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Anti-Microbial Inhibitory Potency and Screening of Bioactive Chemical Compounds of Coriandrum sativum

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Abstract:
Coriandrum sativum L. is an herb that is glabrous, aromatic, and herbaceous, which is an annual herb coriander plant. It is an ingredient with a history of long usage in cooking, and also a source of fragrance compounds and essential oils. Due to antimicrobial properties of its essential oil, C. sativum may be employed in the food industry as an adjuvant and flavor component and prevent food poisoning and food spoilage. The coriander seeds (Coriandrum sativum L.) purchased by the nearby marketplaces were checked by the Faculty of Science at Babylon University located in Iraq. The volatile oil sample was stored in a dark bottle till required. Among the essential compounds that were tested, there was high concentration of the following: trans-geraniol, citral, hydroxy, alpha-terpineol, trans-8-oxolinalool, O-Cymene, p-Mentha-1,5-diene, verbenol, (S)-trans, trans-beta-Farnesene, Dihydrocitronellyl acetate, b-Geranyl Acetate, Camphorquinon, Linalool isobutyrate, (R)-Limonene, beta- Against the known (23.00±0.38, 17.94±0.25, 27.84±0.45 and 29.00±0.96) respectively in Klebsiella pneumoniae, this type of extract (Methanol, Ethanol fraction, Rifambin (Standard) and Bacteracin (Standard)) proved against was recorded respectively. Meanwhile record (21.79±0.35, 26.05±0.43, 32.00±0.90 and 28.76±0.44 Streptococcus pyogenes). Whereas the calculated and experimental values were 19.36+0.28, 24.00+0.41, 27.10+0.45 and 30.00+0.49) Staphylococcus aureus against Rifambin and Bacteracin. Coriandrum sativum metabolites were found to have a high level of activity towards Streptococcus pyogenes (26.05±0.43).
Keywords: Bioactive, Compounds, Anti-Microbial, Coriandrum sativum

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INTRODUCTION

Coriander (Coriandrum sativum L.) is a member of the family Apiaceae and can be utilized as a nutritional substance as well as a therapeutic agent and is a commonly used medicinal herb. Coriander extracts and essential oils have been tested to possess antimicrobial, properties. The composition of the solvent was identified to be the main factor in extracting the bioactive chemicals of the coriander [1-3]. Though you can consume any amount of the coriander plant, the different parts taste and can be used differently. Reported antioxidant studies have mainly been on aerial parts of the Coriandrum sativum. Biofilm production is a significant process in medical and food sectors. The study of successful methods of preventing dangerous biofilms cannot be done without understanding the formation of biofilms. According to the clinically important bacteria, there has been formulation of stringent criteria to limit the formation of biofilms by pathogenic bacteria [4]. Most of the biofilm formation studies have been on the interactions between the Staphylococcus aureus, Pseudomonas aeruginosa and the Staphylococcus epidermidis. The pathogenesis of Stenotrophomonas maltophilia, a significant nosocomial infection occurs by the formation of biofilms on mucosal surfaces or prosthesis [5-7]. Despite the fact that S. maltopharia isolates of environmental and clinical environments have been identified to adhere to the inanimate and living surfaces, very minimal is known concerning the formation of biofilms by these organisms and the impact of antibiotics on the biofilms. Bacillus subtilis is an effective bacterium in food processing sector as it can form rough biofilms at the air-liquid phase interface unlike those bacteria of solid liquid phase [8, 9]. New knowledge on how to prevent the development of dangerous biofilms as well as the replacement of them with beneficial biofilms synthesized in industrial microbes may be helpful to biotechnology. Essential oils are used in the food industry because of their high antimicrobial effect to control microbiological spoilage, guarantee food safety through suppression of foodborne pathogens and extend product shelf life. The use of coriander essential oil (CEO) as a potential antibacterial alternative has been proposed in the prevention of acinetobacter baumannii biofilm [10, 11]. The transmission of pathogens is important to be prevented, and studies reveal that the CEO can aid the latter by encouraging the breakdown of A. baumannii biofilm. Microscopic techniques have been previously employed in the study of bacterial biofilm structure and morphology. MALDI-TOF mass spectrometry (MALDI-TOF MS) has recently been employed in order to characterize the molecular profile of bacteria that generate biofilms. More than that, it has been reported that MALDI-TOF MS profiling has been applied to differentiate at different stages of bacterial biofilm formation [12, 13]. In this study, coriandrum sativum was screened regarding bioactive chemical components and the investigation of antibacterial properties was performed.

