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Research Article
Phytochemical Screening and Antidermatophytic Activity of Lavender Essential Oil from Saudi Arabia

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Abstract

Background and Objective: Lavender is a common and popular aromatic Mediterranean herb belongs to Lamiaceae family. In Saudi Arabia, Lavender is growing in some regions such as Albaha but there is no reported data on it. Recently, Most research on plants reported that lavender have antibacterial, antifungal antimutagenic and neuroprotective activities. The aim of this research was to study phytochemical and antidermatophytic screening of lavender and its essential oil (EO) in Saudi Arabia. Also, to assess the antidermatophytic activity of lavender essential oil before and after radiation. **Materials and Methods:** Essential oil has been isolated from lavender [*Lanvandula angustifolia* (*L. angustifolia*) Miller] harvested from Albaha region. It has been isolated by steam distillation, it was analyzed by Gas Chromatography coupled with Mass Spectrometry (GC-MS). The antidermatophytic activity of isolated compounds of plant was determined against five dermatophytes and yeast by well-cut diffusion method. **Results:** The results showed antidermatophytic activity of irradiated essential oil display the stronger effect against *Microsporum gallinae* (*M. gallinae*), *Microsporum gypseum* (*M. gypseum*), *Microsporum canis* (*M. canis*), *Trichophyton mentagrophytes* (*T. mentagrophytes*), *Trichophyton verrucosum* (T. *verrucosum*) and *Candida tropicalis* (*C. tropicalis*). The inhibition of essential oil before radiation on *T. mentagrophytes* was higher than after radiation. Leaves and flowers extracts have a strong inhibitory effect on *M. canis* and *M. gallinae*. **Conclusion:** The p-value was significantly higher for essential oil after radiation, than essential oil before radiation on pathogenic fungi, then leaves and flowers extract of lavender exhibited antidermatophytic activity on *M. gallinae*, *T. mentagrophytes* and *M. canis*.

Key words: Lavender, essential oil, phytochemical screening, antidermatophytic activity

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Most of herbal products are categorized under GRAS (Generally Recognized as Safe) for human consumption and efficient and rarely have side effects. So extensive research on plants and their essential oils have attracted the attention of many scientists and encouraged them to screen plants to study their chemical constituents and pharmacological effects that may lead to provide new alternative treatments and drugs for industrialized purposes[1,2]. On the other hand, photochemistry plays a significant role in the composition and function of essential oils[3]. Lavender is a common and popular aromatic Mediterranean herb belongs to Lamiaceae family growing almost all over the world; it is marked as the fresh or dried plant[4]. The most valuable constituent isolated from lavender (*L. angustifolia*) is essential oil. The qualitative and quantitative constituents of the essential oil of lavender (*L. angustifolia*) depend on genotype, growing place, climatic environments, propagation and morphological features[5]. It is reported that lavender have antibacterial, antifungal antimutagenic and neuroprotective activities[6-9] as well as it is used in flavor, cosmetics and perfumery productions because of its brilliant fragrances[4,10]. Dermatophyte fungi are superficial mycotic infection which called a keratinophilic pathogenic fungi[11]. They are results of invasion skin, hair and nails and a high increase in world-wide, their ratio of 50% in patients older than 25 years[12,13]. *Microsporum* and *Trichophyton* are responsible for human and animal infections but, *Epidermophyton* is a human pathogen[14]. Tinea capitis infection had the highest prevalence among the patients (22.3%) and *M. canis* were the most common species (25% of isolated dermatophytes)[15]. *Trichophyton* spp. are the most common infection (82.11%), *T. mentagrophytes* was (68.55%) followed by *T. rubrum* (31.45%) and *Epidermophyton* spp., (16.55%). The most affected age were 15-45 years (60%), followed by 5-15 years (32.58%), above 45-60 years (7.42%). Male and female ratio of the positive cases recorded as 11-27% in Hail region of Saudi Arabia[16].

In Saudi Arabia, lavender is growing in some areas such as Albaha, there is no reported data on Albaha's lavender or its essential oils. So the purpose of this study was to examine the chemical composition and antidermatophytic properties of EOs isolated from lavender and the effect of radiation on the constituent of essential oil and its activity. Also to compare the antidermatophytic effect of different extracts of lavender.

