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The Antioxidant Capacities and Antimicrobial Activities of Some *Salvia* L. Seeds

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Abstract

The goal of the present study is to find the penolic contents, antioxidant activities and antimicrobial capacities in the seeds of five *Salvia* L. taxa two of which are endemics (*Salvia euphratica* var. *leiocalycina* and *Salvia euphratica* var. *euphratica*). The flavonoid and phenolic acid are determined by using HPLC while the antioxidant activities are determined based on different methods. Also, the antimicrobial activities of some *Salvia* species are determined by using the well agar method. The current study found that the studied *Salvia* species have low flavonoids. It has been found that *Salvia euphratica* var. *euphratica* has high vanillic acid, ferulic acid and rosmarinic acid among the studied taxa. Similarly, it has been found that *Salvia euphratica* var. *euphratica* has high DPPH and ABTS radical scavening capacity in all concentrations. It has been also found that *Salvia euphratica* var. *euphratica* has the highest total phenolic content (372,63±0,87 µgGAE/mg) while *Salvia tricholoda* has low total phenolic content (46,41±1,71 µgGAE/mg). In addition, this study demonstrated that *Salvia tricholoda* has the lowest metal chelating activity (37,35±0,51%). Furthermore, the present study found that the lipid peroxidation levels of the studied Salvia taxa are between 18,21±0,37 mg/kg and 21,03±0,22 mg/kg while it has been found that the antibacterial properties of the *Salvia* taxa under study are altering.

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1. Introduction

The Latin word Salvare which means health or heal was where the name *Salvia* originates [1]. The genus contains 1000 species distributed throughout the world including Asia, Africa and Europe [2, 3, 4]. In Turkey, the genus is represented by 100 taxa with a 57% endemism ratio [5]. Anatolia is a main centre of gene for the genus *Salvia* [6]. In Turkey, the *Salvia* species are known as adaçayı and are used to make herbal tea [7, 8]. *Salvia* species are exported to different regions of the world from Turkey [2].

In traditional medicine, *Salvia* species are used all throughout the world and they are employed in the management of several diseases such as rheumatism, aches, epilepsy, bronchitis, cold

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improver, and tuberculosis [9, 10]. Also, it has been reported that *Salvia* has a strong antioxidant capacity which is directly correlated with phenolic content [11]. The current study's objective is to assess the radical scavenging abilities of DPPH, ABTS, flavonoids, phenolic acids, lipid peroxidation capacity, Fe chelating, total phenolics and antimicrobial activities in mature seeds of the *S. suffruticosa* Montbret & Aucher ex Bentham; *S. trichoclada* Bentham; *S. euphratica* Montbret & Aucher ex Bentham var. *leiocalycina* (Rech. Fil.) Hedge; *S. euphratica* Montbret & Aucher ex Bentham var. *euphratica* (Rech. Fil.) Hedge; *S. multicaulis* Vahl grown in Elazig.

2. Material and Method

2.1. Plant Materials

In this investigation, plants were used that were gathered from their native environments. The Firat University Herbarium (FUH) is where the plant samples are kept. Table 1 lists the locations of the examined *Salvia* taxa.

Table 1. Localities of studied *Salvia* L. taxa

Taxa	Locality
S. suffruticosa Montbret & Aucher ex Bentham	Elazig Baskil district, marble factory around, railway near, 1330 m.
S. trichoclada Bentham	Elazig Baskil district, 1450m.
S. euphratica var. Montbret& Aucher ex Bentham *leiocalycina* (Rech. Fil.) Hedge	Elazig Baskil district, marble factory around, railway near, 1330 m.
S. euphratica var. Montbret& Aucher ex Bentham *euphratica* (Rech. Fil.) Hedge	Elazig- Malatya road, Komurhan district,755 m.
S. multicaulis Vahl	Elazig Baskil district, Bolucuk village, 1490 m.

