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Research Article
Bioactive Compounds, Antioxidant and Antimicrobial Properties of Wild Plants Seed Extracts Used in Traditional Medicine

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Abstract
Background and Objective: Plant seeds hoarding high concentrations of active substances are medically and therapeutically important. This work was aimed to investigate the antioxidant and antimicrobial properties as well as the bioactive compounds of seed extracts from specific desert plants used in traditional medicine. **Materials and Methods:** Seeds obtained from 10 different types of wild subtropical plants collected from Jazan region, Kingdom of Saudi Arabia and then extracted in methanol and screened for their antioxidant and antimicrobial properties. **Results:** The contents of phenolics and flavonoids were variable in the evaluated seed extracts. *Lawsonia inermis* Linn., *Solanum coagulans* Forsskal., *Ocimum tenuiflorum* L. and *Blepharis edulis* Linn. recorded with the highest phenolics and flavonoids contents. Moreover, the highest antioxidant activity was detected in extracts of *Lowsonia inermis* (93.43%) and *Solanum coagulans* (95.78%) *Blepharis edulis* (88%). In this work, strong antibacterial as well as antifungal activities were found by seed extracts of *Blepharis edulis*, *Lawsonia inermis* and *Tribulus terrestries* L. **Conclusion:** The evaluated seed extracts have beneficial medicinal impacts due to their high antioxidant and antimicrobial properties. They might be beneficial for anti-aging purposes or production of new genera of antibiotics from natural sources.

Key words: Antioxidant, antimicrobial, wild plants, phenolics, flavonoids, traditional medicine, seed extract

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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

Antioxidants are important in assisting the body to avoid oxidative stress before they are able to make any cellular damage. Plants are the main source of antioxidants. Desert plants contain large amounts of antioxidants to be discovered. Antioxidants act against accumulation of free radicals which considered as the main cause of cellular aging and human diseases such as cardiovascular diseases, cancer, diabetes, arthritis, Alzheimer and Parkinson diseases.

Seeds of wild plants contain valuable compounds which can be used for medicinal purposes. Surveswaran *et al.*[1] and Harraz *et al.*[2] reported obvious antioxidant and antimicrobial activities of extracts from *Blepharis edulis* seeds due to its polyphenols content. Previously, polyphenols, present in different kinds of plant materials, showed antioxidant as well as antimicrobial activities[3]. Polyphenols may present in different forms including flavonoids, flavones, tannins and other pharmacologically important compounds. It was proofed that, natural antioxidants can manage cancer cell malignancy and can prevent heart diseases and improve the circulatory system performance[4]. Many polyphenols are considered bioactive antioxidants which are beneficial for human health, they are able to reduce human blood clotting and treat body inflammations[5].

Due to presence in harsh conditions, desert plants are considered a valuable source to obtain antimicrobial compounds. In many places, medicines are obtained from plants and their organs where the active compounds are concentrated. Medicinal plants accumulate their bioactive compounds in their organs such as flowers, seeds, stem, leaves and roots. So that they usually used for obtaining raw drugs from these organs which accumulate the bioactive compounds e.g., leaves. These raw drugs are used in folk medicine for healing and can be introduced to industry of certain medicines[6].

Antibacterial and antifungal activities of desert plant materials such as seeds are previously reported in many plants[7]. Abutbul *et al.*[8] reported that many wild plants extracts showed antibacterial activities against some bacterial strains such as *Vibrio alginolyticus*, *Streptococcus iniae*, *Photobacterium damselae* and *Aeromonas hydrophila*. Moreover, phenolic compounds extracted from desert plants showed characterized antifungal activity. For example, flavonoids extracted from *V. iphionoides* showed antifungal properties to *Aspergilus parasiticus* and *Fusarium solani*. Recently, Al-Faifi[9] showed highly antioxidant and antimicrobial activities of methanolic extract of *Euphorbia cactus* (Jazan common plant) against *B. subtilis*, *S. pneumonia* and *E. coli*. This work was aimed to find a natural antioxidants and antimicrobial agents produced from seeds of wild plants.