MATERIALS AND METHODS

Chemistry

Equipment and techniques: A sodium lamp (Phillips G/5812 SON) was used for irradiation. Gas Chromatography-Mass Spectroscopy (GC-MS) was performed using a Hewlett-Packard 5890 series II chromatograph equipped with a 5972 series mass selective detector (MSD) in the electron impact mode (70 eV). A rotatory evaporator (at 20°C/15 torr) was used to remove the solvents.

Plant material: Aerial parts of lavender at full flowering stage were collected from (Albaha, Saudi Arabia). Aerial parts, leaves and flowers were ground well after dried and stored in air tight containers. The powder has been used in the chemical experiments[5].

Extraction of essential oil: The weighting of lavender flowers (300 g) was used for the extraction of essential oil. It was extracted by steam distillation. The steam distillation was carried out for exactly 3 h. About 35 mL of the distillates were collected and extracted with chloroform (3×100 mL) and dried over anhydrous sodium sulphate (Merck, Germany) and the solvent was removed by evaporation. The pale yellow essential oils were stored in a refrigerator for the GC-MS and antimicrobial activity analysis at 4°C[10].

Preparation of plant extracts: Two hundred gram of the dried and powdered form roots, leaves and flowers of plant were extracted successively using cold percolation system[17], ethanol, methanol, distilled water or chloroform (400 mL for each) for 4 days, using a stirring apparatus[18]. Then collected solutions were filtered with Whatman's No. 1. filter paper and the solvent were evaporated by rotary vacuum evaporator under reduced pressure at 50°C until dryness. The residue finally stored at 4°C until used for further analysis.

Preparation of alcoholic extracts for screening: Approximately 200 g of the plant's dried powder was extracted with 80 mL of 70% menthol for 4 days at room temperature by using stirring apparatus. Then, the extract and the solvent were filtered in at 40°C in a rotary evaporator. The extract was concentrated to dry residue in a desiccator over anhydrous sodium sulphate. The resulting extracts were filled into sample container[19].

Phytochemical screening: Phytochemical screening was implemented by using the standard procedures.

Test for tannins: Two gram of methanolic extract was placed in a test tube. Then, 5% of ferric chloride drops were added. A bluish black or greenish coloration was observed. It was an indication of the presence of pyrogallol tannis or catechol, respectively[20,21].

Test for flavonoids (Shinoda test): Two gram of methanolic extract was placed in a tube. A few fragments of magnesium were added, followed by adding 0.5 mL of hydrochloric acid. The reddish color was an indication of flavonoids presence[22].

Test for saponins: Approximately 1 g of the methanolic extract was boiled with mL de-ionized filtered and wait for 2 min. The content was shaken vigorously. The persistent froth appearance that lasted for 15 min was an indication of saponins presence[23].

Test for terpenoids (Salkowski test): Approximately 2 mL of chloroform was mixed with 0.5 g of the extract. Then, 3 mL of conc. H_2SO_4 was added carefully to form a layer. The red color appearance is an indication of terpenoids presence[24].

Test for carbohydrates (Molisch's test): Two milliliter of the methanolic extract solution was mixed with 0.2 mL of alcoholic solution of α- naphthol (10%) in a test tube and followed with an addition of 2 mL of conc. sulphoric acid by the test tube side. At the interphase of the two layers, a bluish violet zone is formed that indicates the presence of carbohydrates or/and glycosides[25].

Test for anthraquinone (Bontrager's test): Approximately 1 g of the methanolic extract was placed in a test tube. Then 5 mL of benzene was added. Then, it was shaken and filtered. It was followed by an addition of 5 mL of 10% NH_4OH. The appearance of red, violet or pink color in the ammoniac layer (lower phase) was an indication for the presence of free anthraquinones[25].

Test for cardiac glycosides (Keller-Kiliani test): In a test tube 2 mL of glacial acetic acid containing 1-2 drops of 2% solution of $FeCl_3$ was mixed with the methanolic extract and poured into another test tube containing 2 mL of concentrated H_2SO_4. Brown ring was formed. It was taken as presence of cardiac glycosides[22].

Test for alkaloids: One gram of methanolic extract was mixed with 2 mL of dil. HCl (1%) in a test tube. Then gently heated, followed by adding 2-3 drops of Mayer's reagent. The formation of cream or white precipitate was an indication for the presence of alkaloids[22-23].