MATERIALS AND METHODS

Essays on Preparation of Coriander Extract

The coriander seeds (*Coriandrum sativum* L.) purchased in local markets were tested in the Faculty of Science at Babylon University in Iraq and declared to be genuine. Coriander seeds (1 kg) were treated with the help of hydrodistollation. The volatile oil was then collected using desiccators and then dried over anhydrous $CaSO_4$. The sample of volatile oil was kept in a dark bottle until the time it was required.

Gas chromatography (GC) Analysis of Coriander Powder

A gas chromatograph (Perkin-Elmer model 8700) fitted with flame ionization detector (FID) was used in analyzing the chemical components of the plant essential oil. To do the separation. Our column temperature was 80 o C and we raised it to 220 o C at a rate of 4 o C/min. We maintained the column temperature at the start of 3 minutes and the end of 10 minutes. There was a 220 o C detector and a 290 o C injector that were both operational. Helium was used as the mobile phase with a flow rate of 1.5 ml/min. A 100:1 split mode injection of 1.0 100 ml sample was injected. All the quantitative measurements were done via a gas chromatograph (Perkin-Elmer, Norwalk, CT, USA) that has an inbuilt data-handling application. The chemical composition of the oil was provided as percentage of the total area of the peak.

Determination of the IC_{50} Minimum Inhibitory Concentration

Comparison of standard strains of Rifambin and Bacteracin was done with Klebsiella pneumoniae, Streptococcus pyogenes and Staphylococcus aureus. They were cultured in a 10 mL test tube of sterile nutritive broth at 37 ◦C and then allowed to grow after 24 hours. The plates were incubated at 37 ◦C during a time of 24 hours. Several colonies of each strain were transferred in a sterile saline solution. The turbidity of the mixture was adjusted to that of the McFarland 0.5 standard that was cultivated on the Mueller-Hinton agar (1.5 x 101 CFU/mL) of Oxoid Ltd. in Basingstoke, Hampshire, England. Each well in the microplate was then prepared with a bacterial slurry of 1.5 x 10 1 CFU/mL [38]. The MIC was determined using an antibacterial test, which relies on the use of resazurin [39]. A volume of 100 µL of a sterile nutritious broth was put into a 96-well microplate. Subsequently, 100 µL of the material was added to the first well and 100 µL of the material was transferred in the same way in the rest of the wells in each row to achieve 11-fold dilutions in each successive well. The remaining 100 µL were disposed of on the final well of the row. This was followed by the 10 uL of inoculum of 1.5 x 106 CFU/mL in each well. Rifambin (standard) and Bacteracin (standard) with a concentration of 0.04mg/mL in saline solution were used as positive controls and ethanol 96% used as the negative controls. The incubation of the microplates proceeded in the presence of 20 22 hours at 37 o C after which a resazurin aqueous solution containing 0.2 mg/ml was put in each well. This was followed by 2 hours of incubation at 37 ◦C of the microplates. Since then, resarufin or resazurin oxidized to form a fluorescent pink dye was used to detect the presence of live bacteria cells in any environment [14].

Data Analysis by Statistic

To compare the average mean values at a confidence interval of 95% or 99, we used SPSS 19.0 in statistical analysis and Tukey honestly significant differences (HSD) test. ANOVA test of variance was used. The p-value below 0.05 was used as the threshold of statistical significance.

RESULTS AND DISCUSSION

The relevant data on chemical composition is the quantitative and qualitative data, which is presented in Table 1. The essential oil contained 18 different chemicals which researchers were able to isolate. The key compounds that were tested had high concentration of the following: trans-geraniol, citral, hydroxy, alpha-terpineol, trans-8-oxolinalool, O-Cymene, p-Mentha-1, 5-diene, verbenol, (S)-trans, trans-beta-Farnesene, Dihydrocitronellyl acetate, b-Geranyl Acetate, Camphorquinon, Linalool isobutyrate, (R)-Limonene, beta-Myrcene

Table 1. Bioactive Chemical Compounds of *Coriandrum sativum*- Screening.

