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Antimicrobial Activity of *Coriander sativum*

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Authors' contributions

This work was carried out in collaboration between both authors. Authors SA and QA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors SA and QA managed the analyses of the study. Author MA managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The increasing rate of drug-repellent pathogens and poisonousness of existing antiseptic compounds has strained attention toward activity of antimicrobial products which are natural. Main purpose of this research was to assess antimicrobial activity of seeds and leaves of *Coriandrum sativum's* essential oil, antioxidant, antimicrobial activity and chemical composition of *Coriandrum sativum's* ethanol extracts and essential oils. Numerous approaches were used in reviewing the antioxidant activity such as, p-anisidine test – malonaldhyde, DPPH and peroxide value. Antimicrobial activity of the extracts towards six microbial strains; two bacterial strains (*Salmonella typhi* and *Staphylococcus aureus*), one yeast (*Candida tropicals*) and three fungal strains (*Aspergillus flavus*, *Mucor sp* and *Emericella nidulans*) was assessed by determination of inhibition zone and count of bacteria, yeast and spares of fungus. The antimicrobial mechanisms found in these essential oils have been explained on the basis of their content in natural compounds such as carvacrol, thymol, p-cymene and c-terpinene, among others. Although these two essential oils have received much attention, scientists working in the fields of biomedicine and food science are paying increasing attention to a wider variety of aromatic natural oils in an effort to identify original and natural applications for the inhibition of microbial pathogens. In conclusion, utilization of coriander or their components as food additives will increase the antioxidant and the antimicrobial potential of the food which prevent food deterioration and improve the shelf-life of food beside its nutritional value. The results revealed that the leaves extracts have high levels of phenolics than

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the seeds extract. Concerning antioxidant activity, significant decreases ($p>0.001$) were observed in peroxide, P- anisidine and TBA values as compared to control oil. On the other hand, scavenging activity % of the four extracts on DPPH radical were higher than that of butylated hydroxyl toluene (BHT) especially with high concentration (1000 µg/ ml). Regarding antimicrobial activity, the results showed that the extract of coriander seeds has the highest reduction percent in growth of all the examined microorganisms. The result also revealed that *Mucor sp* was resistant to the action of parsley extracts while *Aspergillus flavus* has the highest resistance against coriander extracts.

Keywords: Coriandrum sativum; antibacterial activity; antioxidant activity.

1. INTRODUCTION

Currently, several and thousands of diseases are attacking us day after day, and to tackle them it has become more substantial for us to explore out the antibiotics which are natural and effective counter to numerous ailments which can cause harmful gram-negative and gram-positive bacteria. Artificial antibiotics treatments are already there in shops but every antibiotic have its own side effects. So, scientists are in pursuit of antibiotics which are natural particularly from sources of plants [1,2].

Coriandrum sativum belongs to the family Umbelliferae, is a vertical annual herb with a definite taproot, having diverging shoots ranging from 20 cm to 70 cm in height. Leaves of *Coriandrum sativum* are green or dark green, lanceolate, having plain surfaces mutually and are flexible in form and lobed. Crop of *Coriandrum sativum* reaches its blossom stage within 45 to 60 days after disseminating and ripens within 65 to 120 days, all depends on diversity that what was the condition of cropping [3]. At every branch of *Coriandrum sativum* at least 3 to 10 umbels grow, where each umbel having 10 to 15 flowers. Generally, pollination and flowering biology of coriander is distinctive of that for umbelliferous plants, according to [4,5]. Complete development of flowering for a single umbel takes about five to seven days. But its length depends on conditions of weather. This is significantly extended by rainy and cold weather. Consequently, flowers which met unfavorable weather will have a smaller number of fruits, or numerous fruits will have only one mericarp covering a seed. Vital cross-pollinating insects do not visit the flowers during periods of wet or cold weather [6,7. Beneath favorable conditions, various species of insect are visitors or pollinators of *Coriandrum sativum* umbels. Species of insects that pollinate coriander depend on the area of cultivation [8]. It has been found that plants that were not unable but were pollinated with pollen of other plants still had a degree of self-pollinating of 25% [9]. This simple technique offers data about the biology of plant pollination, but is also significant to note for breeding of plant, because it avoids the difficult procedure of emasculation and can be used for crossings, if the father plant has a marker gene. The same authors also stated that no inbreeding depression was observed after three generations of self-pollinating [10]. *Coriandrum sativum* plant is a cross pollinated crop. Whereas the gradation of plants cross pollination has been stated as 50% [11] to 60% [12]. This aromatic, glabrous annual herbaceous plant, is a small tree is found all over Italy, India, Eastern and Central Europe, China, Netherlands and Bangladesh. [13].