Test for coumarins: In a test tube, 1 g of methanolic extract was placed and covered with filter paper moistened with dilute NaOH, then heated on water bath for a few minutes. The filter paper was examined under UV light. Fluorescence was detected by the UV test (365 nm), yellow fluorescence regarded as positive for the presence of coumarins[26].

Test for steroids (Liebermann-Burchard test): In a test tube, 1 mL of acetic acid anhydride was added to 1 mL of methanolic extract, the solution was cooled well in ice followed by the addition of conc. sulphoric acid carefully. Appearance of color development from violet to blue or bluish-green was an indication for the presence of steroids[25].

Test for protein (Millon's test): About 1 g of methanolic extract was mixed with 2 mL of Millon's reagent (mercuric nitrate in nitric acid containing traces of nitrous acid), white precipitate formed, which transformed to red upon gentle heating. It indicates presence of amino acids and protein[27]. Table 1 shows the presence of phytochemical screening of ethanolic extract of rhizomes, leaves and flowers of lavender.

Photo irradiation for volatile oil: A solution of 2 mL of volatile oil in chloroform was irradiated using sodium lamp (Phillips G/5812 SON) at room temperature. The solvent was removed under reduced pressure at 20°C[28].

Phytochemical investigation of bioactive essential oil of lavender (before and after radiation) by Gas Chromatography-Mass Spectrometry (GC-MS): The bioactive volatile oil samples (before and after radiation) were analyzed using GC-MS technique and performed at National Research Center, Cairo, Egypt. The peaks separated in GC-MS were identified by NIST (National Institute of Standards and Technology) mass spectral databases.

Antidermatophytic activity

Test organisms: The tested dermatophytes used in this study: *Microsporum gallinae*, *M. canis*, *Trichophyton mentagrophytes*, T. *verrucosum* and *Candida tropicalis* were obtained from King Fahed Hospital in Jeddah, Saudi Arabia.

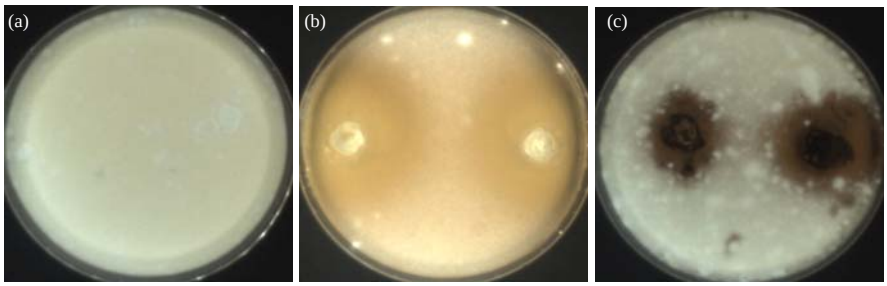

Fig. 1(a-c): Effect of volatile oil and leaves extract on *T. mentagrophytes* growth (a) Control, (b) 1 mL essential oil after radiation and (c) 1 mL leaves extract of lavender plant

Table 1: Antidermatophytic activity by agar diffusion method (mm) of lavender extracts (mean of replicates±SE)

Types of extract	Concentrations of extracts	Fungi				
		T. mentagrophytes	*T. verrcosum*	*M. canis*	*M. gallinae*	*C. tropicalis*
Control	0.0	10.0±0.0	10.0±0.0	10.0±0.0	10.0±0.0	10.0±0.0
Essential oil	0.5	23.5±0.5	35.7±6.8	37.4±3.3	32.7±4.2	-
	1.0	38.3±4.6	31.8±1.1	37.0±0.7	42.0±3.8	13.0±0.0
	p-value	0.029*	0.037*	0.003*	0.014*	0.095
	F-value	14.394	11.977	64.728	24.802	9.000
Essential oil after radiation	0.5	20.5±4.2	35.2±1.1	44.0±0.7	21.7±0.0	15.9±0.3
	1.0	23.1±0.9	37.6±2.4	52.6±2.6	41.5±0.0	23.0±0.0
	p-value	0.066	0.002*	0.001*	0.003*	0.000*
	F-value	7.672	100.614	201.212	76.059	1037.163
Leaves extract	0.5	16.1±0.9	13.9±0.2	17.2±2.0	22.8±0.2	-
	1.0	20.9±1.3	28.5±4.1	37.7±3.3	28.3±3.1	-
	p-value	0.008*	0.023*	0.007*	0.012*	-
	F-value	35.812	16.932	40.288	26.668	-
Flowers extract	0.5	20.2±1.7	16.5±2.4	14.5±1.8	26.1±2.3	17.0±2.5
	1.0	34.2±4.0	26.8±1.3	22.2±1.9	39.2±0.7	21.2±1.7
	p-value	0.015*	0.011*	0.024*	0.002*	0.046*
	F-value	23.443	28.572	16.670	105.834	10.136