No.	Compound	M.F.	M.W. g/mol	No.	Compound	M.F.	M.W.
1.	trans-Geraniol	$C_{10}H_{18}O$	154.25 g/mol	10.	b-Geranyl Acetate	$C_{12}H_{20}O_2$	196.29 g/mol
2.	Citronellol, hydroxy	$C_{10}H_{22}O_2$	174.28 g/mol	11.	Camphorquinon	$C_{10}H_{14}O_2$	166.22 g/mol
3.	alpha-Terpineol	$C_{10}H_{18}O$	154.25 g/mol	12.	Linalool isobutyrate	$C_{14}H_{24}O_2$	224.34 g/mol
4.	trans-8-oxolinalool	$C_{10}H_{16}O_2$	168.23 g/mol	13.	(R)-Limonene	$C_{10}H_{16}$	136.23 g/mol
5.	O-Cymene	$C_{10}H_{14}$	134.22 g/mol	14.	beta-Myrcene-d6	$C_{10}H_{16}$	142.27 g/mol
6.	p-Mentha-1,5-diene	$C_{10}H_{16}$	136.23 g/mol	15.	D-Pantetheine	$C_{11}H_{22}N_2O_4S$	278.37 g/mol
7.	Verbenol, (S)-trans	$C_{10}H_{16}O$	152.23 g/mol	16.	Thiophene-2-thiol	$C_4H_4S_2$	116.2 g/mol
8.	trans-beta-Farnesene	$C_{15}H_{24}$	204.35 g/mol	17.	Sabinene hydrate acetate	$C_{12}H_{20}O_2$	196.29 g/mol
9.	Dihydrocitronellyl acetate	$C_{12}H_{24}O_2$	200.32 g/mol	18.	3-Campholenyl-2-butanol	$C_{14}H_{26}O$	210.36 g/mol

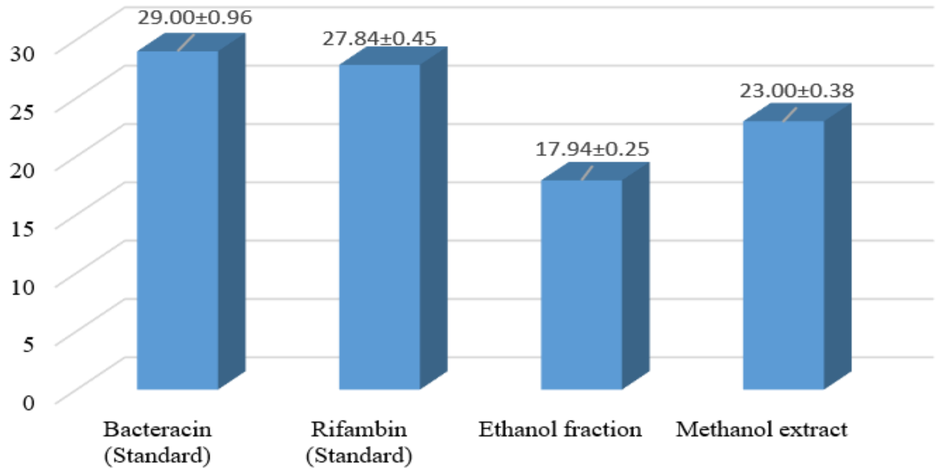

Figure 1. In vitro antimicrobial activity of Coriandrum sativum extracts (Methanolic extract, Ethanol fraction, Rifambin (Standard) and Bacteracin (Standard)) against *Klebsiella pneumoniae*.

