RATING OF ANTIMICROBIAL AGENTS Potential OF distinct SOLVABLE HERBAL EXTRACTS OF CURATIVE PLANTATIONS ,INCLUDING LEPIDIUM SATIVUM,CORIANDRUM SATIVUM, and Cuminum cyminum

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RATING OF ANTIMICROBIAL AGENTS Potential OF distinct SOLVABLE HERBAL EXTRACTS OF CURATIVE PLANTATIONS ,INCLUDING LEPIDIUM SATIVUM,CORIANDRUM SATIVUM, and Cuminum cyminum

Soheir F. M. Allam[*] *Hayam M. Fathy*[**]

Abstract:

Medicinal plants are one of the most essential ways to cure many microbial illnesses. The goal of this study was to assess the antimicrobial activity of various extracts of medical plants such as lepidium sativum, coriandrum sativum and cuminum cyminum against pathogenic strains, G+ bacteria (Staphylococcus aureus, Staph. aureus subsp. aureus and Bacillus cereus) and G- bacteria (Pseudomonas aeroginosa and E. coli). The mold strains were Aspergillus niger, Aspergillus flavus, Penicillium rubrum and Macrophomina phaseoli and the yeast strain was Candida albicans , as determined by the well diffusion assay. The findings revealed that hexane extracts of Lepidium sativum had the maximum efficacy against all tested strains except G+ bacteria. The highest restricting zone of Coriandrum sativum extracts appeared with ethanolic (2.6mm), methanolic (2.03mm), and petroleum ether (1.7mm) extracts against A. flavus. The petroleum ether extract of Cuminum cyminum shown antibacterial activity against A. niger, A. flavus, and Macro phaseoli mold, with zones of inhibition measuring 2.03, 2.22, and 1.3 mm. Overall, all extracts had a considerable impact against strain A. flavus. In contrast, strains A. niger and Macro. phaseoli were resistant to all extracts of Cuminum cyminum and Coriandrum sativum. closing, the hexane extract of Lepidium sativum shown effective antibacterial activity against tested strains and is regarded as a potential extract for further research and applications. It is strongly advised to follow this study's findings, which demonstrate that Lepidium sativum hexane

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extracts exhibited the biggest zone of inhibition in comparison to other extracts like methanol and ethanol. Novel medications to treat a range of microbial infections in humans may be developed using Lepidium sativum as a raw material. Consequently, the research suggests including Lepidium sativum in the regular diet.

Key words: Antimicrobial activity, medicinal plants, Disc diffusion method. Lepidium sativum, coriandrum sativum, and cuminum cyminum

1. Introduction

Numerous studies have shown that herbal medicines are effective in treating bacterial infections caused by antibiotic resistance. Cold water extracts of guava (Psidium guajava) and clove (Syzygium aromaticum) were the most efficient against Escherichia coli, with inhibition zones of 6.2. mm and 5.2mm, respectively. Coriander (Coriandrum sativum) and Sana makki (Cassia angustifolia) leaf cold water extracts were the most efficient plant extracts against Staphylococcus aureus, with inhibition zones of 6.9 mm and 5.9 mm, respectively, Banu, et al., (2024) .

Nouioura,et al., (2024) studied the chemical composition, antioxidant capacity, and antibacterial properties of essential oil derived from C. sativum L. in relation to nosocomial, antibiotic-resistant bacteria. The GC-MS analysis suggests that bioactive chemicals found in the volatile component of CS-EO may be responsible for these effects. The ADMET simulation shows that the principal ingredients of CS-EO have favorable pharmacokinetic properties. CS-EO is a promising natural agent with applications in various industries, thus it deserves major consideration.

Medicinal herbs were traditionally used to treat a variety of parasite disorders. They had preventative and curative effects on a wide spectrum of parasite species. Al-Snafi, (2024).

Herbal spices are a valuable agricultural crop that contribute to basic healthcare in the food and medicine industries. Herbal spices provide nutritional benefits and are used for food flavoring and phytotherapy around the world, Khan, et al.,(2024).

Infectious diseases are a serious health problem and are one of the leading causes of morbidity and mortality worldwide, Mahmoud et al., (2016).

The Food and Agriculture Organization of the United Nations (FAO, 2023), reported that mycotoxin contamination affects around 25% of global food production, resulting in annual losses of $1 billion.

Teles et al., (2019) reported that the hospital-acquired infections are mainly linked to Gram positive pathogens as Staphylococcus aureus and Gram negative pathogens as Escherichia coli and Pseudomonas aeruginosa.

Methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant enterococci (VRE), Streptococcus pneumoniae, Mycobacterium tuberculosis, Enterobacteriaceae producing extended spectrum b-lactamases (ESBLs) and carbapenemases, multidrug-resistant isolates causing severe hospital infections in immunocompromised individuals such as Pseudomonas aeruginosa and Acinetobacter baumannii are increasingly reported from both the human and veterinary medicine practice and the aquatic environment as well, Sakkas et al., (2018).