Each value is the mean of 2 replicates±SE, *There is a significant effect of concentrations on tested pathogenic fungi by using one-way ANOVA at p<0.05

Well-cut diffusion method: The essential oil, leaves and flower extracts of lavender (*L. angustifolia*) were subjected to tested dermatophytes. Well-cut diffusion technique was carried out to assay antidermatophytic activity[29]. The sabouraud dextrose agar media was inoculated with 1 mL from tested spore suspension, then wells were cut from the plate using a sterile 10 mm corkborer. About 0.5 and 1.0 mL of lavender (*L. angustifolia*) extracts were added into each well. All plates were incubated at 4°C for 2 h to slow fungal growth and gives suitable time for the antidermatophytic agent to diffuse. The fungus plates were later incubated at 28°C for a week and 48 h for the yeast[30]. After incubation, the diameter of the growth inhibition zone was measured in mm[31].

Statistical analysis: Results are presented as the mean of three or four replicates±standard error (SE). The statistical analyses were carried out using SPSS program (version 22). Data obtained were analyzed statistically to determine the degree of significance using one way ANOVA at probability level ($p \leq 0.05$) of significance.

RESULTS

Biological activity

Antidermatophytic activity: The extracts of lavender were found to be rich in many compounds that were a high inhibitory effect on tested dermatophytes. The results in Table 1 and Fig. 1 and 2 showed a significant effect of concentrations on tested pathogenic fungi by using one way ANOVA at p<0.05. Whereas, p-value was significantly higher for essential oil after radiation than before radiation on pathogenic fungi but the inhibition of essential oil before radiation on *T. mentagrophytes* was higher than after radiation. Leaves extract of lavender has a strong inhibitory

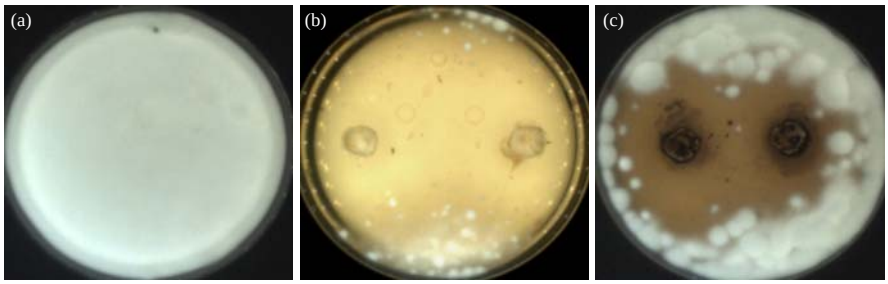

Fig. 2(a-c): Effect of volatile oil and leaves extract on *M. canis* growth (a) Control, (b) 1 mL essential oil after radiation and (c) 1 mL leaves extract of lavender plant

Table 2: Phytochemical constituents of aerial parts, leaves and flowers of lavender

Phytoconstituents	Tests	Observation	Aerial parts	Leaves	Flowers
Carbohydrates	Molisch	Bluish violet zone	+	+	+
Cardiac glycosides	Keller-Kiliani	Brown ring	+	+	++
Alkaloids	Mayer's reagent	White precipitate	-	-	-
Tannins	Ferric chloride	Greenish or bluish back coloration	++	+	++
Saponins	Foaming	Frothing persisted for 10-15 min	+	-	+
Steroids	Liebermann-Burchard	Violet to blue or bluish-green coloration	+++	+	++
Flavonoids	Shinoda	Pink-Red coloration	+	+	++
Coumarines	NaOH	Yellow fluorescence	++	+	++
Anthraquinones	Bontrager	Pink-red or violet coloration	-	-	-
Terpenoids	Salkowski	Red coloration	+	+	+++
Proteins	Millon's	Red coloration	+	++	+

effect on *M. canis* that compared to the control plates. Flowers extract exhibited the significant by the highest level of antidermatophytic activity whereas, the growth inhibition were (39.2, 34.2, 26.8 mm) for *M. gallinae*, *T. mentagrophytes* and T. *verrucosum*.

