

The Importance of Cumin (*Cuminum cyminum* L.) in Protecting and Eliminating Digestive System Pathogens

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Abstract

Curcuma longa essential oil affected food spoilage micro-organisms. The importance was according on the preserving food from micro-organisms spoilage using medicinal plants which helped to keep the food for a long time. The aim was to use the *Curcuma longa* essential oil against the food spoilage micro-organisms in order to prove the benefit of the *Curcuma longa* essential oil in eliminating food spoilage micro-organisms. A laboratory experiment was conducted on the micro-organisms with exposure to the *Curcuma longa* essential oil, and the micro-organisms growth was monitored after exposure.

The growth was (00%, 00%, 00%, and 00%) after one day exposure to 100% concentration of the *Curcuma longa* essential oil. There was after overnight exposure were (6%, 7%, 4%, and 7%) for (*Clostridium* sp., *Shigella* sp., *Campylobacter jejuni*, and *Yersinia enterocolitis*). The 50% had growth (3%, 4%, 3%, and 5%) after one day, and after overnight was (19%, 18%, 15%, and 20%) for (*Clostridium* sp., *Shigella* sp., *Campylobacter jejuni*, and *Yersinia enterocolitis*). The growth was (4%, 5%, and 7%) after one day exposure to 100% concentration, and after overnight exposure were (13%, 14%, and 16%) for (*Streptococcus* sp., *Bacillus* sp., and *Lactobacillus* sp.). The 50% had growth (11%, 11%, and 12%) after one day and was after overnight (41%, 42%, and 43%) for (*Streptococcus* sp., *Bacillus* sp., and *Lactobacillus* sp.). The growth was (7%, 8%, and 10%) after one day exposure to 100% concentration, and after overnight exposure were (29%, 31%, and 32%) for (*Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* sp.). The 50% concentration had growth (20%, 21%, and 22%) after one day, and was after overnight (61%, 62%, and 65%) for (*Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* sp.). The growth was (00%, 00%, 6%, 5% and 6%) after one day of 100% concentration, and after overnight were (8%, 9%, 16%, 14%, and 13%) for (*Mucor*, *Alternaria* sp., *Aspergillus* sp., *Fusarium* sp., and *Candida* sp.). The 50% had growth (2%, 3%, 12%, 14%, and 11%) after one day, and after overnight was (18%, 17%, 43%, 44%, and 42%) for (*Mucor*, *Alternaria* sp., *Aspergillus* sp., *Fusarium* sp., and *Candida* sp.).

It was concluded that, the effect of the *Curcuma longa* essential oil was eliminating the food spoilage micro-organisms. It was recommended that, an implementing a practical system to determine the appropriate amount of the *Curcuma longa* essential oil for preserving food without harming the food or public health.

Key Words: *curcuma longa* essential oil; *staphylococcus aureus*; *streptococcus* sp; *bacillus* sp; *clostridium* sp; *lactobacillus* sp; *salmonella* sp; *shigella* sp; *escherichia coli*; *campylobacter jejuni*, *yersinia enterocolitis*; *mucor*, *aspergillus* sp; *alternaria* sp; *fusarium* sp; *candida* sp

Introduction

Cumin (*Cuminum cyminum* L.) is an annual or biennial plant of the genus *Cuminum* in the family Umbelliferae which widely distributed in the world. It is used as Traditional Medicine; it is a popular spice due to its rich and unique aroma [1]. The *Cuminum cyminum* seeds contains 10% fatty oil,

volatile oil, protein, cellulose, sugar, minerals, and elements. Its volatile oils which are cumin-aldehyde, cymene, cuminol, γ -terpinene, safranal, limonene, eugenol, β -myrcene, α -phellandrene, β -phellandrene, and β -pinene [2]. The *Cuminum cyminum* seeds essential oil have five most

