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In vitro antibacterial activity of cumin (*Cuminum cyminum*) Against Gram-Negative Bacteria

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Abstract
The plant kingdom not only contributes to environmental equilibrium and oxygen production but also serves as a crucial source of modern medicines. Plant-based foods fulfil essential nutritional requirements, promote overall health, and enhance immune defenses against various illnesses. *Nigella sativa* L., commonly known as black cumin or black seeds, is a versatile herb renowned for its culinary and traditional medicinal significance. While its nutritional value is sometimes overlooked in scientific literature, black cumin is rich in protein, fats, essential fatty acids, amino acids, vitamins, and minerals. The synergy between its active phytochemicals and vital nutrients enhances immunity and contributes to overall well-being, establishing this herb as a valuable source of nutraceuticals. Antimicrobial resistance (AMR) stands as a formidable global public health challenge in the 21st century. To combat this urgent issue, the exploration of medicinal plants for treating a range of infections presents a promising solution. In our study, we evaluated the antibacterial potential of cumin seed extracts at different concentrations against a group of pathogenic gram-negative bacteria that have exhibited resistance to multiple drugs, all within a controlled laboratory environment.

Keywords: Protein, fats, essential fatty acids, amino acids

Introduction
Cumin, scientifically known as *Cuminum cyminum* Linn., is a highly significant seed spice in the commercial market. It belongs to the Umbelliferae family and is renowned for its distinctive aroma, as well as its medicinal and therapeutic properties. Originating from the Mediterranean region, cumin is extensively cultivated there [1]. In Hindi, it goes by the names zeera or jeera and is an annual herb. Its use in both traditional medicine and culinary applications dates back to ancient times. Cumin holds a prominent position among spices, ranking second only to black pepper in terms of importance. India stands as the world's largest producer and consumer of cumin, with the country also exporting various value-added products derived from cumin seeds, such as cumin seed oleoresins and cumin oil [2]. It's important to note that cumin should not be confused with sweet cumin, which is a common name for anise (*Pimpinella anisum*). Additionally, it is unrelated to *Nigella sativa,* often referred to as black cumin [3].

Cumin, derived from the dried seeds of the herb *Cuminum cyminum*, is a member of the parsley family. Cumin is primarily cultivated in the Indian subcontinent, Northern Africa, Mexico, Chile, and China. Due to its inclusion in birdseed and global exports, it can become an introduced species in various regions. The major cumin producers are China and India, responsible for 70% of the world's supply and consuming 90% of it (with India alone consuming 63% globally). Mexico is another significant producer, contributing to a worldwide annual production of approximately 300,000 tons [4]. Cumin seeds come in three prominent varieties, differing in seed color, oil content, and flavor: Iranian, Indian, and Middle Eastern. Cumin boasts validated therapeutic uses worldwide. In Ayurveda, it is recognized for its carminative, eupeptic, antispasmodic, and astringent properties, often employed to treat mild digestive issues, diarrhea, dyspepsia, flatulence, colic, edema, bronchopulmonary disorders, puerperal disorders, and as a cough remedy. Additionally, cumin is associated with benefits like improved vision, strength, and lactation. Traditional uses include treating toothaches, epilepsy, dyspepsia, and jaundice. Cumin exhibits various pharmacological effects, such as anti-diabetic, immunologic, anti-tumor, and antimicrobial activities [5].

The widespread antimicrobial resistance among pathogens to various drugs presents a significant challenge in treating various diseases. This issue is primarily attributed to the improper utilization of easily accessible antibiotics, extended hospital stays, and inadequate enforcement of infection control measures. Additionally, potent drugs that have not yet encountered antimicrobial resistance may either be inaccessible or expensive. To address this pressing concern, the utilization of medicinal plants for treating various infections emerges as a robust solution [6]. In this research, we assessed the antibacterial properties of cumin seed extracts of various concentrations. These cumin concentrations were tested against several pathogenic gram negative bacteria known for their resistance to multiple drugs in a laboratory setting.

Materials and methods

Cumin extract: To obtain freshly ground cumin powder, we gathered fresh cumin seeds and then ground them to the desired consistency using a mixer grinder. The resulting cumin powder was carefully stored in a clean, sterile bottle. Desirable concentrations of cumin seeds were obtained by mixing with distilled water.

Disc diffusion methods: Paper discs were created from filter paper, sterilized in an autoclave chamber and subsequently dried in an electric drying oven. Following sterilization, the discs were immersed in various concentrations for a 24-hour duration. Later disc diffusion method protocol method of reference author biemer [7].

Table 1: Disc diffusion setup

Replicates	Concentration of cumin powder
1	25% (25% powder, 75% distilled water)
2	50% (50% powder, 50% distilled water)
3	75% (75% powder, 25% distilled water)
4	100% (100% powder)
5	Control (Amoxicillin-Streptomycin)

Statistics

To assess potential variations in antibiotic effect or susceptibility levels among different concentrations, we performed a Least Significant Test (LST) for gram-negative bacteria. This statistical test is suitable for comparing multiple independent samples, regardless of their size.