Chemistry

Phytochemical screening: Preliminary phytochemical screening of the crude extract of aerial parts, leaves and flowers of lavender revealed the presence of different phytochemical classes. As can be seen from the Table 2, flowers contained a markedly high amount of terpenoids, flavonoids and cardiac glycosides in aerial parts than leaves. While aerial parts was the richest of steroids than flowers and leaves as shown in the Table 2.

GC-MS analysis of bioactive essential oils of lavender: The results pertaining to GC-MS analysis lead to the identification of compounds from GC fractions of essential oil samples of lavender before and after radiation. The GC chromatograms showed 33, 32 peaks corresponding to the compounds of essential oil before and after radiation, respectively. The highest proportions of the oil are camphor (26.08%), D-fenchone (15.18%), linalyl acetate (12.95%) and dl-limonene (8.46) (Table 3). After radiation, camphor still has the highest proportion (31.72%), then L-fenchone (13.28%) and linalyl propionate (6.69%) as shown in Table 4.

DISCUSSION

Antidermatophytic activity: The results presented in this paper can be considered the first report on lavender and its essential oil collected from Albaha, Saudi Arabia. Lavender essential oil was extracted and analysed using GC-MS. A total of 33 compounds representing 98.8 of the oil were identified. This study observed antifungal activity in the lavender extracts and various concentrations of extracts were registered the highest antidermatophytic activity. *Lavandula virid* is from Portugal have antifungal properties and mechanism of action and the essential oils of plant isolated by hydrodistillation, it has fungicidal effect on dermatophytosis and candidosis[32]. As well as, there several biological activity of *Lavandula* oils as antispasmodic properties[33], acaricidal[34], antibacterial[35,36], antifungal[37,38] and antioxidant[39]. Leaves and flowers of plant have many treatment properties that used to remedy for certain diseases. In addition, the purplish flowers

Table 3: Chemical constituents of essential oil of lavender before radiation

Number of peaks	Retention time	Suggested compounds	Molecular weight	Molecular formula	Area (%)
1	3.91	n-nonane	128	C_9H_{20}	0.16
2	4.48	Tricyclene	136	$C_{10}H_{16}$	0.20
3	4.72	α-pinene	136	$C_{10}H_{16}$	2.63
4	4.92	β-pinene	136	$C_{10}H_{16}$	0.52
5	5.16	Camphene	136	$C_{10}H_{16}$	1.92
6	5.27	Verbenene	134	$C_{10}H_{14}$	0.10
7	5.45	Furanone	112	$C_6H_8O_2$	0.26
8	5.90	2-α-pinene	136	$C_{10}H_{16}$	1.85
9	7.40	p-cymene	134	$C_{10}H_{14}$	0.34
10	7.48	dl-limonene	136	$C_{10}H_{16}$	8.46
11	7.60	1,8-Cineole	154	$C_{10}H_{18}O$	1.96
12	8.93	Linalool oxide (2)	170	$C_{10}H_{18}O_2$	2.90
13	0.54	Trans-linalool oxide	170	$C_{10}H_{18}O_2$	3.66
14	9.73	D-fenchone	152	$C_{10}H_{16}O$	15.18
15	10.90	Linalool	154	$C_{10}H_{18}O$	4.18
16	11.74	Pinocarveol	152	$C_{10}H_{16}O$	0.53
17	11.84	(1R)-(+) nopinone	138	$C_9H_{14}O$	0.55
18	12.14	Camphor	152	$C_{10}H_{16}O$	26.08
19	12.69	Pinocarvone	150	$C_{10}H_{14}O$	2.26
20	13.06	Endo-borneol	154	$C_{10}H_{18}O$	1.55
21	14.09	2-Norpinene-carboxaldehyde,6,6-dimethyl	150	$C_{10}H_{14}O$	0.39
22	14.62	1-Verbenone	150	$C_{10}H_{14}O$	1.30
23	14.62	1-Bornyl acetate	196	$C_{12}H_{20}O_2$	1.34
24	15.86	Lavandulol	154	$C_{10}H_{18}O$	1.65
25	20.86	Linalyl acetate	196	$C_{12}H_{20}O_2$	12.95
26	22.72	Lavandulol acetate	196	$C_{12}H_{20}O_2$	1.98
27	25.90	α-selinene	204	$C_{15}H_{24}$	0.72
28	27.22	1S,Cis- calamenene	202	$C_{15}H_{22}$	0.34
29	32.49	α-eudesmol	222	$C_{15}H_{26}O$	1.38
30	33.50	11-Hexadecyn-1-ol	238	$C_{16}H_{30}O$	0.16
31	43.02	Butyl phthalate	278	$C_{16}H_{22}O_4$	0.22
32	48.16	Methyl stearate	298	$C_{19}H_{38}O_2$	0.24
33	58.30	Heptacosane	380	$C_{27}H_{56}$	0.42
					98.38