commonly compounds are cuminaldehyde, p-cymene, cuminal, α -pinene, and α , β -dihydroxy-ethylbenzene [3]. The *Cuminum cyminum* seeds essential oil components are cuminaldehyde (19.9–64.31%), γ -terpinene (6.49–27%), p-cymene (11.82–18.12%), beta-pinene (11.13–11.59%), 2-carene-10-al (7.93–11.20%), trans-carveol (4.49%), myrtenal (3.5%), cumic alcohol (2.8–16.92%), anethol & estragol (4.03–9.15%), cymol (2.9–4.26%), geraniol (0.02–2.39%), α -pinene (0.5–29.2%), limonene (0.5–21.7%), 1, 8-cineole (0.2–18.1%), linalool (10.4–10.5%), linalyl acetate (4.8%), α -terpineol (3.17%), α , β -dihydroxy-ethylbenzene (29.16%), cuminal (36.31%), safranal (10.87%), p-cymene (6.1–47.0 %), β -pinene (1.57–27 %), myrcene (0.3 %), p-menth-3-en-7-ol (0.7–17.5 %), p-mentha-1, 3-dien-7-ol (5.6%), caryophyllene (0.8%), β -bisabolene (0.9–1.01%), β -phellandrene (0.3%), d-terpinene (15.35–29.5 %), cuminal (8–17%), β -myrcene (1.3–1.75%), p-mentha-1, 4-dien-7-ol (1.0–16.9%), γ -terpinene-7-al (6.8–37.2%), cis-sabinene hydrate (0.04–0.06%), trans-sabinenehydrate (0.12–0.17%), terpinene-4-ol (0.16–0.28%), g-terpinene (6.1%), thymol (2.8%), p-cymen-7-ol (4.6%), 1-Isopropylidene-3-n-butyl-2-cyclobutene (6.62%), and alpha-acoradiene (1.62%) [4].

The *Cuminum cyminum* seeds essential oil has antimicrobial activity due to high level of cuminaldehyde and minority compounds as β -pinene limonene and α -pinene [5]. The pharmacological effects of the *Cuminum cyminum* seeds essential oil is antibacterial, the primary reason from the close link between chemical composition and pharmacological effects. It has an effect for the treatment of various diseases [6]. The chemical composition of *Cuminum cyminum* is focused on its essential oil, with a particular emphasis on cuminaldehyde and other monoterpenes. The UPLC-Q-Orbitrap MS and GC-MS analysis methods to comprehensively characterize the chemical constituents [2]. The *Cuminum cyminum* seeds essential oil have a total of 102 compounds were identified, 62 were systematically identified from the aqueous extract, include 10 flavonoids, 7 phenylpropanoids, 5 terpenoids, 4 alkaloids, 7 organic acids, 8 fatty acids, 8 amino acids, 2 glycosides and 10 other components. That contents have biological and therapeutic properties, and antimicrobial effects [2]. The *Cuminum cyminum* seeds essential oil have GC-MS analysis revealed 98.70% of the total. These include monoterpenes, sesquiterpenes, alkanes, alcohols, aldehydes, phenols, ketones, and alkylbenzenes. As the primary active substance, the chemical composition a scientific basis for its comprehensive utilization, cuminaldehyde demonstrates antibacterial. Cuminaldehyde possesses broad pharmacological activities. The GC-MS analysis revealed 41 constituents. The major was cuminaldehyde, γ -terpene, mentha-1,3 diene-7-al, and α -pinene [2]. The *Cuminum cyminum* seeds essential oil attributed to its chemical compounds, notably γ -Terpinene, which acts synergistically with sabinene against pathogens, α -pinene inhibit pathogenic bacteria by exerting toxic effects on cell membrane structure and function, thereby compromising cellular integrity and hindering both respiration and ion transport processes, so leading to alterations in cellular permeability. Furthermore, β -pinene and cymene, recognized for their antibacterial efficacy, further contributes to the overall antimicrobial potency [7].

The *Cuminum cyminum* seeds essential oil has antimicrobial properties. The antibacterial screening revealed an essential oil possesses potent antibacterial activity and has interesting pharmacological effects and could be use as antimicrobial drug [8].