MATERIALS AND METHODS

Plant materials and tissue extraction: Seeds of 10 wide desert plants (Table 1) were collected from different jazan regions (Abu Arish, Fifa, Jizan and Benimalek), south west of Saudi Arabia from November, 2017 to December, 2018. The plants were identified by R. Mockickel, Jazan University Herbarium (JAZUH). Seeds were air-dried in the shade for 15 days then grinded to fine powder and kept in airtight container at room temperature. Weight of 150 g of seed powder were extracted in 200 mL methanol in Soxhlet apparatus at 60°C for 4 h continuously and the solvent was let to evaporate in bakers. The remaining crude materials were dissolved in 50 mL of methanol. The crude extract in methanol was used for evaluation of antioxidant and antimicrobial properties with specified concentrations.

Antioxidant properties

Analysis of polyphenols: According to Singleton and Rossi[10], polyphenols present in seed powder extracts were analyzed. Methanol (80%) was used to extract total polyphenols. A standard solution was prepared using gallic acid with different concentrations. Diluted Folin-Ciocalteu reagent was added to the extracts and shacked vigorously. After 5 min of standing, $NaHNO_3$ (7.5%) was added and mixed well. After standing for 60 min the absorbance was measured at wavelength 765 nm. The concentration was then calculated as µg gallic acid g^{-1} DW.

Analysis of flavonoids: According to Dewanto *et al.*[11], flavonoids content was measured in the extracts of powdered seeds. A certain amount of $NaNO_2$ (5%) was mixed with methanolic extracts of the seeds and left to stand for 5 min

Table 1: Used seeds in the experiment

Scientific name	Family name
Blepharis edulis Linn.	Acanthaceae
Abutilon bidentatum Hochst	Malvaceae
Tribulus terrestries L.	Zygophyllaceae
Solanum coagulans Forsskal	Solanaceae
Ocimum filamentosum Forssk	Labiatae
Ocimum tenuiflorum L.	Labiatae
Tephrosia purpurea L.	Leguminosae
Lawsonia inermis Linn.	Lytheraceae
Cirtullus colocynthis L.	Cucurbitaceae
Calotropis procera Linn.	Asclepiadaceae

Plants were identified by R. Mockickel, Jazan University Herbarium (JAZUH)

Table 2: List of the used bacterial strains

Numbers	Bacterial strains	Gram reaction
1	*Enterobacter ludwigii*	Gram-negative
2	*Pseudomonas* sp.	Gram-negative
3	*Ochrobactrum oryzae*	Gram-negative
4	*Bacillus subtilis* H18	Gram-positive
5	*Stenotrophomonas maltophilia* H8	Gram-negative
6	*Pseudomonas aeruginosa* H40	Gram-negative
7	*Escherichia coli*	Gram-negative
8	*Micrococcus luteus*	Gram-positive
9	*Nesterenkonia halobia*	Gram-positive
10	*Streptomyces parvulus*	Gram-positive

then added 150 µL of $AlCl_3$ (10%) followed by NaOH (0.1 M) and mix all vigorously. Using distilled water, complete to 2.5 mL. The absorbance was recorded at 510 nm. The total flavonoids of seed extract calculated in µg of CE g^{-1} DW where CE is catechin equivalents.

Analysis of total antioxidant activity: DPPH radical scavenging capacity was determined using the method of Sreenivasan *et al.*[12]. Solution of DPPH free radicals was mixed with sample extract and kept for 30 min in dark conditions; a blank was prepared by mixing the extract with methanol. Vitamin C was used as standard antioxidant. The absorbency of sample and blank was measured at λ = 517 nm and calculated as percentage according to Sreenivasan *et al.*[12]:

$$\text{TAA (\%)} = \frac{\text{Absorbance of sample-Absorbance of blank}}{\text{Absorbance of blank}} \times 100$$

Antimicrobial properties of seed extracts

Antibacterial activity of seed extracts: Methanolic extracts of seeds were subjected to antibacterial test against different bacterial strains (Table 2). This test was done by using agar disc diffusion method[13]. Discs of filter paper were impregnated with 10 µL of seed extracts (50 mg mL^{-1}) and left to dry. Using sterile forceps, the discs saturated with seed extracts were applied to the surface of the seeded agar plates inoculated with bacterial strains (Table 2). After incubation at 30°C for 24 h, the inhibition zones diameters were measured by millimeter to detect the antibacterial activity. Discs with streptomycin (100 mg mL^{-1}) were considered as a positive control while some discs loaded with 95% methanol was used as negative control.

