phenyl and 2,4-Di-tert-butylphenol. In addition to the presence of important mineral elements for human health, such as calcium, iron, zinc, and magnesium in high proportions, the extracts of this plant were distinguished by their ability to suppress DPPH free radicals, and this ability increases with increasing concentration. This research paper enables us to conclude that it is possible to develop mixtures of distinctive meat patties with nutritional value, tenderness, and better taste to meet the desires of consumers, and from a functional point of view, the presence of mallow papers within the components of the meat patties gives them a longer shelf life due to the presence of antioxidant compounds that inhibit the oxidative chain of lipids, which eventually deteriorate in quality, and sensory characteristics finally. More research should be done to evaluate the antioxidant efficacy and bioavailability of the mallow plant in vivo.

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