The *Cuminum cyminum* seeds essential oil showed an antibacterial activity against all tested bacterial strains. These assessed the susceptibility which inhibited *Staphylococcus aureus* [9]. The *Cuminum cyminum* seeds essential oil pronounced antibacterial efficacy inhibit the growth of *Salmonella* sp. at low concentrations [10]. The *Cuminum cyminum* seeds essential oil demonstrated a bactericidal effect, against *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* sp. [11]. The *Cuminum cyminum* seeds essential oil effected against *Staphylococcus aureus*, *Bacillus* sp., *Escherichia coli*, *Salmonella* sp., *Vibrio* sp., *Candida albicans*, and *Aspergillus niger*. The highest inhibition was reported for *Bacillus subtilis*, *Aspergillus niger*, and *Vibrio* sp. [10]. The *Cuminum cyminum* seeds essential oil was inhibited *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* sp., and *Candida albicans* [11]. The *Cuminum cyminum* seeds

essential oil had effect *Staphylococcus aureus*, *Bacillus cereus*, *Clostridium tetani*, *Clostridium difficile*, *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, and *Aspergillus niger* [10]. The *Cuminum cyminum* seeds essential oil had the best inhibition against *Staphylococcus aureus*, *Salmonella typhimurium* and *Escherichia coli* [12]. The *Cuminum cyminum* seeds essential oil was affected *Bacillus subtilis*, *Bacillus cereus*, and *Staphylococcus aureus* [10]. The *Cuminum cyminum* seeds essential oil was antimicrobial against *Escherichia coli*, and *Staphylococcus aureus*. The greatest inhibition was for *Escherichia coli* [12]. The *Cuminum cyminum* seeds essential oil was affected *Escherichia coli*, *Staphylococcus aureus* and *Salmonella typhi*. The top inhibition was for *Salmonella typhi* [10]. The *Cuminum cyminum* seeds essential oil was antimicrobial on *Bacillus* sp., *Staphylococcus* sp., *Escherichia coli*, *Aspergillus niger*, and *Aspergillus flavus* [13]. The *Cuminum cyminum* seeds essential oil was disturb *Aspergillus niger*, and *Candida albicans*. *Candida albicans* was a high inhibition, then *Aspergillus niger* [14].

The importance was for testing the *Cuminum cyminum* seeds essential oil in protecting and eliminating digestive system pathogens. That was in order to protect and eliminate infection of the digestive system that which reduces chemical drugs uses and the side effects. So, that pursued to use an Arabian beneficial medicinal plant to dispense with the chemical treatment. The goal was to fix the *Cuminum cyminum* seeds essential oil role on digestive system pathogens. The methodology was a laboratory test to follow the effect of the *Cuminum cyminum* seeds essential oil on the digestive system pathogens.

Methodology:

Essential Oil Extraction:

The original *Cuminum cyminum* seeds were purchased from the central market and was identified. The seeds were cleaned and washed with distilled to remove dust. The *Cuminum cyminum* seeds were exposed to air to remove excess water and dried. The *Cuminum cyminum* seeds were ground in a sterile blender to form a powder that was easy to use for the experiment. The *Cuminum cyminum* seeds essential oil was obtained by the Clevenger apparatus hydro-distillation. Distillation was done by boiling 250 g of The *Cuminum cyminum* seeds powder with 1L water in a 2L flask for 4 hours. The resulting was the *Cuminum cyminum* seeds essential oil, that was carefully stored in an impervious glass container, maintained at a temperature of 4°C. That was considered as crude, and the dilution was by additional mineral created liquid average has Peptone 5.0g/L, Sodium Chloride 5.0g/L, and Yeast Extract 3.0g/L. So, the *Cuminum cyminum* seeds essential oil was obtained into concentration were included (crude, half-dilution and quarter-dilution) [15].