Drugs used during treatment of infections are generally associated with adverse effects on the patient, including hypersensitivity, hepatotoxicity, and nefrotoxicit Teles et al. , (2019).

Over the past years, due to the emergence of drug resistant pathogens, the potential antimicrobial properties of medicinal plants and their metabolites have attracted much interest. The development of new antimicrobials from plants is a possible action against drug-resistance problem (Sakkas et al., 2016). The antimicrobial properties of many plants, particularly plant oils and extracts, are attributed to their ability to synthesize aromatic substances, most of which are phenols or oxygen-substituted derivatives, Sakkas and Papadopoulou (2017).

One of the actions to counter the emergence of the drug resistance problem is the development of new antimicrobials. Plant essential oils are explored as a promising substitute to currently used antimicrobials, and to date, many plant essential oils have been reported to present considerable antimicrobial activity. This activity is attributed to their ability to synthesize aromatic substances, the majority of which are phenols or oxygen-substituted derivatives, Sakkas and Papadopoulou (2017).

Plant-based natural products are increasingly used in several fields including pharmaceutical, food and cosmetics, Sarikurkcu et al., (2015).

Aromatic and therapeutic plants have long been of commercial interest in a variety of businesses, including medicines, food, cosmetics, and healthcare. In addition to their aromatic and culinary features, they contain a variety of active elements, such as alkaloids, flavonoids, carotenoids, tannins, saponosides, and oils, which also confer therapeutic properties, Benmakhlouf et al., (2022).

Medical plants are one of the most important mean to treat of many bacterial infections due to its different antibacterial compounds and don’t have side effects against human , Jaloob (2018).

The effectiveness of the antimicrobial effect of the essential oil varies from species to species, as well as from different bacteria depending on the structure. Because of their lipophilicity, they easily pass through the membrane of the bacterium. The mechanism of antimicrobial action of essential oils is reflected in the increase in the permeability of the cell membrane, Marjanović-Balaban et al., (2018).

Moreover, medicinal plants are behold natural and therefore safer than conventional synthetic pharmaceuticals, and the beneficial effects of phytochemicals on human health have gained a major interest (Mocan et al., 2016 and 2017; Molli□a et al., 2017). One of the most popular and well documented medicinal plants over the world is Chamomilla recutita (L.) or simply chamomile. Its flower-heads are used both internally and externally to alleviate or even cure a vast list of health conditions, Rotblatt (2000).

Benefits of consuming oat products were mainly due to the presence of dietary fibers, phenolic acids and a unique group of amide derivatives known as avenanthramides, Sen et al., (2011).

Lepidium sativum seed (LSS) (Cruciferae) is used in traditional medicine to treat jaundice, liver difficulties, spleen ailments, and gastrointestinal disorders. It was also found to have antihypertensive, diuretic, anti-asthmatic, antioxidant, and anti-inflammatory properties, Al Asmari et al., (2015).

Lepidium sativum (LS), sometimes known as 'hub arachad', belongs to the Brassiaceae family. Plant seeds and leaves contain flavonoids, glycosides, essential oils, carbohydrates, proteins, fatty acids, β-carotene, and vitamins such as riboflavin, niacin, and ascorbic acid (Yadav et al., 2010). Traditional medicine has employed both the plant's leaves and seeds. The plant is reported to have hypoglycemic, antihypertensive, diuretic (Jouad et al., 2001; Patel et al., 2009) hemagglutinating, fra□ture healing (Eddouks et al., 2005; Yadav et al., 2011), anti-inflammatory (Raval et al., 2013), hepatoprotective (Abuelgasim et al., 2008; Al-Asmari et al., 2015), antioxidant (Agarwal and Verma, 2011; Zia-Ul-Haq et al., 2012) and anti-carcinogenic activities, (Maghrani et al., 2005).

The edible entire seed of Garden Cress is recognized to have health-promoting characteristics, hence it was hypothesized that these seeds can serve as raw material for functional meals, (Snehal et al., 2012; Rehman et al., 2012).

Kukde et al.,(2024) discovered that pumpkin seeds are heavy in oil and minerals, but garden cress seeds are especially high in iron. Despite its nutritional and functional benefits, garden cress is nevertheless one of the world's most underutilized crops. It intends to emphasize the chemical and nutritional properties of Lepidium sativum, with an emphasis on its bioactive profile, health claims, therapeutic benefits, and industrial applications. Anti-nutritionals are plant-derived chemicals that limit nutrient availability and utilization, as well as food intake.

Gilani et al.,(2013), mentioned that lepidium sativum is a popular herb that is generally known in Arabic as (Hab el Rashaad or Thufa), grown in several parts of Saudi Arabia, such as Hijaz, the Eastern province, and Al-Qaseem.