2.2. Microbial Strain

4 bacteria (*Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* FMC 5, *Staphylococcus aureus* COWAN 1, *Bacillus megaterium* DSM 32), 2 yeasts (*Candida albicans* FMC 17, *Candida glabrata* ATCC 66032) and 2 dermatophyte species (*Trichophyton sp*., *Epidermophyton sp*.) are employed in this inquiry. Microorganisms are supplied by the Department of Biology, Firat University, Microbiology Labarotory, Elazig-Turkey.

2.3. Extraction of Dried Seed Materials

To analyze the phenolic compounds, including flavonoids and phenolic acids, 2 g of seed material is homogenized in 5 ml of 80% methanol. Centrifuging the homogenates at 5000 rpm and +4 °C. Rotary evaporation is used to treat the supernatant. Finally, to create a stock solution, extracts are suspended in dimethyl sulphoxide (DMSO) [12]. Three times the experiment is conducted.

2.4. Determination of Bioactive Properties

2.4.1. Chromatographic Conditions for Flavonoids and Phenolic Acids

A PREVAIL C18 reversed-phase column (15x4.6mm, 5m, USA) isused for the chromatographic analysis. The mobile phase is composed of methanol, water, and acetonitrile (46/46/8, v/v/v), and contains 1.0% acetic acid [12,13]. A Millipore 0.45 m membrane filter is used to filter the mobile phase. Morin, kaempferol, quercetin, naringin, catechin, resveratrol, rutin, myricetin, naringenin, erulic acid, caffeic acid, vanillic acid, cinnamic acid, and rosmarinic acid have been determined by DAD following RP-HPLC. Flow rate and injection volume are 1.0 ml/min and l0 µL, respectively. By comparing the samples' retention periods to those of the reference standards, the chromatographic peaks of the samples are confirmed. At 25°C, the entire chromatographic process is completed.

2.4.2. Antioxidant Assay by DPPH Radical Scavenging Activity

The Liyana-Pathiranan and Shahidi [14] approach is used to assess the radical scavenging abilities of the study's seed materials. Shortly, 4.0 ml of a daily 25 mg/L DPPH in methanol solution are mixed with 25, 50, 100, 150, and 250 µL of extract in DMSO. The samples are maintained at room temperature for 30 minutes in the dark. At 517 nm, the mixture's absorbance is spectrophotometrically analyzed. As a benchmark, quercetin at 1 M is employed.

The ability to scavenge DPPH radicals was calculated by the following formula: DPPH radical scavenging activity (%) = [(Abs control – Abs sample)]/ (Abs control)] x 100. where Abs control is the absorbance of DPPH radical + methanol; Abs sample is the absorbance of DPPH radical + sample extract /standard.

2.4.3. Antioxidant Assay by ABTS [2,2-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt]

The ABTS radical cation decolorization assay is used to investigate another free radical-scavenging action [15]. The ABTS radical cation (ABTS•+) was created by combining 2.45 mM potassium persulphate with 7 mM ABTS. At room temperature, the solution was incubated for 12–16 hours. Water is used to dissolve the (ABTS•+) solution, resulting in an absorbance of 0.700±0.020 at 734 nm. The decrease in absorption is then observed over the course of six minutes after three ml of diluted ABTS cation solution has been treated with 25, 50, 100, 150, and 250 µL of extract. Three experiments are conducted [16]. The absorbance of the control (3.0 mL (ABTS•+) solution with 30 L water) is recorded as Acontrol.

The ability to scavenge ABTS radicals (734 nm) was calculated by the following formula: ABTS radical scavenging activity (%) = [(Abs control – Abs sample)]/ (Abs control)] x 100

2.4.4. Determination of Total Phenolic

The Folin-Ciocalteu technique is used to assess total phenolics [17]. Following the treatment of the 100 ml extracts with 200 ml of Folin-Ciocalteu reagent and 3.16 ml of water, the samples are left at room temperature for 3 minutes. The mixture is then supplemented with anhydrous sodium carbonate (20% w/v), and the total phenolic content is determined two hours later at room temperature. At 765 nm, the samples' absorbance is measured [18]. Gallic acid equivalents per gram of dry weight (gGAE/mg) have been used to calculate the total phenolic content.