Antifungal activity: Seed extracts were tested against *Curvularia* sp. by employing inhibition of radial growth method according to Fiori *et al.*[14]. Filtered seed extracts were homogenized with potato dextrose media (PDA) at the desired concentrations. An eight millimeter diameter disc from a *Curvularia* plate (7 days old) were added into the pre-sterilized PDA medium and incubated at 25±2°C. PDA without seed extract was considered as a control. Five days after growth, diameters of the grown colonies were analyzed and reduction percentage was calculated according to the given equation[14]:

$$\text{Inhibition (\%)} = \frac{C - T}{C} \times 100$$

where, C and T are diameters of fungal colony in control and treated samples, respectively.

Gas chromatography-mass spectrometry analysis of the extracts: Compounds present in seed extracts were detected and identified by (GC-MS) system model 7890 (Regional Centre for Food and Feed, ARC) according to Essa and Fathy[15]. The Hp-5MS fused silica capillary column (Hewlett Packard, 30 m, 0.25 mm i.d., 0.25 µm film thicknesses, cross-linked to 5% phenyl methyl siloxane stationary phase) was used. The system was managed by MS ChemStation (Hewlett Packard, version A.01.01). The carrier gas used was Ultra-high purity helium (99%) at a flow rate of 1 mL min^{-1}. The Electron mass spectra were detected at 70 eV. One microliter was injected. Injector temperatures were 250°C. Temperature program was used: 60°C (2 min)-30°C min^{-1}-170°C (5 min)-7°C min^{-1}-250°C (10 min).

Statistical analysis: Comparisons of the results were done using Duncan and person correlation tests (significance p<0.05). All analysis were done using SPSS program (ver. 22).

RESULTS

Antioxidant properties

Total phenolics of seed extracts: The content of phenolics presents in seed extracts were analyzed and presented in Fig. 1a. Variable amounts of phenolics were detected among seed extracts. Four of extracts had higher contents of phenolics compared with the others. In details, the seeds of *Blepharis edulis*, *Solanum coagulans*, *Ocimum tenuiflorum* and *Lawsonia inermis* showed the highest contents of phenolics among the tested seed extracts. Interestingly, *Lawsonia inermis* showed the highest amount of phenolics which reached 241.30 mg gallic acid equivalents g^{-1} dry tissue. *Blepharis edulis*, *Solanum coagulans* and *Ocimum tenuiflorum* extracts had phenolics contents of 67.29, 206.65 and 68.20 mg gallic acid equivalents g^{-1} dry tissue, respectively.