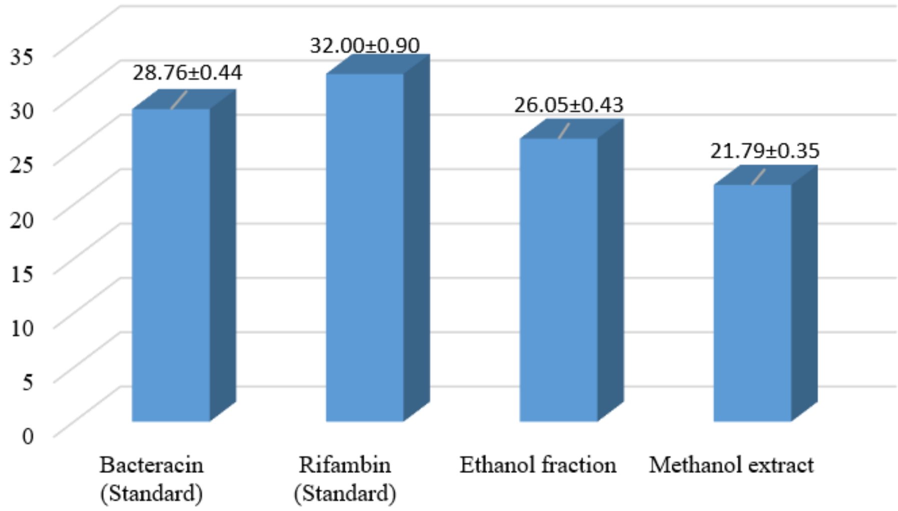

Figure 2. In vitro antimicrobial activity of Coriandrum sativum extracts (Methanolic extract, Ethanol fraction, Rifambin (Standard) and Bacteracin (Standard)) against *Streptococcus pyogenes*.

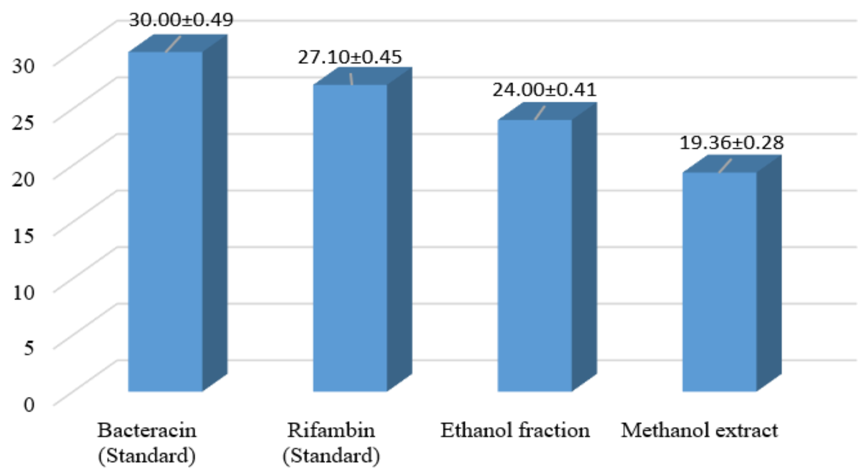

Figure 3. In vitro antimicrobial activity of Coriandrum sativum extracts (Methanolic extract, Ethanol fraction, Rifambin (Standard) and Bacteracin (Standard)) against *Staphylococcus aureus*.

Antimicrobial effects of Coriandrum sativum extracts in vitro carried out on three microorganisms Klebsiella pneumoniae, Streptococcus pyogenes and Staphylococcus aureus compared to Rifambin and Bacteracin. Klebsiella pneumoniae recorded (23.00±0.38, 17.94±0.25, 27.84±0.45 and 29.00±0.96) against the extracts of Rifambin (Standard) and Bacteracin (Standard) respectively depending on the type of extract (Methanol, Ethanol fraction) against the recorded (23.00±0.38, 17.94±0.25, 27.8 Simultaneously isolate (21.79+ 0.35, 26.05+ 0.43, 32.00+ 0.90 and 28.76+ 0.44) Streptococcus pyogenes. Whereas in comparison with Rifambin and Bacteracin, Staphylococcus aureus showed a recorded (19.36±0.28, 24.00±0.41, 27.10±0.45 and 30.00±0.49) value. Coriandrum sativum metabolites were found to have a high level of activity on Streptococcus pyogenes (26.05±0.43). The physiologically active components present in aromatic plant and spice extracts and essential oils are antioxidant, antifungal and antibacterial, therefore these essential oils and extracts find application in food processing and pharmaceutical industry. The radical scavenging activity was also determined based on the same approach but as an IC50 value of 47.2 µg/mL [15-18]. Natural antioxidants present in coriander and the spices are extensively utilized in the food industry since they slow down or inhibit the process of wilting of old food. Others have proposed that instead of synthetic antioxidants, coriander essential oil should be used as a natural antioxidant in the preservation of foods as it has the natural antioxidant properties and is used in cakes [19]. In a previous study, eleven bacterial and three fungal species causing food poisoning and decay were tested and the effect of essential oils prepared in other plants was compared to coriander oil. Coriander essential oils were the most effective against bacteria whilst thyme and spearmint essential oils were more effective against fungi. previous studies have demonstrated that essential oils derived out of coriander have the greatest antifungal effect on Aspergillus flavus and aflatoxin formation at all concentrations used. The result is in line with the previous results of the Apiaceae family. In that study, researchers concluded that food additives with 1000 ppm of coriander essential oil was able to inhibit biodeterioration caused by fungi and aflatoxin contamination [20–23]. Coriander oil had the strongest antibacterial activity when compared with B. subtilis, S. maltophilia, and P. expansum. I concluded that both at 4 µL/ml of MIC and MBC, the essential oil of coriander was antibacterial against the biofilm that the Acinetobacter baumannii is capable of producing. To determine the anti-adhesion qualities of the coriander essential oil, crystal violet assay was employed in order to quantify the inhibition of cell attachments. They found that the coriander essential oil produced different effects on biofilm formation and growth such as the total inhibition of S. aureus and half the cell attachment reduction. Coriander oil essential oil prevented the formation of S. aureus biofilm up to 91 percent. Two bacterial strains were studied and treated with different essential oils, and the MIC values were identified to be between 0.8 and 0.63 µL/mL.