2.4.5. Metal Chelating Activity

This methodology was utilized by Dinis et al. [19] to ascertain the chelating abilities of the studied taxa. 50 µl of 2 mM FeCl2 is added to extracts at different concentrations (50, 100, 250, and 500 µg/mL). The reaction was started by adding 0.2 mL of 5 mM ferrozine to the mixture. After a vigorous shake, the combinations are left at room temperature for 10 minutes. At 562 nm, sample absorbances are determined.

The percentage blocking of of ferrozine–Fe2+ complex was measured based on following formula: Ferrous ion chelating activity (%) = [1 - (As /Ac)] × 100 where Ac was the absorbance of the control, and As was the absorbance of the extract/ standard (Kızılpınar et al., 2017). Na2EDTA was used as positive control.

2.4.6. Determination of Antioxidant Activity by MDA/TBARS Formation

The Shimoi et al. [20] method is used to measure the antioxidant activity of the samples. The sample extracts are extracted using dimethyl sulfoxide, or DMSO. In the experiments, hydrogen peroxide and solutions of Fe2+ (FeCl2.2H2O) are utilized. Additionally, DMSO is used to dissolve oleic acid (3.35 mM), linoleic acid (9.01 mM), and linolenic acid (2.30 mM). The groups of controls, sage extracts, and the Fenton reagent are established. The fenton group is treated with 0.5 mL of fatty acid, a buffer solution, FeCl2.2H2O (50 µM), and hydrogen peroxide (0.01 mM), whereas the control group is treated with 0.5 mL of fatty acid, a buffer solution, 0.2% Tween 20, 0.05 M Tris HCl, and 0.15 M KCl, pH=7.4. 0.5 mL of fatty acid, a buffer, 50 µM FeCl2, 0.01 mM hydrogen peroxide, and 0.25 mL of all sage extract are added to the sample extracts as a treatment. To stop further oxidation, 0.1 mL of 4% (w/v) BHT is added to each group and all groups are incubated at 37 °C for 24 hours of incubation. After that, the reaction mixture is added 1 mL of 0.6% TBA, and it is then incubated at 90 °C for 30 min using 1 mL of samples from each of the three groups. The tubes are then filled with 4 mL butan-1-ol, mixed, and centrifuged at 4250 rpm for 10 min. Using a Shimadzu UV mini-1240 spectrophotometer, the absorbance of the supernatant is measured at 532 nm. Tetraethoxyopropane is used to create MDA standard curves, and TBARS are represented as mg MDA/kg dry matter [21].

2.5. Antimicrobial Activity

The well agar method is used to conduct antimicrobial tests, and 100 µL of suspension containing, according to the McFarland standard, 106 cells/mL of bacteria, 104 cells/mL of yeast, and cells/mL of dermatophyte

fungi is inoculated into Mueller Hinton Agar (Difco), Malt Extract Agar (Difco), and Sabouroud Dextrose Agar (Oxoid), respectively. Wells are furnished with plates and a 0.85-cm cork-borer. The flavonoids from the seed materials are poured into the well in a volume of 10 µl. 9 cm diameter sterile Petri dishes are kept at 4 °C for two hours. The infected plates are then incubated for 24 hours at 37±1°C for bacterial strains and for 72 hours at 25±1°C for yeast and dermatophyte fungus. By analyzing the zone of inhibition against the test organisms, antimicrobial activity is evaluated [22]. Methanol and hexane injection wells were employed as negative controls. Three times experimental experiments are conducted.