Abd El Rahman et al.,(2024) evaluate the anti-inflammatory and antioxidant effects of Lepidium sativum seed extract, olive leaf extract, resveratrol, and Eucalyptus, either alone or in combination with pyrimethamine-sulfadiazine. Natural plants (Lepidium sativum, Eucalyptus, and Olive leaf extract) and resveratrol demonstrated anti-toxoplasma activity by significantly reducing the number of brain cysts when taken alone or in combination with PYR and SDZ (unpublished data). In the present study, we wanted to evaluate the anti-inflammatory effects of OLE, LSSE, Eucalyptus, and RSV against chronic experimental T. gondii infection in mice.

L. sativum extract may enhance immune cell initiation by activating cytokines, leading to faster regeneration of injured tissue,

Salem et al.,(2024) .

L. sativum seeds are widely used as a treatment for a variety of conditions, including inflammation, arthritis, hypertension, bronchitis, hepatotoxicity, cancer, and diabetes, Amer et al.,(2022). Indeed, the seed extract included a significant concentration of volatile chemicals as well as antioxidant components such as phenolic compounds, flavonoids, and glucosinolates.

Bamidele et al.,(2024) mentioned that the seeds and leaves of the plant contain volatile oils. Garden cress seeds have bitter, thermogenic, depurative, rubefacient, galactogogue, tonic, aphrodisiac, ophthalmic, antiscorbutic, antihistaminic, and diuretic properties.

According to Tufail et al.,(2024) , garden cress is one of the world's most underutilized crops, despite its nutritional and functional characteristics.

Abdel-Aty et al. (2023) employed garden cress gum and maltodextrin as microencapsulation coatings to enhance the storage stability and antioxidant and antibacterial properties of a phenolic-rich extract.

Garden cress contains numerous bioactive chemicals, including gallic acid, protocatechuic acid, coumaric acid, caffeic acid, and kaempferol glucuronide. The chemicals have anti-inflammatory, anti-carcinogenic, antihypertensive, laxative, and antioxidant effects, Morya et al., (2022).

Garden cress seeds contain several anti-nutritional chemicals, including phytin phosphorus, oxalates, tannins, protease inhibitors, saponins, phytic acid, lectins, and amylase inhibitors. Raw garden cress seeds contain a high concentration of phytin, phosphorus, and oxalates, Azene et al., (2022).

Mir et al ., (2024) displays the percentages of fungal infections in spice samples. The study indicated that black pepper had the highest contamination rate (87.6%), followed by saffron (76.2%), cayenne pepper (72.1%), coriander (65.0%), and cumin (64.4%). Fenugreek (52.5%) and cinnamon (51.6%) were the least polluted spices observed. A. flavus dominated white pepper (70.0%) and black pepper (34.0%). Ginger contains a high concentration of A. niger, A. flavus, and Rhizopus stolonifera (50%). Cinnamon was found to be infected with fungus species including Aspergillus flavus (40%), Aspergillus niger (40%), Rhizopus stolonifera (40%), and legumes contaminated with Aspergillus niger (40%), Penicillium arenicola (40%), and Penicillium oxalicum (40%). Other spices infected include aniseed, which was contaminated with Acremonium strictum (40%), Aspergillus flavus (35%), Alternaria alternate (40%), and Mucor racemosus. Cumin spice is infected primarily by Aspergillus niger (30%), Aspergillus tamarii (30%), Penicillium dunkii (20%), and Rhizopus stolonifera (20%). In reality, turmeric, black pepper, and fenugreek are the least affected by numerous microbial strains.

As the number of inflammatory diseases grows, herbal therapy is becoming an increasingly important form of inflammation treatment. Inflammation is the immune system's response to external stresses like germs, allergies, and burns, as well as internal impacts like auto-immune illnesses, Mssillou et al .,(2022).

The ethnobotanical survey discovered that a large number of medicinal species are used to treat inflammation and stomach pain, as well as otorhinolaryngology and dermatological conditions. Leaves were the most commonly used plant portion, and decoction was the major technique of preparation in traditional herbal medicinal procedures. The findings suggest that the Fez-Meknes community relies on medicinal plants to alleviate pain and inflammation, Lefrioui, et al .,(2024).

Cumin's total phenolic concentration, when extracted with the same solvent, is two times that of coriander.Cumin (C. cyminum L.) extracts have stronger antioxidant activity than coriander (C. sativum L.) extracts, possibly due to the plant's phenolic content, Demir, & Korukluoglu, (2020).

Spices are used in medicine for their therapeutic effects, as well as to enhance flavor, aroma, and color. There are several research papers on the chemical compositions and pharmacological actions of spices due to their high mineral, nutritional, and antioxidant content, Vivek et al ., (2024).