Table 4: Chemical constituents of essential oil of lavender after radiation

Number of peaks	Retention time	Suggested compounds	Molecular weight	Molecular formula	Area (%)
1	4.76	1-[(1-Propoxypropane-2-yl)oxy]-propan-2-yl-acetate	218	$C_{11}H_{22}O_4$	0.88
2	4.81	Trans-2-methoxy-5-hydroxytetrahydropyran	132	$C_6H1_2O_3$	0.99
3	5.00	1,3-Dioxane	102	$C_5H_{10}O_2$	1.94
4	5.16	Camphene	136	$C_{10}H_{16}$	2.67
5	7.38	o-cymene	134	$C_{10}H_{14}$	1.40
6	7.47	Cyclohexanol,1-methyl-4-(1-methylethenyl)acetate	196	$C_{12}H_{20}O_2$	0.92
7	7.60	1,8-Cineole	154	$C_{10}H_{18}O$	0.95
8	8.92	Cis-linalool oxide	170	$C_{10}H_{18}O_2$	1.15
9	9.38	4-Methyl-2-pentyldioxolane	158	$C_9H_{18}O_2$	0.55
10	9.53	Trans-linalool oxide	170	$C_{10}H_{18}O_2$	2.85
11	9.72	L-fenchone	152	$C_{10}H_{16}O$	13.28
12	10.70	L-linalool	154	$C_{10}H_{18}O$	0.47
13	10.90	D-fenchyl alcohol	154	$C_{10}H_{18}O$	1.42
14	11.11	Cis-linalool oxide	170	$C_{10}H_{18}O_2$	1.52
15	11.52	3-Cyclohexen-1-ol,methyl-4-(1-methylethyl)	154	$C_{10}H_{18}O$	1.73
16	11.84	α-pinone	138	$C_9H_{14}O$	0.36
17	12.10	Camphor	152	$C_{10}H_{16}O$	31.72
18	12.8 3	Acetic acid, phenylmethyl ester	150	$C_9H_{10}O_2$	2.98
19	14.05	Linalyl propionate	210	$C_{13}H_{22}O_2$	6.69
20	17.38	4-Methyl-2-propyl-1,3-dioxolane	130	C_7H14O_2	1.50
21	17.80	Pentanal propylene glycol acetal	144	$C_8H_{16}O_2$	2.11

Table 4: Continue

Number of peaks	Retention time	Suggested compounds	Molecular weight	Molecular formula	Area (%)
22	19.30	6,6-Dimethyl-9-propenyl-1,4-dioxa-spiro[4.5]decane	210	$C_{13}H_{22}O_2$	0.36
23	20.24	α-terpinyl acetate	196	$C_{12}H_{20}O_2$	0.40
24	20.53	α-ionone	192	$C_{13}H_{20}O$	1.36
25	23.84	4-(2,2-Dimethyl-6-methylene-cyclohexyl)-but-3-en-2-one	192	$C_{13}H_{20}O$	0.55
26	32.49	α-eudesmol	222	$C_{15}H_{26}O$	0.27
27	35.04	2-Naphthalenebutanoic acid, ç-oxo	228	$C14H_{12}O_3$	0.65
28	39.24	Musk xylene	297	$C_{12}H_{15}N_3O_6$	1.24
29	44.77	2-Heptanone,6-(3-acetyl-1-cyclopropene-1-yl) 3-hydroxy-6-methyl,(R*,R*)	224	$C_{13}H_{20}O_3$	0.50
30	45.13	2-Iodo-5-methyl-4-oxatricyclo[(4.2.1.0,3,7)]nonane-6-carboxylic acid	308	$C_{10}H_{13}IO_3$	0.77
31	56.27	1,2-Benzenedicarboxylic acid, diisononyl ester	418	$C_{26}H_{42}O_4$	0.92
32	59.11	Phthalic acid, nonyl 4-octyl ester	404	$C_{25}H_{40}O_4$	0.57
					84.45