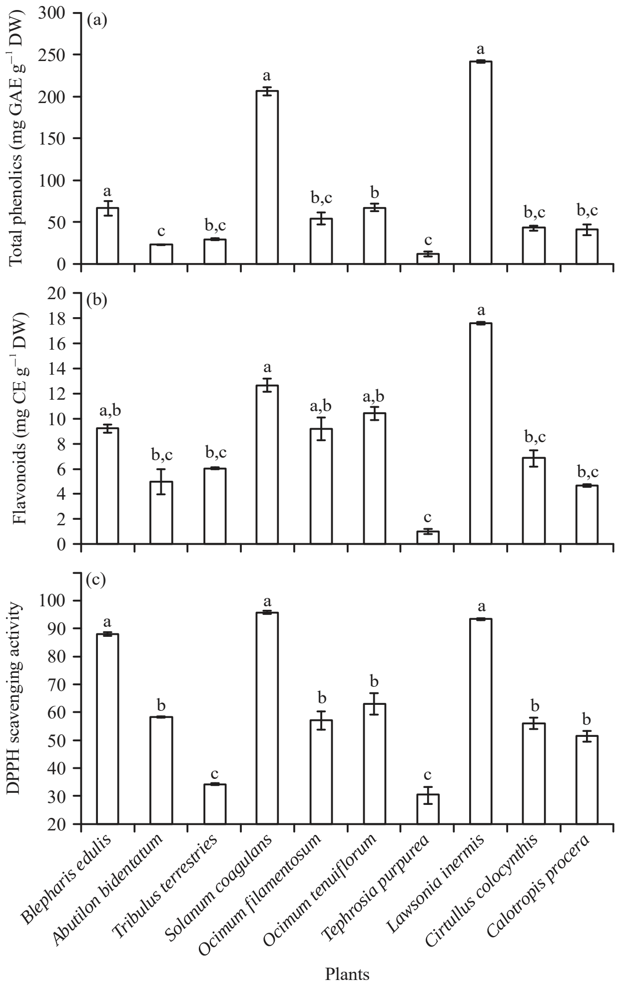

Fig. 1(a-c): Analysis of (a) Total phenolics (mg GAE g^{-1} DW seeds, (b) Flavonoids (mg CE g^{-1} DW seeds) and (c) Contents and percentage of total antioxidant activity of seed extracts

Almost same contents of phenolics were detected in case of *Cirtullus colocynthis* L. and *Calotropis procera* Linn. (41 mg gallic acid equivalents g^{-1} dry tissue). Extracts of other types of seeds showed lower amounts of phenolics, for example, *Tephrosia purpurea* L. and *Abutilon bidentatum* Hochst. had the lowest amounts of phenolics 11.89 and 22.52 mg gallic acid equivalents g^{-1} dry tissue, respectively.

Flavonoids content of seeds extracts: The determined flavonoids contents are represented in Fig. 1b. The flavonoids content followed the same patterns similar to that of phenolics among tested seed extracts. In other words, there is strong correlation between the content of phenolics and the content of flavonoids. Meaning, the higher the phenolics, the higher the flavonoids in same extract. Extracts of *Solanum coagulans* and *Lawsonia inermis* recorded the highest amounts of flavonoids (12.66 mg and 17.61 CE g^{-1} DW, respectively). Moreover, the values of flavonoids present in the extracts of *Blepharis edulis*, *Ocimum filamentosum*, Forssk. and *Ocimum tenuiflorum* were 9.20, 9.19 and 10.43 mg CE g^{-1} DW, respectively. The lowest flavonoid content was found in *Tephrosia purpurea* seed extract (1.05 mg CE g^{-1} DW). Moreover, *C. procera* and *C. colocynthis* showed values of flavonoids 4.71-6.88 mg CE g^{-1} DW, respectively.

Total antioxidant activity: All seed extracts showed antioxidant activities with variable amounts. The seed extracts of *Blepharis edulis*, *Solanum coagulans* and *Lawsonia inermis* recorded the highest total antioxidant activities while the extracts of *Tribulus terrestries* and *Tephrosia purpurea* recorded the lowest (Fig. 1c). In details, *Solanum coagulans* and *Lawsonia inermis* seed extracts scavenged 95.78 and 93.43% of DPPH radical. Moreover, *Tribulus terrestries* seed extract recorded the lowest antioxidant activity of 34.15%. Most of the tested seed extracts showed activities above 50%. In detail, *Ocimum tenuiflorum* (62.94%) was higher than *Ocimum filamentosum* (57.12%) antioxidant activity of seed extract.

Antimicrobial properties

Antibacterial activities of seed extracts: Data in Table 3 showed a broad spectrum activity of the seed extracts of *Tribulus terrestries* and *Lawsonia inermis* against most of the tested bacterial strains. The maximum activity of *T. terrestries* was recorded against *Pseudomonas* sp. (17 mm) while *L. inermis* showed the highest antagonistic activity against *Stenotrophomonas maltophilia* H8 (16 mm). At the same time, *Blepharis edulis*, *Solanum coagulans* and *Ocimum filamentosum* showed moderate antibacterial potentiality. On the other hand, *Abutilon bidentatum*, *Ocimum tenuiflorum*, *Tephrosia purpurea*, *Cirtullus colocynthis* and *Calotropis procera* demonstrated low antibacterial activities.