Digestive System Pathogens:

The digestive system pathogens were obtained from a "Private Laboratory". These were isolated and were identified that caused gastrointestinal infections. These were included: *Escherichia coli*, *Salmonella* sp., *Staphylococcus aureus*, *Bacillus cereus*, *Shigella* sp., *Clostridium* sp., *Campylobacter jejuni*, *Yersinia* sp., *Vibrio* sp., *Candida* sp., and *Aspergillus* sp. The digestive system pathogens suspensions were inoculated onto the "Mueller Hinton Agar" for 24 hours at 37 Degrees Celsius. Then the digestive system pathogens suspensions were created using pure colonies into "Peptone Water Broth" [16].

Experimental Steps:

The "Microtitration Plates" were used, that were used three wells for each digestive system pathogen. Fifty micro mL of the *Cuminum cyminum* seeds essential oil were placed in each well, followed by an adding the same amount of digestive system pathogen suspension in each well. The mixing process for the "Microtitration Plates" was carried out using an "Electric Vibrator". The "Microtitration Plates" were incubated at 35 to 37 degrees Celsius. The samples were taken from every well at 6 and 12 hours after incubation and cultured on "Chromosome Agar" to determine the digestive system pathogens growth after exposure to the *Cuminum cyminum* seeds essential oil [17].

Data Analysis:

The results were amassed, were treated by "Excel Program", and were presented in a table showing the digestive system pathogens culture percent after Cuminum cyminum seeds essential oil exposure [18].

Results And Discussions:

Microorganism	Time	Essential oil			Mean	Level	
		Crude (1)	Half (1/2)	Quarter (1/4)			
Escherichia coli	6hr.	5.2% ±0.04	8.7% ±0.02	15.2% ±0.03	9.7%	I	
	12hr.	0.00% ±0.00	0.00% ±0.00	0.00% ±0.00	0.00%		
Salmonella sp.	6hr.	5.6% ±0.03	9.1% ±0.01	15.3% ±0.02	10.0%		
	12hr.	0.00% ±0.00	0.00% ±0.00	0.00% ±0.00	0.00%		
Staphylococcus aureus	6hr.	5.8% ±0.04	9.4% ±0.01	15.5% ±0.03	10.2%		
	12hr.	0.00% ±0.00	0.00% ±0.00	0.00% ±0.00	0.00%		
Bacillus cereus	6hr.	8.2% ±0.03	12.3% ±0.02	22.2% ±0.02	14.2%	II	
	12hr.	0.00% ±0.00	0.00% ±0.00	9.0% ±0.04	3.0%		
Shigella sp.	6hr.	8.4% ±0.02	12.6% ±0.02	22.6% ±0.01	14.5%		
	12hr.	0.00% ±0.00	0.00% ±0.00	9.8% ±0.04	3.3%		
Clostridium sp.	6hr.	8.3% ±0.02	12.5 ±0.01	22.5% ±0.02	14.4%		
	12hr.	0.00% ±0.00	0.00% ±0.00	9.7% ±0.01	3.2%		
Campylobacter jejuni	6hr.	8.6% ±0.03	12.7 ±0.03	22.4% ±0.03	14.6%		
	12hr.	0.00% ±0.00	0.00% ±0.00	9.9% ±0.02	3.3%		
Yersinia sp.	6hr.	13.5% ±0.01	20.1% ±0.02	30.2% ±0.03	21.3%	III	
	12hr.	0.00% ±0.00	8.6% ±0.01	13.3% ±0.02	7.3%		
Vibrio sp.	6hr.	13.8% ±0.02	20.8% ±0.01	30.4% ±0.02	21.7%		
	12hr.	0.00% ±0.00	8.8% ±0.02	13.6% ±0.01	7.5%		
Candida sp.	6hr.	8.7% ±0.02	12.8 ±0.01	22.7% ±0.02	14.7%		IV
	12hr.	0.00% ±0.00	0.00% ±0.00	9.7% ±0.01	3.2%		
Aspergillus sp.	6hr.	8.8% ±0.02	12.9 ±0.01	22.6% ±0.02	14.8%		
	12hr.	0.00% ±0.00	0.00% ±0.00	9.8% ±0.01	3.3%		