Boudaia et al ., (2024) examines the occurrence of cancer in women, namely breast cancer, and emphasizes the use of Marrubium vulgare in traditional cancer treatment. The emphasis on plant leaves and decoction preparation aligns with regional norms, emphasizing the value of maintaining and sharing traditional knowledge.

The combination of black cumin extract and soursop or celery leaves had an antagonistic effect (IF>1) on antioxidant activity, Wardatun et al ., (2024).

Coriandrum sativum has been studied extensively for its hypotensive, hypolipidemic, antiarrhythmic, and cardioprotective properties. Alotaibi and co-authors ,attribute these capacities to substances like quercetin kaempferol, vanillic acid, and ferulic acid World et al ., (2023).

Nouioura et al., (2023) focuses on Coriandrum sativum L. (C. sativum), a spice and medicinal plant with significant essential oil content in leaves, stems, flowers, and fruits/seeds

Furthermore, the most beneficial microbiological qualities were identified when coriander seed powder was applied at a 7% ratio, as it successfully reduced the population of dangerous ileum bacteria. El-Gogary et al., (2024).

Bouzaid, et al., (2024) mentioned that conventional cumin had the highest level of phenolic compounds (16.49 mg GAE/g dry weight), followed by caraway (15.9 mg GAE/g DW), mystical cumin (15.01 mg GAE/DW), and coriander (12.89 mg GAE/g DW). This study found a strong link between the antioxidant activity of the seeds and the solvents utilized for extraction, Caraway, coriander, cumin, and mystical cumin were evaluated for their total phenolic content and antioxidant properties. These spices have high antioxidant properties, making them a natural source of protection. The antioxidant capabilities of the aqueous extract and its derivative fractions were strongly linked with their total phenolic content.

Herbal spices have therapeutic benefits in addition to their culinary usage. Herbal spices play a significant role in traditional homoeopathic medicine, Khan, et al., (2024). Some species have significant therapeutic significance for treating acute and chronic illnesses. They are also known for their fragrant and strong flavors. Various spices, including garlic, onion, pepper, nutmeg, cumin, cloves, chiles, and asafetida, are used for both medicinal and culinary purposes. The main constituents are terpene oil and oleoresin, which are noted for their peppery taste.

Both components have been shown to be useful in treatments. Spices contain vitamins, terpenoids, oleoresins, flavonoids, alkaloids, prostaglandins, and essential oils. Spices commonly found in groceries contain bioactive compounds such as curcumin, eugenol, capsaicin, thymol, gingerol, crocetin, D-carvone, and D-limonene aldehyde cumin, which may provide medical benefits for common ailments such as coughs, colds, fevers, headaches, stomach issues, and cancer. Strong flavors are used in small amounts, providing food with essential minerals. However, some flavors may be high in fat, protein, and carbohydrates due to the structure of the seed, Hanwate et al., (2024) .

Cumin essential oils (EOs) were tested for antibacterial activity against Bacillus cereus, Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli using the agar diffusion method. The minimal bactericidal concentration was found. Coriander, cumin, and dill essential oils effectively inhibited all tested bacteria except P. aeruginosa. Fennel and celery essential oils were efficient against E. coli and B. cereus strains, respectively. However, anise and carrot EOs had no antibacterial effect. Hierarchical Cluster Analysis (HCA) identified four categories based on the EO contents of seven species ,Önder et al., (2024).

Medical plants are one of the most important mean to treat of many microbial infections due to its different antibacterial compounds and don't have side effects against human. Therefore, this work aimed to evaluate the antimicrobial activities of Cuminum cyminum, Coriandrum sativum and Lepidium sativumagainst pathogenic and food born strains.

2. Materials and Methods

2.1 Samples collection and identification

Three herb species, belonging to three different families (Table 1) were investigated. The plants were purchased from herbs market and it was identified by department of Botany, Faculty of Agriculture, Cairo University, Egypt. The three plants were dried and grounded to fine powder then stored at 4 ^{o}C until used.

Table 1: (Three herb species, belonging to three different families)

Family	Species	Common name	Tested Part
Brassicaceae	Lepidium sativum	Garden Cress	Seeds
Apiaceae	Cuminum cyminum	Cuminum	
Apiaceae	Coriandrum sativum	Coriander	

2.2 Preparation of extracts

Organic extracts from each herb were prepared by soaking 10 gm of the dried powder separately in 100ml of analytical organic solvents (Petrolum ether, Hexane, Methanol 80% and Ethanol 70%), using a conical flask. The mixtures were kept at room temperature overnight under continuous shaking at 150 rpm in dark place. The mixtures were filtered using Whatman (No.1) filter paper. The filtrates were evaporated using vacuum rotary evaporator. Stock solutions of different crude extracts were prepared by dissolve the dried extracts with 10% Dimethyl Sulphoxide (DMSO) solution to obtain a final concentration of 10 mg / ml.