Antifungal activities of seed extracts: The obtained results (Fig. 2 and Table 4) showed a marked capability of the seed extract to suppress the fungal growth. *Blepharis edulis* seed extract demonstrated 100% inhibition of the fungal growth at 24 mg mL^{-1} DW while *Tribulus terrestries*, *Ocimum tenuiflorum* and *Lawsonia inermis* seed extracts recorded high antifungal activities at the different extract

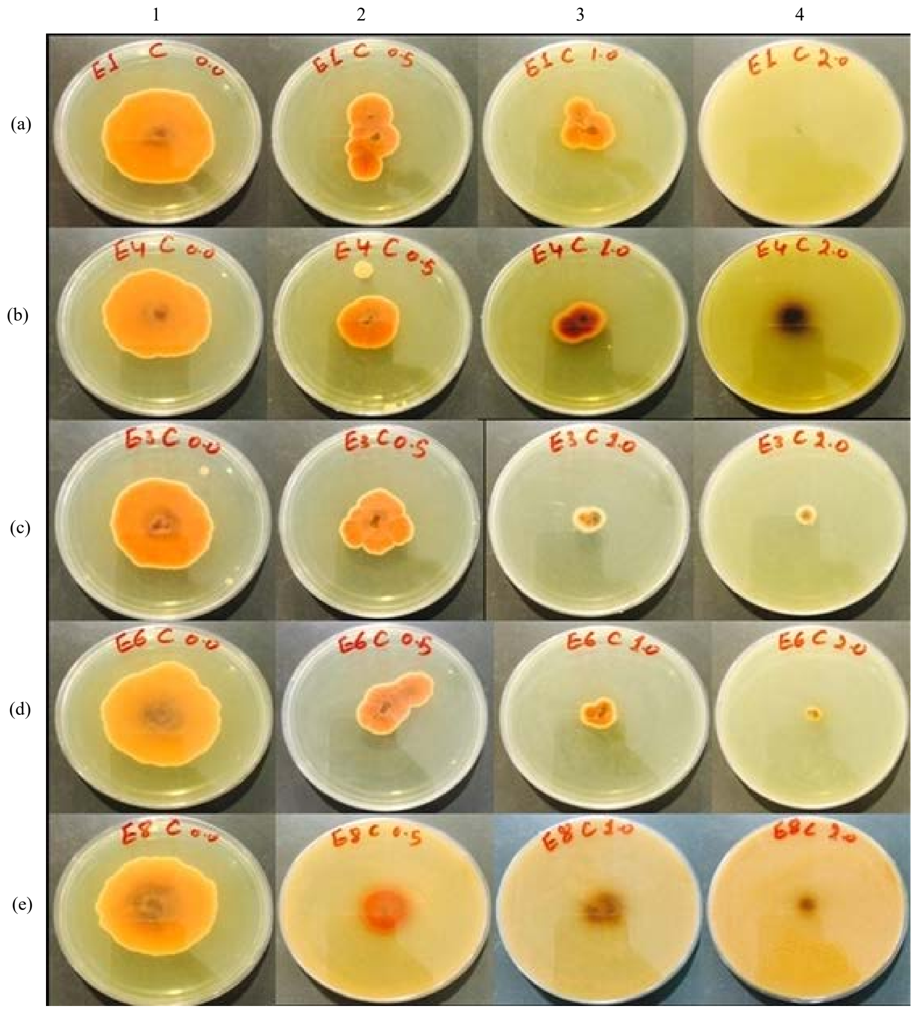

Fig. 2(a-e): Antifungal activity of the methanolic seed extracts of (a) *Blepharis edulis*, (b) *Solanum coagulans*, (c) *Tribulus terrestries*, (d) *Ocimum tenuiflorum* and (e) *Lawsonia inermis* at different concentrations against *Curvularia* sp. using radial growth method, diameters of the fungal growth were measured by millimeters

Table 3: Evaluation of antibacterial activity of the methanolic seed extracts against different Gram-negative and Gram-positive bacteria using standard agar disc diffusion method