To understand the molecular pathways of biofilm formation, the model microbe B. subtilis, which is famous, has been studied. The formation of a biofilm in the colony type was the basis of the morphological and growth dynamics of Bacillus subtilis. The B. subtillis biofilms form complex structures with a rapid formation of the complex structures and an unaltered core, and the expansion is mainly due to the increasing size of the outer cell subpopulations. There was an inhibition of at least 85 percent of biofilm formation of Acinetobacter baumannii in experiments of the effect of coriander essential oils on the biofilm cells and plankton of the bacterium. Bread is one of the food elements that most individuals consume but it has medium moisture content and thus prone to spoilage due to mold. Rhizopus, Cladosporium, Mucor, Endomyces, Monilia, Cladosporium, and Penicillium are some of the most commonly occurring types of fungi that can corrupt bread. The rationale behind the experimental design is the fact that Penicillium expansum is identified to be more resistant compared to other species that are usually present in breads. The duration in which baked goods will remain fresh is dependent on the level of moisture and aw. The water activity of a substance can be calculated as the quotient of the vapour pressure of a substrate over the substance and that of pure water under the same conditions of temperature and pressure. Microscopic fungus grows in objects whose aw is under 0.80 and up to 0.65. The increased activity of the enzyme is decreased when the amount of these oxygen-free radicals increases and the levels are always high [24]. The possible reason to the increase in this enzyme activity after the treatment with coriander oil is the fact that the coriander oil is an antioxidant that decreases the formation of oxygen free radicals and consequently enhanced the activity of the enzyme. The other potential reason is that coriander oil acts as a substrate to peroxidase system. Some studies suggest that coriander oil contains some pro-oxidants. Previous studies have also demonstrated that *coriandrum sativum* activates antioxidant enzymes including glutathione peroxidase and catalase in rat [25].

CONCLUSIONS

Our results indicate the presence of the biofilm-inhibiting effect by coriander essential oil. Furthermore, this paper demonstrates that coriander oil which is vital is antimicrobial; therefore, it can be used as an alternative to chemicals to prevent the proliferation of bacteria in bread. The bioactive compounds present in coriander such as essential oils, flavonoids, as well as, polyphenols, all lead to better insulin secretion, glucose uptake, lipid metabolism, and antioxidant properties. Due to its anti-inflammatory effect, coriander can help resolve the metabolic disease issues, such as insulin resistance, organ damages, oxidative stress, and other problems of that type. It is also a good substitute or complement to usual treatments as it is of low-cost and low risk profile. Out of the integration of ancient medicine with modern data of pharmacology, a promising nutritional and treatment approach to counteract the growing occurrence of metabolic issues has been introduced, which is coriander. More clinical trials are required to demonstrate its effectiveness and learn more about its mechanism in humans before it can be utilized more extensively in the field of public health management.

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