Results and Discussion

Table 1 displays the susceptibility of specific gram-negative bacterial specimens, including *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Shigella dysenteriae*, *Enterobacter aerogenes*, and Escherichia coli. These specimens were tested in the laboratory, inoculated with varying cumin concentrations (25%, 50%, 75%, and 100%), and their susceptibility was compared to that of Streptomycin, serving as the positive control [8]. It also illustrates the susceptibility of gram-negative bacteria to various cumin concentrations. Cumin's effectiveness increased with concentration; at 25%, it exhibited a 4-8mm zone of inhibition, while at 75% -100%, it showed high inhibition zones ranging from 15-32mm. The table also compares the potent impact of high cumin concentration with the control, Streptomycin [9].

Table 2: Qualitative Assessment Results of bacterial inoculation of positive control and four concentrations of cumin on Gram-negative bacteria

GRAM (-VE) Bacteria	25%	50%	75%	100%	Streptomycin (Control)
Proteus mirabilis	04	12	15	20	22
Pseudomonas aeruginosa	08	25	28	30	32
Shigella dysenteriae	04	22	24	25	28
Enterobacter aero genes	06	20	26	28	30
Escherichia coli	08	25	29	32	36

The analysis reveals a highly significant difference among treatments. Specifically, treatment with streptomycin and cumin concentrations of 100% and 75% did not differ significantly from each other. However, they exhibited a significant contrast with treatments using 50% and 25% cumin concentration [10]. The data indicates that higher cumin concentrations correspond to increased susceptibility in gram-negative bacteria. In the absence of streptomycin, 75-100% cumin treatments are effective against gram-negative bacteria [9]. The ANOVA table indicates a test probability level of 0.0000, which is below the significance level of 0.05. This result signifies a highly significant difference among the treatments. (Table-2).

Table 3: Analysis of variance result

Source	DF	Sum of Square	Mean square	F value	Pr(>F)
Treatment	4	1724.9600	431.2400	19.12	0.0000**
Error	20	451.2000	22.5600		
Total	24	2176.1600			
Highly significant CV (%) (22.03) Mean (21.56)					

Table 3 mean statistical analysis of gram-negative bacteria treatment reveals that the highest susceptibility was observed in the Streptomycin (Control) group, recording 29.60 mm. This was followed by 100% cumin (100% powder) with a high susceptibility of 27.00 mm, then 75% cumin (75% powder, 25% distilled water) with 24.40 mm of high susceptibility. Additionally, 50% cumin (50% powder, 50% distilled water) exhibited moderately high susceptibility at 20.80 mm, while 25% cumin (25% powder, 75% distilled water) displayed lower susceptibility [11].

Table 4: Mean values of various concentrations of cumin

Treatment	Means
STREPTOMYCIN (CONTROL)	29.60^{a}
25% (25% powder, 75% distilled water)	6.00^{c}
50% (50%powder, 50% distilled water)	20.80^{b}
75% (75% powder, 25% distilled water)	24.40^{ab}
100% (100% powder)	27.00^{ab}

Means with the same letter are not significantly different.

In Figure 1, the susceptibility of gram-negative bacteria is evident. Escherichia coli displayed the highest susceptibility, followed by *Pseudomonas aeruginosa*, *Enterobacter* *aerogenes*, and *Shigella dysenteriae*, with *Proteus mirabilis* exhibiting the lowest susceptibility. When comparing treatment concentrations to streptomycin (control), 75% and 100% cumin powder demonstrated nearly identical effects on various gram-negative bacteria.