	Bacterial strains									
Seed extracts	1*	2*	*3	4*	5*	6*	7*	8*	9*	10*
Blepharis edulis	7.2	9.5	8.4	13.1	9.6	10.4	11	NI	NI	NI
Abutilon bidentatum	11.4	10.5	NI	NI	8.5	NI	8.3	NI	NI	NI
Tribulus terresties	NI	7.7	10.3	11.4	8.6	7.4	8.6	NI	17.6	11.7
Solanum coagulans	9.8	8.9	9.8	NI	10.4	8.8	9.1	NI	NI	NI
Ocimum filamentosum	10.7	14.3	NI	10.7	7.2	8.4	9.2	NI	NI	NI
Ocimum tenuiflorum	NI	13.7	NI	NI	NI	NI	NI	NI	NI	NI
Tephrosia purpurea	NI	13.6	NI	NI	10.6	NI	NI	NI	NI	NI
Lawsonia inermis	NI	10.2	13.5	10.5	11.8	16.4	9.8	10.1	10.7	13.3
Cirtullus colocynthis	NI	9.7	NI	NI	11.3	NI	NI	NI	NI	NI
Calotropis procera	NI	9.2	NI	NI	NI	NI	NI	NI	NI	NI

Diameters of the zones of inhibition were measured by millimeter, streptomycin (100 mg mL^{-1}) was used as a positive control while a disc prepared by 95% methanol instead of seed extracts was used as negative control, values represent means of 3 replicates, NI: No inhibition, *Numbers refer to bacterial strains which are listed in Table 2

Table 4: Inhibition of *Curvularia* sp. radial growth by different concentrations of the seed methanolic extracts

	6 mg mL^{-1}		12 mg mL^{-1}		24 mg mL^{-1}	
Seed extracts	Diameter (mm)	Percentage	Diameter (mm)	Percentage	Diameter (mm)	Percentage
Blepharis edulis	31	32.6	24	47.8	0	100.0
Abutilon bidentatum	33	28.3	28	39.1	17	63.0
Tribulus terrestries	31	32.6	14	69.6	9	80.4
Solanum coagulans	26	43.5	23	50.0	10	78.3
Ocimum filamentosum	34	26.1	21	54.3	19	58.7
Ocimum tenuiflorum	29	36.9	16	65.2	6	86.9
Tephrosia purpurea	39	15.2	32	30.4	21	54.3
Lawsonia inermis	20	56.5	16	65.2	7	84.8
Cirtullus colocynthis	40	13.1	31	32.6	19	58.7
Calotropis procera	31	32.6	27	41.3	16	65.2

Diameters of the fungal growth were measured by millimeter and the recorded diameter of the control treatment was 46 mm, values represent means of 3 replicates

Table 5: GC-MS analysis of the secondary metabolites of seed extracts of *Blepharis edulis* and *Lawsonia inermis*

Plants	Compounds	RT (min)	Area sum (%)
Belipharis edulis	Salicylic acid	4.108	1.03
	Ferulic acid	4.551	15.04
	3-hydroxy-4-methoxycinnamic acid	4.728	31.20
	4-hydroxybenzoic acid	5.546	0.83
	3-hydroxyanthranilic acid	6.184	4.75
	Caffeic acid	6.701	0.73
	7,8-dihydroxy-4-methyl-coumarin	7.003	0.92
	Fraxetin	7.165	1.46
	Genistin	9.583	0.76
	Vanillin, 5-nitro-	15.825	0.40
	Caffeic acid phenylethyl	16.015	2.09
	Sinapic acid	16.198	3.57
	Disalicylidene Propylenediamine	17.001	1.25
	3,5-Di-t-Butylcatechol	17.310	0.77
Lawsonia inermis	Ferulic acid	4.551	8.65
	3-hydroxy-4-methoxycinnamic acid	4.728	9.67
	4-hydroxybenzoic acid	5.546	1.18
	3-hydroxyanthranilic acid	6.184	2.66
	Fraxetin	7.165	1.53
	4-(Diethylaminomethyl)-2,5-dimethylphenol	12.704	1.52
	Esculetin	13.492	1.35
	2,6-naphthalenediol, 1,5-bis[[3-(4-methylpiperazino)propylimino]methyl]	15.831	1.16
	Levallorphan	15.966	4.33
	o-Guaiacol	16.182	1.33
	Octahydrochromen-2-one	16.674	2.95
	Tyrosine,3-hydroxy-α-methyl-	16.931	1.06
	4-hydroxypyridine	17.175	15.06
	4-octadecenal	17.245	3.38
	2-naphthalenol,3-[(4-methyl-1-piperazinyl) carbonyl]-	17.468	2.89
	Salicylaldazine	18.045	0.89
	Dimethyl caffeic acid	19.661	1.54