Table 1: The digestive system pathogens culture percent after Cuminum cyminum seeds essential oil exposure

Table (1) exposed the digestive system pathogens culture percent after Cuminum cyminum seeds essential oil exposure. In the reverse order, it indicated the extent of digestive system pathogens elimination after six and twelve hours [1-4]. The (I) level of the digestive system pathogens was contained Escherichia coli, Salmonella sp., and Staphylococcus aureus, they were the most similar in their elimination after the Cuminum cyminum seeds essential oil exposure. The (I) group had culture mean (9.7%, 10.0% and 10.2%) at the 6th hours for all concentration of the Cuminum cyminum seeds essential oil, that were indicated that they did not completely eliminate. At the 12th hour, they were indicated mean (0.00%, 0.00%, and 0.00%) growth, thus, they were completely eliminated with all dilutions the Cuminum cyminum seeds essential oil [5-14]. The (II) level of the digestive system pathogens was contained Bacillus cereus Shigella sp., Clostridium sp., and Campylobacter jejuni. They were the most similar in their elimination after the Cuminum cyminum seeds essential oil exposure. The (II) group had culture mean (14.2%, 14.5%, 14.4%, and 14.6%) at the 6th hours for all concentration of the Cuminum cyminum seeds essential oil, that were indicated that they had growth, so they did not completely eliminate. At the 12th hour, they were indicated mean (3.0%, 3.3%, 3.2% and 3.3%) growth, thus, they did not completely eliminate with all dilutions the Cuminum cyminum seeds essential oil. They need more time for completely eliminated [5-14]. The (III) level of the digestive system pathogens was limited Yersinia sp., and Vibrio sp., they were the most alike in their elimination after the Cuminum cyminum seeds essential oil exposure. The (III) group had culture mean (21.3%, and 21.7%) at the 6th hours for all concentration of the Cuminum cyminum seeds essential oil, that were indicated that they had growth, so they did not completely eliminate. At the 12th hour, they were designated mean (7.3%, and 7.5%) growth, thus, they did not totally eliminate with all dilutions the Cuminum cyminum seeds essential oil. They need more period for totally eliminated [5-14]. The (IV) level of the digestive system pathogens was limited Candida sp., and Aspergillus sp. they were the greatest alike in their elimination after the Cuminum cyminum seeds

essential oil exposure. The (IV) group had culture mean (14.7%, and 14.8%) at the 6th hours for all concentration of the Cuminum cyminum seeds essential oil, that were designated that they had growth, so they did not totally eliminate. At the 12th hour, they were elected mean (3.2%, and 3.3%) growth, thus, they did not entirely eliminate with all dilutions of the Cuminum cyminum seeds essential oil. They need more time for wholly eliminated [5-14]. The crude Cuminum cyminum seeds essential oil had totally elimination for levels (I, II, III, & IV) of the digestive system pathogens. While the half (1/2) concentration had whole elimination for levels (I, II, & IV) of the digestive system pathogens. The quarter (1/4) concentration had whole elimination for level (I) solitary of the digestive system pathogens [1-4].

Conclusions:

It was concluded that the Cuminum cyminum seeds essential oil contains active ingredients for protecting and eliminating digestive system pathogens. So, these seeds essential oil can be used to develop alternative herbal medicines to treat infectious diseases caused, protecting against digestive system pathogens and maintaining digestive health. Therefore, the microscopic plant components, and multiple medical applications must be studied for prevention and herbal treatment of health problems.

Recommendations:

It was recommended that continuing in-depth research on the Cuminum cyminum seeds essential oil with a pharmacist, and determining the appropriate dose for protecting and eliminating digestive system pathogens. It is considered an alternative herbal treatment to reduce the need for chemotherapy.

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