2.6. Statistical Analysis

Using the SPSS 21.0 package program, all analyses are carried out. The relationship between total phenolic content and antioxidant capacity (ABTS, DPPH, and metal chelating) is determined using a simple linear regression model. The data from the current investigation is shown as mean values±S.D. Additionally, the significance of variations between antimicrobial activity is assessed using the LSD (least significant difference). The results are presented as mean ± S.D. and $p<0.0001$, $p<0.001$, $p>0.05$ are conceived as significant compare to the control group (ampicillin sulbactam, mikostatin). Each sample is examined three times.

3. Results and Discussion

Scientific research on *Salvia* species is drawn to them due to their significant therapeutic value. The present study demonstrated that the flavonoid content of *Salvia* seeds are low amounts (Table 2). It has been detected that the rutin amount is relatively higher than the other studied flavonoids. *S. euphratica* var. *euphratica* has high rutin contents (61,67±1,27 µg/mg) while *S. tricholoda* has low rutin content (1,21±0,07 µg/mg). Besides, catechin content has been only found in *S. euphratica* var. *leicalycina* (90,4±1,27 µg/mg). The naringenin is not determined in the present study. In addition, it has been shown that the other studied flavonoids are absent or in trace amounts (Table 2). Similarly, Kivrak et al. [23] suggested that in *Salvia* species other than this study don't have myricetin, resveratrol and quercetin contents.

Also, a current study showed that vanillic acid contents of studied *Salvia* taxa have been found between 9,97±0,34 µg/mg (*S. tricholoda*) and 56,32±0,99 µg/mg (*S. euphratica* var. *euphratica*) except for *S. multicaulis* has trace amount (0,2±0,01 µg/mg) (table 3). Cinnamic acid is only found in trace amounts in *S. multicaulis* (0,4±0,01 µg/mg). In addition, it has been determined that caffeic acid content is between 2,23±0,06 µg/mg and 12,64±0,41 µg/mg and *S. euphratica* var. *euphratic*a, *S. euphratica* var. *leicalycina* and *S. multicaulis* have higher ferulic acid and rosmarinic acid contents than the other taxa in this study. And also, the present study showed that *S. euphratica* var. *euphratica* has high vanillic acid (56,32±0,99 µg/mg), ferulic acid (82,45±0,65 µg/mg) and rosmarinic acid (145,27±1,55 µg/mg) contents (Table 3).

It has been demonstrated that *S. euphratica* var. *euphratica* has the highest rutin (61,67±1,27 µg/g), vanillic acid (56,32±0,99 µg/g), ferulic acid (82,45±0,65 µg/g) and rosmarinic acid (145,27±1,55 µg/g) contents (Table 2, 3). Kocak et al. [11] found that rosmarinic acid is in high amounts in *Salvia* taxa. Likewise, it has been found that *S. euphratica* var. *leicalycina* has the second major vanillic acid (33,2±0,3 µg/g) content. Moreover, *S. euphratica* var. *leicalycina* and *S. multicaulis* have high ferulic acid and rosmarinic acid contents (Table 3). Similarly, Francik et al. [24] found that Salvia species have significant ferulic acid amounts. Also, Zengin et al. [25] and Kivrak et al. [23] found that *Salvia* species including *S. euphratica* var. *leiocalycina* have apigenin, kaempferol, luteolin, naringenin, rutin, caffeic acid, protocatechuic acid, vanillic acid, rosmarinic acid, ferulic acid and 3-O-caffeoylquinic acid. Yumrutas et al. [26] found that major phenolic acids are rosmarinic and caffeic acid in *S. euphratica* var. *euphratica* and *S. euphratica* var. *leiocalycina*. On the other hand, the present study showed that cinnamic acid is absent or in trace amounts (Table 3). In a study done by Erdogan et al [27] supported that cinnamic acid contents of Salvia taxa are trace amounts.