concentrations. At the same time, a moderate fungicidal potentiality was recorded by *Solanum coagulas* seed extract.

GC-MS of seed extracts: Table 5 represents the GC-MS analysis of *Belipharis edulis* and *Lawsonia inermis* extracts. Different compounds were detected in extracts of both types of seeds for example; 3-hydroxy-4-methoxycinnamic acid, ferulic acid, 3-hydroxyanthranilic acid, fraxetin and 4-hydroxybenzoic acid at retention times 4.55 and 6.18 min, respectively. Moreover, in *Belipharis edulis* extract other metabolites were identified such as 5-nitro-vanillin, genistin, caffeic acid phenylethyl, sinapic acid, disalicylidene propanediamine, 7,8-dihydroxy-4-methyl-coumarin, caffeic acid and salicylic acid at retention times between 6.701 and 16.19 min. On the other hand, *Lawsonia inermis* extract showed Levallorphan, 4-hydroxypyridine, 4-Octadecenal, 3-[(4-methyl-1-piperazinyl) carbonyl]-2-Naphthalenol, Octahydrochromen-2-one, 3-hydroxy-α-methyl-Tyrosine, at retention times 15.97 and 17.47 min, respectively.

DISCUSSION

Seeds are commonly used as traditional medicine because of their antioxidant and antimicrobial properties. It was previously reported that seeds of wild plants had antioxidant and antimicrobial properties[16]. Most oiled seeds contain a variety of compounds that have shown to be effective in protecting the lipids within the seeds from oxidation[17]. In this respect, seeds of wild plants were collected, extracted and then tested for their antioxidant, antibacterial and antifungal properties. They normally used as traditional medicine in the area of study.

In this work, the antioxidant compounds including phenolics and flavonoids which have much health benefits were found to be variable among the tested seed extracts. In details, seed extracts of *Lowsiana inermis*, *Solanum coagulans*, *Ocimum tenuiflorum* and *Blepharis edulis* recorded the highest phenolics and flavonoids contents. *Lowsiana inermis*, traditionally used for skin staining and cosmetic purposes, was previously reported to have antioxidant properties in their leaves[18] and seeds[19] as well as antimicrobial properties[20]. Many natural antioxidants can manage and remove oxidative stress[21]. Moreover, Fidrianny *et al*.[22] reported that *Solanum coagulans* extract had high antioxidant activity. To support, *Blepharis edulis*, which traditionally used as antiseptic and anti-inflammatory, was reported to have both antioxidant and antimicrobial activities[23]. Natural antioxidants such as total phenolics are used against aging and other diseases relates to free radicals in plants[24]. Because of their high contents of phenolics and flavonoids, *Lowsiana inermis*, *Solanum coagulans* and *Blepharis edulis* extracts showed the highest antioxidant activity among the tested plants. Phenolics and flavonoids are considered powerful antioxidants function against free radicals. Moreover, flavonoids are considered one of the most health beneficial natural compounds produced in seeds. In details, flavonoids could inhibit blood clotting, protects body from inflammations and protects body from allergic symptoms by inhibiting histamine production[25]. Also, flavonoids are considered scavengers for free radicals which cause degradation of fatty acids in foods. They cause oxidative burst of triglycerides[25]. According to the present work, there is a strong correlation between the total antioxidant activity of the tested seed extracts and their contents of phenolics and flavonoids. To support the obtained results, Surveswaran *et al*.[1] reported that the antioxidant properties of plant extracts were strongly correlated to their contents of polyphenols.