Coriandrum Sativum is extremely believed medicinal ayurvedic tree generally recognized as Dhanya. Vital oil, fatty acids, flavonoids and sterols have been cultivated from diverse portions of *Coriandrum sativum*. Different parts of this plant such as leaves, seeds, flower and fruit, have different activities such as antifungal activity, antioxidant, anti-diabetic, anti-helmintic, anti-mutagenic soporific-hypnotic, diuretic, anticonvulsant, lowering cholesterol, anti-feeding, anticancer, anxiolytic, hepatoprotective, anti-ulcer, anti-protozoal, defensive role counter to poisonousness of lead, detoxification of heavy metal and post-coital [14]. By basis, *Coriandrum sativum* is Mediterranean plant but it is refined on huge measure in central Europe, North Africa and Asia. It is being used for several and multi purposes. The dried seeds of *Coriandrum sativum* is useful in many spices leaving its organic and healthy effects in meals which in turns benefits our digestive system. For flavoring foods such as in bakery and meat it has been playing a vital role since ages [1].

Traditionally used herbal medicines are in the limelight these days because of their organic importance and compounds which are bioactive also known as secondary metabolites.

Coriandrum sativum which is generally identified as coriander is a traditional and commonly herb which is used as spice in many countries. It has also very essential and used in industries of food and drugstore, also used as a common remedy. The extraction of its essential oil is done through its seed and *Coriandrum sativum* oil is ranked among the twenty famous oils in the world due to its food, medical and industrial specialties [15].

It is thrombotically very significant like in several kinds of digestive treatments. It is also helpful in treating in typhoid fever, indigestion, diarrhea, and ulcerative colitis. Water of *Coriandrum sativum* is very beneficial in lowering high cholesterol levels if consumed on daily basis. While it has special properties to treat skim disease such as pimples, blemishes and also helpful for those having dry skin. After processing it also serves as an eye refresher [2].

Coriander is generally distributed and primarily cultivated for seeds. The seeds of *Coriandrum sativum* are chiefly accountable for therapeutic usage as well as coriander have been also used as a suppository for issues such as rheumatism, against worms, indigestion, and in joints discomfort. Current studies have similarly verified hypoglycemic act and effects on metabolism of carbohydrate [16,17]. Explosive components in vital oil, from seeds and leaves, have been stated to prevent growth of micro-organisms in a wide range [18] and reserve of peroxidation of lipid is also described [19,21]. *Coriandrum sativum* essential oil from leaves has shown antimicrobial activity against both Gram-negative bacteria and Gram-positive. This herb is identified not to be poisonous because it has been used up for eras deprived of displaying any symptoms of toxicity. Due to identified antibacterial activity of leaf essential oil of *Coriandrum sativum*. Also, to assess the potential usage of *C. sativum* essential oil as a phyto therapic product, the toxicity was examined using *Artemia salina* lethality test [22]. Aqueous fermentations and decoctions of *Coriander sativum* against 186 isolates of bacteria belonging to ten diverse types of Gram-positive bacterial populace and two isolates of Candida albicans isolated from specimens of urine. Essential oil from leaves of *Coriandrum sativum L.* (Apiaceae), attained by hydro-distillation was examined. Main elements were decanalled (14.3%), 2E-decenal (15.9%), 2E-decen-1-ol (14.2%) and n-decanol (13.6%). Further elements present in equally respectable quantities are 2E-tridecen-1-al (6.75%), 2E-dodecenal (6.23%), dodecanal (4.36%), undecanol (3.37%), and undecanal (3.23%). Oil was separated for antimicrobial activity against both Gram positive (*Staphylococcus aureus, Bacillus* spp.) and Gram negative (*Escherichia coli, Salmonella typhi, Klebsiella pneumonia, Proteus mirabilis, Pseudomonas aeruginosae*) bacteria and a pathogenic fungus, *Candida albicans* [3].

Leaves of *Coriandrum sativum* displayed stronger antioxidant activity than seeds, and in equal portions of coriander, ethyl acetate extract donated to strongest activity [23]. Coriander was also extremely inhibitors to E. coli and other bacteria and fungi tested. Polyphenols or phenolic compounds, vegetal secondary metabolites, has created an extensive and intricate collection of phytochemicals which display antioxidant activity and subsequently a useful physiological outcome [24]. Phenolic materials with an antioxidant activity, including phenolic acids and flavonoids, have been isolated from a variation of sources such as sage, rosemary [25] thyme, pepper and oregano [26]. Temporarily, these compounds are universally dispersed all over the plant kingdom [27].