The present study demonstrated that all of the studied taxa showed highest DPPH activities in 150 and 250 µl except for *S. suffruticosa* (57,8±0,43%) and *S. tricholoda* (23,7±0,41%) (Table 4). *S. euphratica* var. *leicalycina* and *S. euphratica* var. *euphratica* have shown high radical scavening activity in 100 µl (81,47±0,87% and 94,84±1,14%, respectively). Generally, it has been measured that the DPPH radical scavenging activity of studied taxa are low in 25 µl and 50 µl except for *S. euphratica* var. *euphratica* has 91,11±0,49% and 90,73±1,54%, respectively. Besides, *S. euphratica* var. *euphratica*

has represented the highest DPPH radical scavenging activity among the studied Salvia taxa. Similarly, Tepe et al. [28] found that the most active herb is *S. euphratica* var. *euphratica*, with an IC50 value of 20.7±1.22 g/ml. Further, Orhan et al. [29] and Zengin et al. [25] indicated that the Salvia species exhibited significant antioxidant properties. Also, Svydenko et al. [30] and Onder et al. [31] suggested that the Salvia species under investigation is a source of polyphenol chemicals with high antioxidant activity. However, it has been determined that *S. tricholoda* has the lowest radical scavenging activity in the present study. (Table 4). Similarly, Culhaoglu et al. [32] showed that *S. tricholado* has weak DPPH activity.

In addition, it has been found that the studied *Salvia* taxa have the highest ABTS radical scavenging apart from *S. suffruticosa* in 25 µl and *S. tricholoda* in 50 and 100 µl (Table 5). The several literatures showed that *Salvia* species strong DPPH and ABTS radical scavenging activities [33,34,35].

Table 2. The results of flavonoid contents of *Salvia* taxa (µg/mg)

Taxa	Rutin	Myricetin	Morin	Quercetin	Kaempferol	Catechin	Naringin	Naringenin	Resveratrol
Salvia suffruticosa	24,04±1,06	-	-	-	-	-	-	4,61±0,18	-
Salvia tricholoda	1,21±0,1	0,19±0,01	0,21±0,02	0,21±0,02	0,2±0,01	-	-	-	0,59±0,02
Salvia euphratica var. *leicalycina*	32,62±1,17	1,41±0,08	1,02±0,08	-	0,39±0,01	90,4±1,27	-	-	-
Salvia euphratica var. *euphratica*	61,67±1,27	-	-	-	-	-	-	-	-
Salvia multicaulis	32,15±0,68	-	-	-	-	-	-	2,05±0,04	-

Table 3. The results of phenolic acid contents of *Salvia* taxa (µg/mg)

Taxa	Vanillic acid	Cinnamic acid	Caffeic acid	Ferulic acid	Rosmarinic acid
Salvia suffruticosa	20,78±0,54	-	12,64±0,41	3,43±0,03	25,81±1,17
Salvia tricholoda	9,97±0,34	-	2,23±0,06	3,32±0,04	3,39±0,12
Salvia euphratica var. *leicalycina*	33,2±0,3	-	4,02±0,06	36,64±0,79	61,2±1,4
Salvia euphratica var. *euphratica*	56,32±0,99	-	10,65±0,43	82,45±0,65	145,27±1,55
Salvia multicaulis	0,2±0,01	0,4±0,01	8,82±0,78	28,66±0,45	79,37±0,64

Table 4. The DPPH results of *Salvia* species (%)

Taxa	25 µl	50 µl	100 µl	150 µl	250 µl
Salvia suffruticosa	14,98±0,98	54,37±0,76	20,1±0,71	57,8±0,43	92,1±0,53
Salvia tricholoda	23,48±0,72	20,57±0,47	20,92±0,74	88,32±1,17	23,7±0,41
Salvia euphratica var. *leicalycina*	45,38±1,03	40,92±0,57	81,47±0,87	93,14±1,27	93,24±0,64
Salvia euphratica var. *euphratica*	91,11±0,49	90,73±1,54	94,84±1,14	92,1±0,57	92,68±0,28
Salvia multicaulis	34,49±0,63	38,58±0,43	75,49±0,78	92,3±0,64	94,06±1,15

Table 5. The results ABTS of *Salvia* taxa (%)