2.3 Microorganisms

The microorganisms used to assay the antimicrobial activities of extracts were obtained from Cairo University, Faculty of Agriculture, Research Park. These microorganisms represented G+ bacteria (Staphylococcus aureus (MRSA), Staph. aureus subsp. aureus ATCC 25923 and Bacillus cereus ATCC 33018), G- bacteria (Pseudomonas aeroginosa ATCC 9027 and Escherichia coli ATCC 8739). The four strains as molds were Aspergillus niger (nrrl 1957), Aspergillus flavus, Penicillium rubrum and Macrophomina phaseoli (nrrl 62743), and one strain as yeast was Candida albicans ATCC 1023.

For experimentation, the indicator strains were inoculated in Mueller-Hinton broth medium and incubated at the optimum temperature for each strain for 24h. The same method was used to enhance the growth of fungal strains.

2.4 Evaluation of Antimicrobial Activity of herbs extracts using well diffusion assay

Microorganism (500µl) were plated in sterile petri dishes then melted and cooled Muller Hinton agar medium was poured into all petri dishes. The plates then were moved slowly to ensure regular distribution of the microorganisms and then allowed to solidify. After solidification, 5 mm diameter of circular wells were carefully punched using a sterile cork borer. Each herb extract (30 µl) was tested as triplicate. The plates were allowed to stand for half hour, incubated overnight at 30°C. Growth inhibition was detectable as clear zone around the well.

3. Statistical Analysis.

Statistical analysis was carried out using one way analysis of variance (ANOVA) test followed by Duncan test through the program of statistical packages for the social science (SPSS) version 16. Results were expressed as mean± SD. The differences among means at $p \leq 0.05$ are considered significant (Snedecor and Cochran, 1989).

4. Result & discussion

The inhibitory spectrum of different extracts was tested against 10 strains selected depend on their relevance as human and plant pathogens (Staph. aureus MRSA, Staph. aureus subsp. aureus ATCC 25923 and B. cereus ATCC 33018, P. aeroginosa ATCC 9027 and E. coli ATCC 8739, A. niger nrrl 1957, A. flavus, Pen. rubrum, Macro. phaseoli nrrl 62743 and C. albicans ATCC 1023).

Table (2): The antimicrobial activity of different extracts of Lepidium sativum

	zone of inhibition (mm)*			
	Ethanolic extract	Methanolic extract	Hexane extract	Petroleum ether extract
G+ bacteria				
Staph. aureus subsp. aureus ATCC 25923	0	0	0	0
Staph. aureus (MRSA)	0	0	0	0
B. cereus ATCC 33018	0	0	0	0
G- bacteria				
P. aeroginosa ATCC 9027	0^{b}	$2.23^{a} \pm 0.25$	0^{b}	0^{b}
E. coli ATCC 8739	0^{b}	0^{b}	$0.93^{a} \pm 0.15$	0^{b}
Molds				
A. niger (nrrl 1957)	0^{b}	0^{b}	0^{b}	$2.3^{a} \pm 0$
A. flavus	$1.2^{a} \pm 0$	$1.6^{a} \pm 0.46$	$1.7^{a} \pm 0.36$	$1.3^{a} \pm 0.25$
Pen. rubrum	0	0	0	0
Macro phaseoli (nrrl 62743)	0^{b}	0^{b}	0^{b}	$1.9^{a} \pm 0$
Yeast				
C. albicans ATCC 1023	0^{b}	0^{b}	$1.17^{a} \pm 0.06$	0^{b}

Means ± standard deviation Letters indicate the significant differences between treatments.

The antimicrobial activity of different extracts of Lepidium sativum was shown in table (2). The methanolic extract of Lepidium sativum outperformed other Cuminum, Coriander extracts in terms of antibacterial activity (Table 2), with inhibition zones ranging from 1.60 to 2.23 mm. The antibacterial activity of the Hexane extract was measured using A. flavus and E. coli at 1.7 and 0.93 mm, respectively. In contrast, the petroleum ether extract of the same plant had no effect on G+ or G- pathogenic bacteria or yeast strains, but did have a modest effect on A. niger (2.23 mm), A. flavus (1.3mm), and Macro. Phaseoli (1.9 mm).

The antibacterial activity of the ethanolic extract varied and was significant depending on the microbiological strains used.

But the largest inhibition zone of Lepidium sativum extracts was observed with Hexane (1.7 mm), methanolic (1.6 mm) and petroleum ether (1.3 mm) extracts, respectively against A. flavus.

In this respect , El-Gogary et al., (2024) found that feeding meals containing Salmonella typhimurium and Staphylococcus aureus increased the cecal contents of chickens. These data demonstrated that the addition of CSP resulted in a considerable decrease in the number of coliform bacteria (Mackoncy and S.S.) compared to the control treatment. However, feeding the diets containing CSP resulted in a considerable rise in the overall viable bacterial population. The group that was administered CSP-diet 7.0% had the lowest coliform bacteria levels when compared to the other groups.