The extent of antimicrobial resistance among pathogenic microorganisms has produced vast clinical complexity in the treatment of infectious diseases. Consequently, there is a huge necessity to look for innovative antimicrobial agents that should be safe, less expensive and more effective against pathogenic organisms to substitute the ineffective ones. This study demonstrated a broad spectrum antibacterial activity of seed extracts of the wild plants against Gram-negative, Gram-positive bacteria and fungi. These results are in agreement with some studies that showed the desert plants have a powerful aptitude to inhibit the microbial growth[26]. The potent antimicrobial activity of the seed extracts could be attributed to their content of polyphenolic and flavonoids compounds. These bioactive metabolites that belong to phenolic compounds are involved in plant growth and reproduction, provide a protection against pathogenic microorganisms and predators and protect crops[27]. At the same time, they have many medicinal properties, among them the antimicrobial, antioxidant and anti-inflammatory[28]. Several studies have proved the biocidal action of plant phenolic compounds against various microbial strains including *Candida* sp., *Klebsiella pneumoniae*, *Salmonella enterica*, *Staphylococcus* sp. and anaerobic strains[29]. In addition to the detrimental effect of phenolic compounds on the microbe cell membranes, seed extracts could contain other secondary metabolites that inhibit the synthesis and activity of some essential enzymes leading to an interruption of the metabolic activity of the microbial cell[30]. Actually, the microbial conversion of phenolic compounds leads to the production of a vast array of metabolites that may have beneficial effects on human health[31]. Flavonoids possess antimicrobial activity against *C. albicans*[28], *Aspergilus flavus*[32], *A. tamari*, *A. flavus*, *Cladosporium shaerospermum*, *Penicillium digitatum*, *Penicillium italicum*[33]. The mechanism of antimicrobial activity of flavonoids might be through their effects on cytoplasmic membrane functions[34], inhibition of DNA synthesis and energy metabolism[35] depending on the structure and the amount of flavonoids[23].

GC-MS analysis showed bioactive compounds present in seeds extracts which are medically valuable and important compounds. For example; ferulic acid which present in high amounts in both *Belipharis edulis* and *Lawsonia inermis* extracts is a highly antioxidant compound[36]. furthermore, fraxetin and genistein were also detected which are well known antioxidants and antibacterial[37]. On the other hand the 4-hydroxybenzoic acid which act as an antioxidant and antimicrobial[38]. Moreover 7,8-dihydroxy-4-methyl-coumarin which is used in Neuroprotection and Induces apoptosis[39]. Numerous compounds were found in seed extracts that can be used for medical purposes. Further pharmacological studies should be done to know about the activity of those active compound present in seeds of wild plants especially those present in Jazan region, Kingdom of Saudi Arabia with its harsh conditions.

CONCLUSION

The results showed that extracts of *Lowsiana inermis*, *Solanum coagulans*, *Ocimum tenuiflorum* and *Blepharis edulis* recorded the highest phenolics and flavonoids contents. The highest antioxidant activity was detected in *Lowsonia inermis* (93.43%) and *Solanum coagulans* (95.78%). Testing the antimicrobial activities of extracts showed that the maximum antibacterial as well as antifungal activities were recorded by seed extracts of *Blepharis edulis*, *Lawsonia inermis* and *Tribulus terrestries*. Some valuable bioactive compounds were detected in high amounts in both *Belipharis edulis* and *Lawsonia inermis* seed extracts such as ferulic acid which is considered a highly antioxidant and fraxetin and genesitin which are well known antioxidants and antibacterial compounds. From the present work, seeds of wild plants are valuable source of medicinally active compounds and rich material for research to be discovered.

SIGNIFICANCE STATEMENT

This study discovered the antioxidant and antimicrobial as well as the active compounds of seeds of wild plants that can be beneficial in medical use. Many scientists are dealing with the plant organs such as leaves but less had studied the seeds of the tested wild plants which are valuable medicinal source. It is an open research for future to use such seeds that concentrating natural products to produce some beneficial medicines. This study will help the researcher to uncover the critical areas of medicine production from seeds of wild plants that many researchers were not able to explore.

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