The plant of coriander is well modified to conditions of tropical and sub-tropical climatic. Fertile soil with tolerable organic matter, sunshine and liberty from water logged circumstances are finest matched for its development. Pakistan is reasonably a minor manufacturer of coriander, though it is grown all over the nation. Throughout the year between 2004 to 2005 around 2,9000 tons of coriander was formed, utilizing 5,600 hectares [28].

It has usually been stated to as antidiabetic [29], anti-inflammatory and lowering cholesterol [30]. It is also used as diuretic, carminative, stimulant, analgesic, refrigerant, stomachic, aphrodisiac [31], anthelmintic [32] and hypoglycemic [33]. *Coriandrum sativum* also holds active phenolic acid mixtures as well as chlorogenic acid and caffeic. Investigation also guides that unbalanced oils originate in leaves of *C. sativum* plant may have antimicrobial activities in contradiction of food tolerated pathogens such as *Salmonella* species [34]. Antimicrobial complexes with sources of plant have frequent beneficial capacities. Which are effective in handling various diseases which are infectious and also concurrently decrease a huge amount of side effects that are often related with antimicrobial compounds [35-37]. Archaeologically,

antimicrobial complexes can fight with contagion [38]. It is predicted that 250000 to 500000 species of plant exist on Earth and nearly some of them are extensively used in medication [39]. The aim of the study was to evaluate the antimicrobial activity and antifungal activity of *Coriandrum sativum* plant extracts.

2. MATERIALS AND METHODS

Corianders, Cilantro also known as Dhanya and scientifically (*Coriandrum sativum)* plants leaves were collected from a local plant for the experiment.

2.1 Plant Materials

For the present research work, Coriander (*Coriandrum Sativum L*.) plant was selected and its material was taken from the upper branches of the plant. The leaves were separated from the shoots of plants through a knife.

2.2 Chemicals

All the chemicals used were of analytical grade which were purchased from the Sigma Chemical Co.

2.3 Samples Preparation

Leaves and seeds of both parsley and coriander plants were dried and grinded in a blender. The powder of each sample was kept in a polyethylene bags and preserved in deep freezer until use.

2.4 Preparation of Aqueous Infusions

Aqueous infusions of *C. sativum* were prepared by steeping 20 g in 100 ml sterile distilled water in separate sterile flasks. The flasks were kept for two days with occasional shaking. The contents of flasks were filtere.

2.5 Bacterial Activity

First of all, took 6 to 7-gram nutrient broth and mix it with 500 ml of water. Then put it on autoclave and do its pouring and leave it till next day. Next day apply bacterial strain on it, if it shows some result then the result will be positive and if it doesn't show anything then the result will be negative.

2.6 Antibacterial Activity

The activities of antimicrobial in *Coriandrum sativum* leaves against microorganisms were determined by assessing the existence of inhibition zones, diameter of zone and MIC values. Their strengths were evaluated both quantitatively and qualitatively. The plant showed important antimicrobial activities against many microbial strains. The ethanol extract of the plant showed weak antimicrobial activities against microbial strains in both disc diffusion and MIC tests. First of all, took 6 to 7-gram nutrient broth and mix it with 500 ml of water. Then put it on autoclave and do its pouring and leave it till next day. Next day apply bacterial strain on it if it shows some results then the result will be positive and if it doesn't show anything then the result will be negative.

2.7 Antifungal Activity

First of all, took 6 to 7-gram nutrient broth and mix it with 500 ml of water. Then put it on autoclave and do its pouring and leave it till next day. Next day apply fungal strain on it if it shows some results then the result will be positive and if it doesn't show anything then the result will be negative. Our results showed that the antifungal properties of *Coriandrum sativum* is not related to cell wall biosynthesis pathways, as the findings of the antifungal test were unaltered either in presence or absence of an osmotic protector (sorbitol). Instead, the MIC values of the EO increased between 8 and 16 times with the increase of exogenous ergosterol concentration, indicating that the EO seems to bind to membrane ergosterol and increases ionic permeability, ultimately causing cell.

3. RESULTS AND DISCUSSION

For the purpose of present study almost one hundred stems of *Coriandrum sativum* belonging gram positive's different genera and were separated from stem of *Coriandrum sativum. Coriandrum sativum's* plant was kept in vegetative chambers and sprayed at 6°C (chilling stress) and 18 °C (control stress) for 6 days. Biomarkers of stress were given to determine concentration of pigment, photosynthetic fluorescence, and antioxidant activity. In case of chilled chamber, antioxidant value is increased as a result of bio stimulant. The plant has showed more acclimation to low temperature when kept in 6 days continuous chilling chamber through increased values of stress and photosynthesis indicators. It indicates that bio stimulants influence particular metabolic ways, in chilled chamber of coriander plants.

