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# Encapsulation of Karela Extract in Polymer Nanoparticles

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***Abstract***

*Karela (Momordica charantia) fruit extract possesses promising antibacterial properties. However, its direct application can be limited by factors like degradation and uncontrolled release. This study explores the encapsulation of Karela extract within biocompatible and biodegradable polymeric nanoparticles as a potential strategy to enhance its efficacy. The research investigates the development of nanoparticle systems using various polymers and their impact on the stability, controlled release, and antibacterial activity of the encapsulated Karela extract. The abstract will be further refined based on the specific polymers chosen and the evaluation methods employed. The overall goal is to demonstrate the feasibility of using polymer nanoparticles as a delivery system to improve the therapeutic potential of Karela extract against bacterial strains. Many plants, and their parts such as fruits, roots, stems, and extracts have medicinal value. Further the objective of the research was to examine the antibacterial function of Karela powder against laboratory strains. In this study, the karela fruit extract (25%) was prepared in the lab. The powder was diluted with sterile water and filtered through the bacteria-proof filter; a solution was used for the testing of the antimicrobial effectiveness of karela. The antimicrobial effectiveness of karela was assessed utilizing the agar disk diffusion method. Ten-fold dilutions of concentrated 10% aqueous extracts were made, and organisms were spread inoculated on the agar surface and wells were prepared by using a sterile borer and filled with different dilutions of karela solution. Eight isolates such as (four Gram-positive and four Gram-negative) were used as organisms under investigation, out of these eight only three were found organisms such as B. subtilis, M. luteus, and E. coli sensitive to both types of Karela solutions. Slightly increased sensitivity was observed to fresh Karela fruit extract. It indicates that the incorporation of Karela in a regular diet helps to maintain stomach health. Also, karela extract can be useful in controlling contamination of Bacillus subtilis, Micrococcus luteus, and E. coli.*

**Keywords:** Polymeric nanoparticles, karela, antimicrobial activity, escherichia coli, balsam pear, terpenoids, nanoparticles

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## INTRODUCTION

Globally, clinical infections resulting from resistant bacteria have emerged as a significant public health threat, resulting in over 700,000 fatalities annually, necessitating the exploration of alternative antimicrobial agents wherein Natural compounds have become one significant option [1]. Momordica charantia, often referred to as bitter melon or karela, is a vine native to tropics and subtropics regions, belongs to the Cucurbitaceae family. The discovery and development of multi-resistant bacteria has coincided with an increase in the need for novel antimicrobial drugs [2]. Bitter gourd, also known as karela, belongs to the Cucurbitaceae family and is used both as a

 

vegetable and in traditional folk medicine practices [3]. Karela has a rich historical background in traditional medicine systems, particularly in Asian and African cultures, for the treatment of various ailments, including infections. Numerous pharmacological studies have demonstrated the diverse biological activities of karela, including antimicrobial properties [4]. Its bioactive constituents, such as alkaloids, flavonoids, terpenoids, and phenolic compounds, are believed to contribute to its therapeutic effects. Using the bitter melon as a traditional remedy is very common in a number of regions [5]. Research conducted on karela has led to the discovery of numerous phytochemicals. Karela also has antioxidant, hypoglycemic, antitumour, antimicrobial, activities and has insulin-like substances [6, 7]. A recent study showed that the ethanolic extract of karela had limited activity against Proteus mirabilis and Klebsiella pneumoniae [2]. The antimicrobial activity of karela extract or powder has been extensively researched against various bacterial strains in laboratory settings. The antimicrobial mechanisms of karela are thought to involve the disruption of bacterial cell membranes, hinderance of bacterial enzymes, and interference with bacterial DNA replication or protein synthesis.[8] The central goal of this research is to assess the antibacterial function of karela powder derived from Momordica charantia against laboratory strains of bacteria.

**Encapsulation of Karela Extract in Polymer Nanoparticles**

Karela (Momordica charantia) fruit extract has gained attention for its potential antibacterial properties against various bacterial strains. However, its direct application faces limitations due to factors like:

*Uncontrolled release*: Direct application may lead to a rapid burst of the extract, potentially reducing its sustained antibacterial effect.

**Materials and Methods**

*Sample collection*: The commercially available karela powder was brought from an Ayurvedic medicine shop.