of lavender used in perfume[40], balms, salves, cosmetics and topical applications and alternative medicine for the symptoms of stress, anxiety, exhaustion, irritability, headaches, migraines, insomnia, depression, colds, indigestion, flatulence, upset stomach, liver and gallbladder problems, nervousness and loss of appetite as well as being used as a breath freshener and mouthwash[41,42].

Chemistry: Previous phytochemical studies have indicated that *Lavandula* species contain essential oil, triterpenes, coumarins, hydroxycinnamic acids and flavonoids[43]. In this study, the phytochemical screening of lavender extracts showed that lavender flowers has a higher percentage of (cardiac glycosides, terpenes, steroids, coumarins, flavonoids, saponins, tannins and anthocyanates) than in the leaves (Table 2). They are believed to have antibacterial and antifungal activities[33].

In present study, the essential oil of lavender in Albaha by GC-MS was analyzed as no information was found in literature and compared with the oil constituents and biological activity after radiation.

Although most reports indicate that linalool and linalyl acetate are the main specific constituents of lavender essential oils[44], this study showed that oxygenated monoterpenes constituted were the highest proportion of the oil (62.67%), among which camphor (26.08%), D-fenchone (15.18%), linalyl acetate (12.95%) and dl-limonene (8.46%) (Table 3). However, chemical differences in the oil composition of the species, in relationship to geographical origins of plants and harvesting season.

Highly significant qualitative and quantitative differences were revealed for the majority of the essential oil components after radiation (Table 4). A total of 32 compounds (84.45% of the total oil) were identified. The monoterpene oxygenated monoterpenes were increased such as camphor (31.72%), others were isomerated as D-fenchone to L-fenchone (13.28%), also some compounds were oxidized such as linalool which was oxidized to trans and cis linalool oxide (2.85, 1.52), respectively. That were due to photo irradiation.

The essential oil after radiation showed a higher activity against dermatophytes and yeast, which could be related to oxidation of some oil composition by the radiation. Lavender essential oil has major compounds as oxygen-containing monoterpenes and monoterpene hydrocarbons, which have an inhibitory effect against *M. canis*, *M. gallinae*, T. *verrucosum*, *T. mentagrophytes* and *Candida*.

On the other hand, the antimicrobial activity of plant extracts depends strongly on the type and amount of active principles. Their contents and composition vary from plant to plant species and even in different parts of the same species[45]. The antidermatophytic activity of the lavender extracts against *Microsporum gallinae*, *M. canis*, *Trichophyton mentagrophytes*, *T. verrcosum* and *Candida tropicalis* might be related to the presence of terpenoids, flavonoids, coumarines and tannins. These compounds have potentially significant effects for diseases such of the Central Nervous System (CNS)[1] beside another diseases.

CONCLUSION

Lavender essential oil after radiation displayed stronger antidermatophytic activity against *Microsporum gallinae*, *M. gypseum*, *M. canis*, *Trichophyton mentagrophytes*, T. *verrucosum* and *Candida tropicalis*. Whereas, lavender extracts were recorded strong inhibitory effects on tested pathogenic fungi and yeast. The p-value was significantly higher for essential oil after radiation than before radiation. Leaves extract of lavender has a strong inhibitory effect on *M. canis.* Also, flower extract exhibited antidermatophytic activity on *M. gallinae*, *T. mentagrophytes* and *M. canis*.

SIGNIFICANCE STATEMENT

This study evaluates the essential oil and extracts of lavender from Albaha and discovers the possible use of essential oil of lavender after radiation and methanolic extracts of lavender in treatment as antidermatophytic. This study will help to do more research about the effect this plant as antimicrobial and antifungal.

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