Taxa	25 µl	50 µl	100 µl	150 µl	250 µl
Salvia suffruticosa	39,54±0,81	64,48±0,53	98,87±0,73	95,11±0,62	98,55±1,14
Salvia tricholoda	81,14±0,48	15,86±0,41	48,13±0,51	62,04±0,64	90,71±0,49
Salvia euphratica var. *leicalycina*	65,68±1,04	98,69±0,92	98,47±0,76	98,61±1,17	98,78±1,1
Salvia euphratica var. *euphratica*	98,75±0,71	98,37±0,84	98,73±1,16	98,4±0,84	98,85±0,76
Salvia multicaulis	64,51±0,36	98,6±1,21	98,54±0,88	98,61±1,14	98,68±0,84

Besides, this study found that studied *Salvia* species have similar lipid peroxidation values (18,21±0,37 mg MDA/kg-21,03±0,22 mg MDA/kg) (Table 6). Works of literatures displayed that *Salvia* species have considerable potent to protection of TBARS formation [7, 36]. In addition, It has been found that *S. euphratica* var. *euphratica* has high total phenolic content (372,63±0,87 µgGAE/mg) and *S. tricholoda* has low total phenolic content (46,41±1,71 µgGAE/mg) (table 6). In a study done by Kocak et al. ([11] found that sage has rich in total phenolics which is measured as 64,98 mol GAEs/g dry plants. Another study done by Zengin et al. [25] found that *S. euphratica* var. *leicalycina* has 108,00±0,11 mg GAE/g total phenolic content. However, the results of Firuzia et al. [37] conflict with current study. Because they determined that *S. multicaulis* has 13.0±2.3 mg CE/g DW total phenolics [37]. Kivrak et al. [23] claimed that the total phenolic contents are responsible for the antioxidant capacity of *Salvia*. On the contrary, Jeshvaghani et al. [38] don't find a high correlation between total phenolic and antixodant capacity. Further, it has been determined that *S. multicaulis* has the highest metal chelating activity (76,25±0,69%) whilst *S. tricholoda* has the lowest metal chelating activity (37,35±0,51%) in the present study (Table 6). Zengin et al. [25] found that *S. euphratica* var. *leicalycina* has significant metal chelating activity. And also, Orhan et al. [29] showed that *Salvia* taxa represented the finest metal chelating activity. However, Orhan et al. [39] found that *Salvia* taxa displayed low metal chelating activity (92 ± 1.17% and 24.19 ± 3.28% at 1000 lg ml-1) and Senol et al. [40] found that the methanol extracts of fifty-five *Salvia* taxa comprising *S. euphratica* var. *euphratica, S. euphratica* var. *leicalycina, S. russellii* and *S. tricholoda* showed weak chelation activity. Additionally, this study shows that there is a poor association between total phenolics and metal chelating (r2:,158), but an important relationship

between total phenolics and DPPH (r2:,959) and ABTS (r2:,803). Also, Svydenko et al. [30] suggested that the *Salvia* species under investigation is a source of polyphenol chemicals with high antioxidant activity. In addition, According to Adımcılar et al. (2019), there was a strong correlation between the bioactivities and the rosmarinic acid levels in the samples. Furthermore, Onder et al. (2022) demonstrated that *Salvia* species, including *S. sclarea*, and *S. palaestina*, have the potential to be rich sources of interesting bioactive chemicals.

Additionally, the findings of this investigation revealed that *Trichopyton sp*., *Epidermophyton sp.*, and *C. glabrata* did not show any antimicrobial action against the examined *Salvia* species (Table 7). Also, the studied *Salvia* taxa showed low antimicrobial activity against *K. pneumoniae*. On the contrary, it has been found that *Salvia* taxa apart from *S. suffruticosa* have high antimicrobial capacity against *E. coli* (Table 7). In a study done by Gulcin et al. [43] showed that *S. tricholoda* had no antimicrobial activity against fungal and bacterial strains. Similarly, another study by done Guzel et al. [44] demonstrated that the extracts of *S. euphratica* extracts don't represent antifungal activity against *C. glabrata*, *S. aureus* and *E. coli*. However, a study by done Norouzi-Arasi et al. [45] found that S. *suffruticosa* represented significant antimicrobial activity