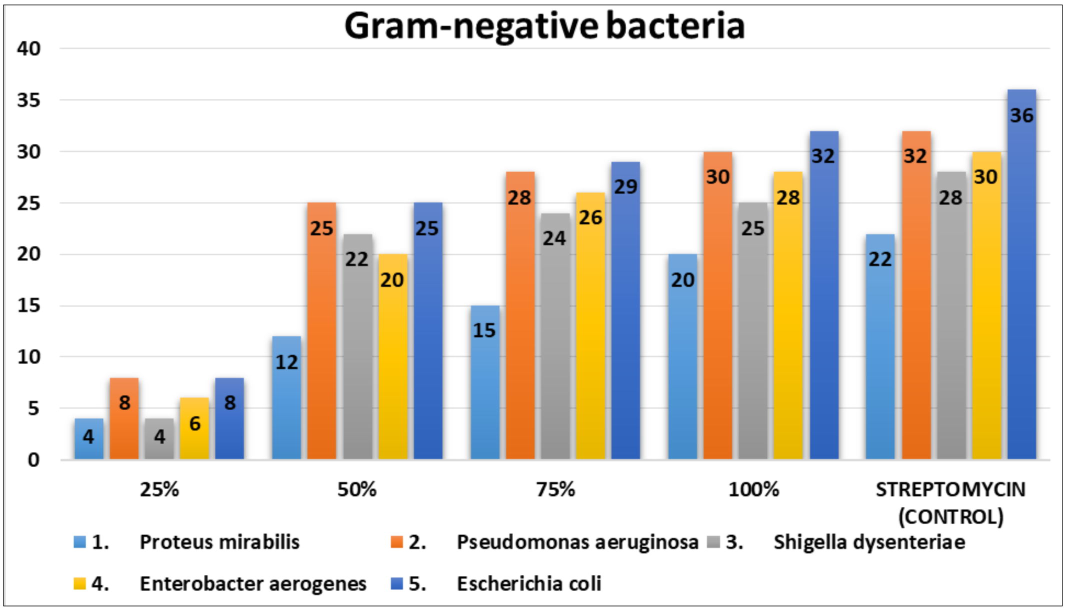

Fig 1: Gram negative bacteria's susceptibility (mm)

Our results clearly indicate that cumin, across various concentrations, exhibited inhibitory effects on the growth of gram-negative bacteria, resulting in zone of inhibition diameters ranging from 4 mm to 32 mm. Notably, *Proteus mirabilis* consistently displayed the smallest zone of inhibition across all cumin concentrations, while *Shigella dysenteriae* exhibited its lowest susceptibility at the 25% cumin concentration. In contrast, *E. coli* demonstrated the maximum zone of inhibition at concentrations of 50%, 75%, and 100%, while *Pseudomonas aeruginosa* exhibited its highest susceptibility at 25% and 50% cumin concentrations [12] (Figure-2).

These findings align with the research conducted by Nazia Masood, who similarly observed that cumin extracts inhibited the growth of S. aureus and *E. coli*, yielding zone diameters of 8.9±5.6 and 23.8±1.2, respectively [13]. This suggests that spices like cumin can serve as effective antimicrobial agents, potentially preventing bacterial deterioration in stored foods, provided that the taste remains acceptable in the targeted foods. Furthermore, the study highlights the potential for future research aimed at identifying the active compounds responsible for cumin's biological activity and elucidating the precise mechanisms behind its antimicrobial effects.

Fig 2: Gram negative bacteria diffusion plates

Conclusion

In summary, the emergence of multidrug resistance has become a prevalent issue, particularly among organisms associated with ailments like diarrhea and other enteric diseases. This is compounded by the concerning trend of resistance observed against commonly prescribed drugs, posing a significant challenge, especially in countries, where access to adequate healthcare can be limited. Therefore, cumin seeds, with their demonstrated antibacterial properties against various multidrug-resistant bacteria, offer a promising and cost-effective alternative for treatment. Further research is warranted to refine the extraction process of cumin seeds and isolate the specific components responsible for their antibacterial efficacy.

References

1. Saif S. Garlic. Medicinal plants of South Asia, Amsterdam: Elsevier; c2020.
2. Alkubaisy SA. Evaluation study of the anti-ulcer activities of *Cuminum cyminum* Seed extract against

ethanol-induced gastric ulcer in rats. Research Journal of Biotechnology. 2019;14:149-255.

3. Jain M, Jain S. Seed-borne nature of *Alternaria alternata* in Cumin, its detection and location in seed. Journal of Mycology and Plant Pathology (India); c1999.
4. Sachan A. Medicinal uses of spices used in our traditional culture: Worldwide. Journal of Medicinal Plants Studies. 2018;6(3):116-122.
5. Jiang TA. Health benefits of culinary herbs and spices. Journal of AOAC International. 2019;102(2):395-411.
6. Morrison L, Zembower TR. Antimicrobial resistance. Gastrointestinal Endoscopy Clinics. 2020;30(4):619-635.
7. Biemer JJ. Antimicrobial susceptibility testing by the Kirby-Bauer disc diffusion method. Annals of Clinical & Laboratory Science. 1973;3(2):135-140.
8. Bakht J. Antimicrobial activities of different solvents extracted samples of *Linum usitatissimum* by disc diffusion method. African Journal of Biotechnology. 2011;10(85):19825-19835.
9. Carson C, Riley T. Antimicrobial activity of the major components of the essential oil of *Melaleuca alternifolia*. Journal of applied bacteriology. 1995;78(3):264-269.
10. Chaudhry NMA, Tariq P. *In vitro* antibacterial activities of Kalonji, cumin and poppy seed. Pakistan Journal of Botany. 2008;40(1):461.
11. Al-Shawi SG, Al-Younis ZK, Abd Al-Kareem NF. Study of cumin antibacterial and antioxidant activity of alcoholic and aqueous extracts. Pakistan journal of biotechnology. 2017;14(2):227-231.
12. Bourgou S. Antioxidant, anti-inflammatory, anticancer and antibacterial activities of extracts from *Nigella sativa* (Black cumin) plant parts. Journal of Food Biochemistry. 2012;36(5):539-546.
13. Chaudhry NMA, Tariq P. Anti-microbial activity of *Cinnamomum cassia* against diverse microbial flora with its nutritional and medicinal impacts. Pakistan Journal of Botany. 2006;38(1):169.