The ethanolic extract of Coriandrum sativum outperformed other Cuminum and garden cress extracts in terms of antibacterial activity (Table 3), with inhibition zones ranging from 0 to 2.6 mm. The antibacterial activity of the hexane extract was tested on, A. niger , A. flavus and C. albicans at 1.3 , 2.27 and 1.4 mm, respectively. In contrast, the petroleum ether extract of the same plant had no effect on G+ or G- pathogenic bacteria or yeast strains, but had a moderate effect on A. niger (3.03 mm), A. flavus (1.7 mm), and Macro. Phaseoli (2.6 mm). The methanolic extract's antibacterial effectiveness varied significantly depending on the microbiological strains tested. with inhibition zones on A. flavus (2.03 mm)

The findings of this study are consistent with those of Taha et al. (2019), who discovered that broilers fed with various doses of CSP (0.1%, 0.2%, and 0.4%) had considerably lower levels of E. coli and C. perfringens than the control group. This antibacterial action could be related to coriander's essential oil content, as Burt (2004) proved in his research on plants that produce antimicrobial essential oils.

Table (3): The antimicrobial activity of different extracts of Coriandrum sativum

	zone of inhibition (mm)*			
	Ethanolic extract	Methanolic extract	Hexane extract	Petroleum ether extract
G+ bacteria				
Staph. aureus subsp. aureus ATCC 25923	0	0	0	0
Staph. aureus (MRSA)	0	0	0	0
B. cereus ATCC 33018	0	0	0	0
G- bacteria				
P. aeroginosa ATCC 9027	0	0	0	0
E. coli ATCC 8739	0	0	0	0
Molds				
A. niger (nrrl 1957)	0^{c}	0^{c}	$1.3^{b}\pm0.17^{b}$	$3.03^{a}\pm0.15$
A. flavus	$2.6^{a}\pm0.2$	$2.03^{bc}\pm0.15$	$2.27^{ab}\pm0.2$	$1.7^{a}\pm0.17$a
Pen. rubrum	0	0	0	0
Macro phaseoli (nrrl 62743)	0^{b}	0^{b}	0^{b}	$2.6^{a}\pm0.2$
Yeast				
C. albicans ATCC 1023	0^{b}	0^{b}	1.4 ± 0.15^{a}	0^{b}

Means ± standard deviation Letters indicate the significant differences between treatments.

The antimicrobial results revealed that the essential oil had a stronger antimicrobial effect against Gram-positive bacteria than Gram-negative bacteria, with Staphylococcus aureus and Salmonella typhi being the most sensitive and resistant microbial strains to P. abrotanoides essential oil, respectively. In disc diffusion agar and well diffusion agar tests, the minimum inhibitory and bactericidal concentrations for S. aureus were 16.50 mm, 17.30 mm, 2 mg/mL, and 128 mg/mL, while S. typhi had values of 7.60 mm, 9.20 mm, 16 mg/mL, and 512 mg/mL. In general, P.abrotanoides essential oil acts as a natural antioxidant and antibacterial, Noshad, (2024).

In the same direction, Bouzaid, et al., (2024) investigated the extracts of coriander, caraway, and magical cumin were for their total phenolic content (TPC) and flavonoid content (TFC). Coriander seeds had a TPC of 518 mg GAE/100 g, while caraway had the highest value at 925 mg GAE/100 g. Caraway seeds had considerably greater TFC levels ($p < 0.05$), while mystical cumin had the lowest at 57 mg of catechin equivalents per 100 g.

Barzegar, (2024) found that the essential oil of P. fraxinifolia is rich in phenolic and flavonoid components and has substantial antioxidant properties. Microbial studies revealed that B. subtilis and E. aerogenes had minimum growth inhibitory concentrations of 2 and 64 mg/mL, respectively, while the minimum bactericidal concentrations were 32 and greater than 512 mg/mL. In disk and well diffusion agar tests, B. subtilis had the biggest inhibitory zone of essential oil, whereas E. aerogenes had the lowest.

The ethanolic, methanolic, and petroleum ether extracts of Cuminum cyminum demonstrated no antibacterial action against all tested pathogenic microorganisms except A. flavus, which had inhibition zones of 2.13, 2.21, and 2.22 mm, respectively (Table 4). The petroleum ether extract shown antibacterial activity against A. niger, A. flavus and Macro phaseoli mold (2.03, 2.22, and 1.3 mm, respectively).

In the same direction, Bouzaid, et al., (2024) investigated the extracts of coriander, caraway, and magical cumin were for their total phenolic content (TPC) and flavonoid content (TFC). Coriander seeds had a TPC of 518 mg GAE/100 g, while caraway had the highest value at 925 mg GAE/100 g. Caraway seeds had considerably greater TFC levels ($p < 0.05$), while mystical cumin had the lowest at 57 mg of catechin equivalents per 100 g.