**The Experimental Methodology Will Involve the Following Steps:**

1. *Preparation of karela powder*: Fresh Momordica charantia fruits will be harvested, washed, and dried under controlled conditions. The dried fruits will be pulverized to obtain karela powder using a mechanical grinder or mortar and pestle.
2. *Bacterial strains*: These strains may encompass Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and other clinically relevant bacterial species.
3. *Antimicrobial assays:* The antimicrobial activity of karela powder will be evaluated using standard microbiological assays, such as the agar well diffusion method or broth microdilution method. Various concentrations of karela powder will be tested against bacterial cultures, and the zones of hindrance or growth hindrance will be measured.
4. *Determining* MIC which is known as the lowest content of karela powder that inhibits visible bacterial growth, while MBC is the minimal content that kills the bacteria.
5. *Synergistic studies*: Combination studies will be conducted to assess the potential synergistic effects of karela powder in combination with conventional antibiotics against multidrug-resistant bacterial strains. The fractional inhibitory concentration index will be computed to ascertain the nature of the interaction between karela powder and antibiotics.
6. *Mechanistic studies*: Biochemical and molecular techniques, such as scanning electron microscopy, transmission electron microscopy, DNA fragmentation assays, and protein synthesis hindrance assays, will be employed to elucidate the underlying antimicrobial mechanisms of karela powder.

**Agar Disk Diffusion Method**

The antimicrobial effectiveness of karela aqueous extract was assessed utilizing the agar disk diffusion method, in this method 10 -fold dilutions of concentrated karela aqueous extract was prepared and used to study their antimicrobial activity. The wells were made with the help of the cork borer and

 

0.1mL of each dilution was poured with sterile pipette. All the plates were allowed to diffuse and kept for incubation at 37°C for 24 -h. After incubation zones of hinderance were recorded in tabular form shown in Table 1.

## RESULTS

It is revealed from the above table that the aqueous extract of karela juice shows antimicrobial effectiveness against *Bacillus subtilis (Gram positive), Micrococcus luteus (Gram negative) and E. coli. (Gram negative)* And have no antimicrobial effectiveness against *Bacillus cereus, Salmonella typhi, Proteus vulgaris, Staphylococcus aureus, Pseudomonas aeruginosa* and it shows maximum antimicrobial activity against *Bacillus subtilis.*

**Table 1.** Antimicrobial effectiveness of Karela against test organisms.

| S N. | Test organism | Zone of hinderance (in mm) | | | |
|---|---|---|---|---|---|
| | | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ |
| 1 | *Bacillus cereus* | - | - | - | - |
| 2 | *Salmonella typhi* | - | - | - | - |
| 3 | *Proteus vulgaris* | - | - | - | - |
| 4 | *Micrococcus luteus* | 21 | 17 | - | - |
| 5 | *Bacillus subtilis* | 20 | 18 | - | - |
| 6 | *Staphylococcus aureus* | - | - | - | - |
| 7 | *Pseudomonas aeruginosa* | - | - | - | - |
| 8 | *Escherichia coli* | 19 | 16 | - | - |

## DISCUSSION

The antibacterial function of karela powder on laboratory strains of bacteria has yielded notable results, shedding light on its potential as a natural antimicrobial agent [9]. The study revealed significant antimicrobial activity of karela powder against laboratory strains of bacteria [10]. This aligns with previous research indicating the antimicrobial properties of Momordica charantia. [11]. Exploring the mechanisms underlying the antimicrobial activity of karela powder is essential. Karela encompasses a range of bioactive compounds, including charantin, momordicin, and cucurbitacins, which potentially attribute to its antimicrobial effects [12]. Incorporating karela powder into pharmaceutical formulations or as a food additive could enhance antimicrobial properties and extend shelf life. Additionally, utilizing karela powder in healthcare settings may help combat bacterial infections, particularly those resistant to conventional antibiotics [13]. Despite its promising antimicrobial activity, several challenges and limitations should be acknowledged. Variability in the composition of karela powder due to factors such as plant genotype, growing conditions, and extraction methods may influence its efficacy. Moreover, the susceptibility of bacterial strains to karela powder could vary, necessitating further research to identify optimal conditions for its use [14]. Subsequent research endeavors should prioritize unraveling the distinct bioactive compounds accountable for the antimicrobial efficacy of karela powder and elucidating their mechanisms of action. Additionally, conducting in vivo studies to measure the protection and productivity of karela powder in animal models is crucial. Furthermore, exploring potential synergistic effects of karela powder with existing antibiotics or other natural antimicrobial agents could enhance its therapeutic potential [15].

## CONCLUSION

The effects of this research are anticipated to offer important insights into the antimicrobial properties of karela powder extracted from Momordica charantia. By elucidating its antimicrobial mechanisms and evaluating its efficacy against laboratory strains of bacteria, this research may contribute to the development of novel natural antimicrobial agents for combating bacterial infections and addressing the challenges of antibiotic resistance. Moreover, the utilization of karela powder in combination with conventional antibiotics may offer synergistic effects and enhance treatment outcomes against multidrug-resistant bacterial pathogens.

 

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