Table 1. Antibacteial and antifungal activities of *Coriander sativum*

Microbial Strains	Diameter of inhibition zone (mm)*													
	Coriander herb essential oil concentration (%)						Coriander seed essential oil concentration (%)						Phenol (%)	
	0.3	0.6	0.9	10	50	100	0.3	0.6	0.9	10	50	100	1	10
Gram- positive bacteria														
Bacillus cerius	4	9	14	22	27	34	5	8	15	23	30	38	8	17
Total	110						113						25	
Staphylococcus aureus	6	10	14	19	30	38	7	12	17	25	32	47	6	10
Total	117						140						16	
Gram-- negative bacteria														
Escherichia coli	5	8	13	18	20	26	6	12	18	21	26	30	6	12
Total	90						113						18	
Pseudomonas aeruginosa	4	5	16	20	33	44	4	7	14	23	35	49	14	20
Total	90						112						16	
*Salmonill*a	5	9	14	17	26	43	2	5	11	18	35	50	9	18
Total	114						118						27	
Molds														
Aspergillus niger	2	5	6	11	19	28	2	5	8	18	30	35	8	14
Total	71						98						22	
Aspergillus flavus	1	4	7	10	15	25	4	7	11	15	20	28	6	13
Total	62						85						19	
*Aspergillus Para*siticus	2	5	9	20	29	36	3	5	12	25	37	42	14	28
Total	108						124						42	
Aspergillus Fumigatus	2	5	9	13	18	26	3	6	10	18	22	30	12	25
Total	73						89						37	
Penicillium digitatum	3	9	14	26	32	37	5	12	18	30	38	42	10	22
Total	97						145						32	
Yeasts														
Candida lipolytica	3	7	13	18	22	27	5	12	16	20	27	32	6	10
Total	90						112						16	
Saccharomyces cerevisiae	5	8	11	16	21	30	3	7	10	18	25	36	12	16
Total	91						99						28	
Antimicrobial Spectra	1171						1374							

Consequences presented that seed and herb of coriander essential oil showed highest antimicrobial activities. Antimicrobial spectra stood 1171 and 1374, correspondingly tracked with seed of celery's essential oil (1105) although the inferior one stood herb of celery essential oil (967). Over phenol herbs and seeds of *Coriander Sativum* displayed antimicrobial activity with respect to the spectrum of antimicrobial carrying 10%-gram positive bacteria of coriander's seeds and for the herb essential oil it showed 1.77 and for 10% phenol it showed 1.52 times. For gram negative bacteria 10% phenol showed 1.27 and 1.10 times. Spectrum of anti-yeast for 10% phenol was 1.46 and 1.31 times respectively. For 10% of phenol anti mold showed 1.04 and 0.78 times correspondingly. Whereas 10% of antimicrobial spectra of corianders' herbs and seeds of essential oil were

1.24 and 1.02 times than 10% phenol respectively (Table 1).

Moreover, same statistics indicated that seed of coriander was essential emollient which had a solid inhibitory effect compared to verified pathogenic microorganisms specifically, *Staphylococcus aureus*, in which antibacterial activity showed 10% of phenol, which is 1.5, 1.7 and 1.9 times as compared to herbs of coriander.

To control the important nutrition compounds in the foliage of coriander we can use less plant growth regulators. In this work decoction and aqueous infusion of *C. sativum* were also assessed through antibacterial activities. All tested segregates were found unaffected to decoction and aqueous infusion of *C. sativum*. These findings remain in fair association with the work carried out through [40-45] who found the decoction of *C. sativum* does not consume antibacterial potential compared to Gram-positive and Gram-negative bacteria. Correspondingly, coriander's aqueous decoction was found to have no bactericidal activity against *Helicobacter pylori* [45]. In difference, some researchers have found that *Coriandrum sativum* has dense antibacterial activity in contrast to both Gram-positive and Gram-negative [47-50]. The compounds alkanals and aliphatic 2E-alkenals, isolated from new leaves of *C. sativum* were found to possess bactericidal activity against *Salmonella choleraesuis* [51,52].

4. CONCLUSION

Current study has exposed the position of natural products to control resistant against antibiotic bacteria through which human health is at risk. *C. sativum* plant is used to treat several diseases and can serve as an important podium for the expansion of reasonable, effective and safe and medicines. Negative results were shown against the bacterial, antifungal and antibacterial activities.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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