The antimicrobial activity (AMA) of polysaccharides (PSs) extracted from five different plant seeds was tested against four bacteria strains (S.

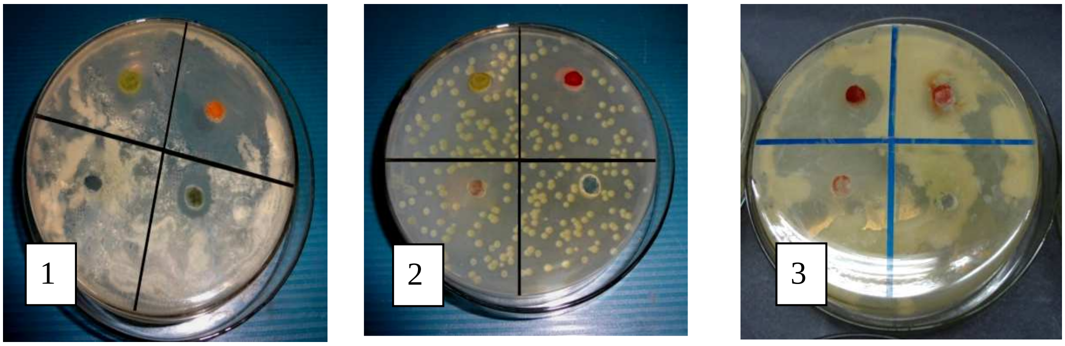
aureus, E.coli, B. subtilis, and MRSA), The current findings revealed that PSs samples of pumpkin (Cucurbita pepo), purslane (Portulaca oleracea), safflower (Carthamu stinctorius), coriander (Coriandrum sativum),

Table (4): The antimicrobial activity of different extracts of Cuminum cyminum

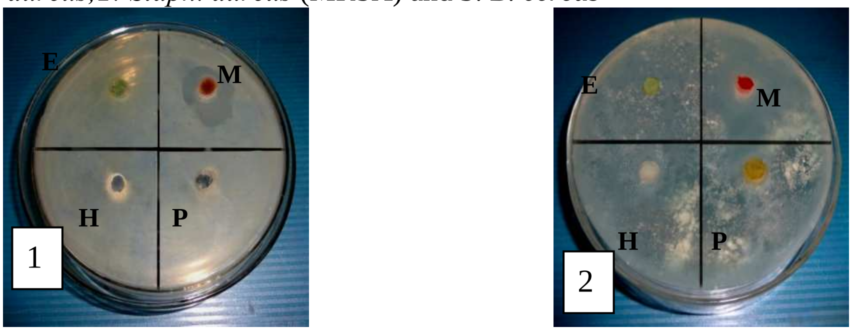
	zone of inhibition (mm)*			
	Ethanolic extract	Methanolic extract	Hexane extract	Petroleum ether extract
G+ bacteria				
Staph. aureus subsp. aureus ATCC 25923	0	0	0	0
Staph. aureus (MRSA)	0	0	0	0
B. cereus ATCC 33018	0	0	0	0
G- bacteria				
P. aeroginosa ATCC 9027	0	0	0	0
E. coli ATCC 8739	0	0	0	0
Molds				
A. niger (nrrl 1957)	0^{b}	0^{b}	0^{b}	2.03^{a} ±0.15
A. flavus	2.13^{a} ±0.25	2.21^{a} ± 0.1	1. 7^{b} ±0.15	2.22^{a} ±0.2a
Pen. rubrum	0	0	0	0
Macro phaseoli (nrrl 62743)	0^{b}	0^{b}	0^{b}	1.3^{a} ±0.15
Yeast				
C. albicans ATCC 1023	0^{b}	0^{b}	1.3^{a}±0.17	0^{b}

Means ± standard deviation Letters indicate the significant differences between treatments.