Table 6. The lipid peroxidation inhibition (mg MDA/kg), total phenolic contents (µgGAE/mg) and metal chelating (%) results of *Salvia* taxa

Taxa	Lipid Peroxidation Inhibition	Total Phenolics	Metal Chelating %
Salvia suffruticosa	20,67±0,49	125,14±1,29	75,52±0,77
Salvia tricholoda	19,61±0,47	46,41±1,71	37,35±0,51
Salvia euphratica var. *leicalycina*	18,21±0,37	195,08±0,9	68,12±1,03
Salvia euphratica var. *euphratica*	19,67±0,22	372,63±0,87	63,29±0,54
Salvia multicaulis	21,03±0,22	223,32±1,13	76,25±0,69

Table 7. The disc diffusion assay results of the antimicrobial susceptibility tests for growing reference microorganisms

Microorganisms	1	2	3	4	5	Standart antibiotics
			Inhibition *zone*			
E. coli	8.33±0.3^{c}	13.33±0.3^{d}	11.00±0.0^{d}	13.33±0.3^{d}	13.33±0.3^{d}	11.66±0.3*
S. aureus	8.33±0.3^{c}	8.33±0.3^{c}	13.33±0.3^{d}	11.00±0.0^{d}	12.33±0.3^{d}	9.66.±0.3*
K. pneumoniae	8.33±0.3^{c}	8.33±0.3^{c}	8.33±0.3^{c}	9.66±0.3^{d}	9.66±0.3^{d}	11.66±0.3*
B. megaterium	9.33±0.3^{c}	14.33±0.3^{d}	8.33±0.3^{c}	8.33±0.3^{c}	11.00±0.0^{d}	11.66±0.3 **
C. albicans	-	13.66±0.3^{d}	8.33±0.3^{c}	8.66±0.3^{c}	-	11.66±0.3 **
C.glabrata	-	-	-	-	-	8.66±0.3**
Epidermophyton sp.	-	-		-	-	8.33±0.3**
Trichopyton sp.	-	-	-	-	-	8.33±0.3**

The positive control; ampicillin sulbactam (*) and mikostatin (**) (120 µL and 20µg/disc Inhibition zone> 15 mm (highly significant effect; p<0.0001; cd), 14 – 10 mm (significant effect; p<0.001;d), 10-8 mm (moderate effect; c: p<0.01), not inhibited (-) (a: p>0.05) 1: *S. suffruticosa*, 2: *S. trichoclada* Bentham, 3: *S. euphratica* var. *leicalycina*, 4: *S. euphratica* var. *euphratica*, 5:*S. multicaulis*

4. Conclusion and Suggestions

The current investigation demonstrated the low flavonoid concentration of Salvia taxa. Additionally, it was discovered that the investigated Salvia has no or very little cinnamic acid. It has been found that the phenolic acid content of *S. tricholoda* has the lowest among the studied *Salvia* taxa. *S. euphratica* var. *euphratica* has high rosmarinic acid, vanillic acid, and ferulic acid. Also, it has been found that the rosmarinic acid content of studied *Salvia* taxa are high apart from S. tricholoda. In addition, *S. euphratica* var. *euphratica* has high DPPH and ABTS radical scavenging capacity. Similarly, *S. euphratica* var. *euphratica* has the highest total phenolic content whilst *S. tricholoda* has the lowest total phenolic content and metal chelating activity. On the other hand, current study showed that lipid peroxidation inhibition levels of studied *Salvia* are changed from 18,21±0,37 mg/kg to 21,03±0,22 mg/kg. This study showed that the studied *Salvia* taxa represented different antimicrobial activities.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

Statement of Research and Publication Ethics

The study has complied with research and publication ethics

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