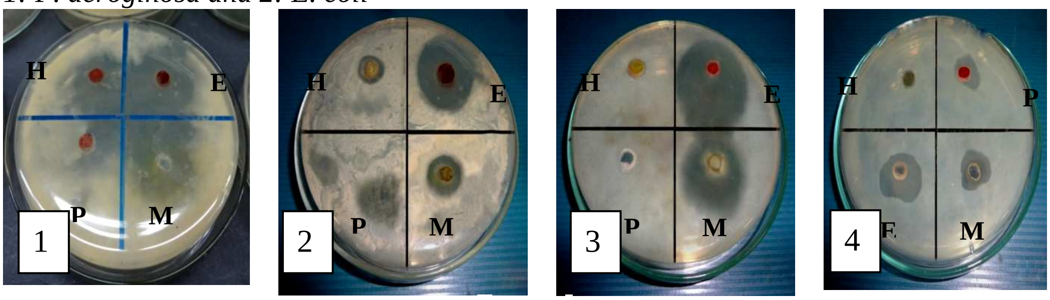
and rapeseed (Brassica napus) provide AMA against S. aureus, E.coli, B. subtilis, and MRSA. PSs derived from pumpkin and coriander seeds had little effect on B. subtilis and MRSA. However, PSs derived from five different plant seeds prevented the growth of S. aureus, E. coli, B. subtilis, and MRSA. In vitro. PS antibacterial activity was determined at various doses using the diffusion technique test, and inhibition zones were calculated in mm diameter .The results obtained with all PS shown more antibacterial efficacy against S. aureus and E. coli than the other two microbiological strains utilized in this investigation. PSs derived from purslane, safflower, and rapeseed were effective against both B. subtilis and MRSA bacteria. These findings suggest that PS has antibacterial efficacy against certain bacterial strains, Moharib, & Adly, (2024).



1: Staph. aureus;2: Staph. aureus (MRSA) and 3: *B. cereus*



1: P. aeroginosa and 2: E. coli



1: A. niger; 2: A. flavus; 3: *Pen. rubrum* and 4: *Macro phaseoli*

Fig.1. The zones of inhibition of different extracts of Lepidium sativum on tested pathogenic strains (E: ethanolic extract, M:methanolic extract, H:hexane extract and P:petroleum ether extract).

5.Conclusion

In conclusion, the current investigation clearly shows that hexane extracts of Lepidium sativum had the largest zone of inhibition when compared to other petroleum ether and ethanolic extracts. Lepidium sativum may be used as a raw material for the development of novel drugs to treat a variety of microbial illnesses in humans.

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تصنيف العوامل المضادة للميكروبات المحتملة لمستخلصات عشبية قابلة للذوبان من نباتات علاجية، كحب الرشاد والكزبرة والكمون

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الملخص العربي:

النباتات الطبية هي واحدة من أهم الوسائل لعلاج العديد من الأمراض المختلفة الميكروبية ، يهدف البحث إلي تقييم النشاط المضاد للميكروبات في المستخلصات المختلفة من النباتات الطبية مثل حب الرشاد والكزبرة والكمون ضد السلالات الممرضة والبكتيريا الموجبة لصبغة جرام مثل
(Staphylococcus aureus (MRSA), Staph. aureus subsp. aureus ATCC and Bacillus cereus ATCC),
والبكتيريا السالبة لصبغة جرام -G مثل
(Pseudomonas aeroginosa ATCC and Escherichia coli ATCC).
وأربعة سلالات من الفطريات مثل
(Aspergillus niger, Aspergillus flavus, Penicillium rubrum and Macrophomina phaseoli,
وسلالة واحدة من الخميرة هي (Candida albicans) باستخدام طريقة الانتشار عبر الحفر.

كشفت النتائج أن مستخلصات الهكسان من حب الرشاد كان لها أقصى فعالية ضد جميع السلالات المختبرة باستثناء البكتيريا الموجبة لصبغة جرام وقد لوحظ أن أكبر منطقة تثبيط لمستخلصات الكزبرة كانت مع مستخلصات الإيثانول (٢,٦ مم) والميثانول (٢,٠٣ مم) و البتروليم إيثر (١,٧ مم) على التوالي ضد .A. flavus , أظهر مستخلص إيثر البترول من الكمون نشاطًا مضادًا الفطريات مثل A. niger وA. flavus و Macro phaseoli، مع مناطق تثبيط ٢,٠٣ و٢,٢٢ و١,٣ مم. بشكل عام، كان لجميع المستخلصات تأثير كبير ضد سلالة .A. flavus ومن ناحية أخرى ، فأن سلالات A. niger وMacro. phaseoli تقاوم جميع مستخلصات الكمون والكزبرة

الخلاصة:، أظهر مستخلص الهكسان من حب الرشاد نشاطًا فعالًا ضد مضادات الميكروبات وضد السلالات المختبرة ويعتبر مستخلصًا واعدًا لإجراء مزيد من الدراسات والتطبيق.

التوصيات :تُظهر الدراسة الحالية بوضوح أن مستخلصات الهكسان من حب الرشاد لديها أكبر منطقة تثبيط عند مقارنتها بمستخلصات أخرى مثل الميثانول والإيثانول. لذا يمكن اعتبار حب الرشاد مادة خام لتصنيع دواء جديد لعلاج العديد من الإصابات الميكروبية في الإنسان. لذلك ، توصي الدراسة باستخدام حب الرشاد في النظام الغذائي اليومي .

الكلمات الدالة : نشاط مضادات الميكروبات ، النباتات الطبية ، طريقة الانتشار عبر الحفر، حب الرشاد ،الكزبرة ، الكمون.

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