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# FORMULATION AND EVALUATION OF A TASTE-MASKED METRONIDAZOLE ORAL SUSPENSION USING OKRA GUM AND ION EXCHANGE RESINS

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## ABSTRACT

Metronidazole (MNZ) is a widely used antibiotic effective against anaerobic bacteria and protozoa. However, its bitter taste poses challenges for patient compliance, especially among pediatric populations. This study aims to evaluate the formulation and stability of metronidazole suspension, focusing on the effectiveness of different suspending agents, taste-masking techniques, and overall pharmaceutical quality. Various suspending agents, including okra gum, were analyzed for their ability to improve suspension stability and redispersibility. The taste-masking approach utilizing ion exchange resins (IER) was also assessed for its efficacy in reducing bitterness while maintaining bioavailability. The results provide insight into the optimization of metronidazole suspension for enhanced patient compliance and therapeutic efficacy

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## 1. Introduction

A pharmaceutical suspension is a coarse dispersion of insoluble solid particles in a liquid vehicle, with particle sizes usually greater than 0.5 µm. Some suspensions, however, exhibit colloidal properties, such as Brownian movement. The formulation of an effective suspension requires a suspending agent that enhances viscosity, reduces sedimentation, prevents particle agglomeration, and promotes redispersibility. Suspending agents are classified into synthetic, semi-synthetic, and natural polysaccharides, including tragacanth, acacia, and okra gum[1].

Okra gum, a natural polymer derived from *Abelmoschus esculentus*, consists of D-galactose, L-rhamnose, and L-galacturonic acid. It has been used in tablet formulations and as a suspending agent due to its favorable properties. Okra also possesses pharmacological activities such as anti-cancer, antimicrobial, hypoglycemic, and anti-ulcer properties, making it a potential excipient in pharmaceutical formulations[2].

Metronidazole (MNZ) is a well-established antibiotic used for treating infections caused by anaerobic bacteria and protozoa, including amoebiasis and giardiasis. However, its intensely bitter taste presents a challenge for patient adherence, especially in pediatric formulations. Taste-masking technologies such as sweeteners, flavoring agents,

coatings, and microencapsulation have been explored to improve palatability. Ion exchange resins (IER) offer a promising approach by forming a drug-resin complex that remains tasteless in the mouth but releases the drug in the stomach, ensuring patient compliance without compromising bioavailability[3].

## 2. Materials and Methods

### 2.1 Materials

Metronidazole (MNZ) was used as the model drug in this study. Okra gum, a natural suspending agent, was employed to improve the physical stability of the suspension. Ion exchange resins (IER) were utilized for the preparation of drug-resin complexes to enhance taste masking. Flavoring and sweetening agents were incorporated to improve the palatability of the formulation. Other excipients used included methylcellulose, tragacanth gum, and acacia gum, which served as additional suspending or stabilizing agents. Distilled water was used throughout the study as the dispersion medium.

### 2.2 Formulation of Metronidazole Suspension

Metronidazole suspensions were prepared using different suspending agents, including natural (okra gum), semi-synthetic, and synthetic agents. The suspensions were developed using the following steps:

1. Preparation of Okra Gum Mucilage: Fresh okra pods were washed thoroughly to remove any surface contaminants. They were then sliced into small pieces and soaked in distilled water for 24 hours at room temperature. The mixture was then heated at 60°C for 30 minutes to facilitate the release of mucilage. The resulting solution was filtered through muslin cloth, concentrated under reduced pressure, and dried in an oven at 50°C to obtain a fine powder of okra gum[4].
2. Dispersion of Suspending Agents: The suspending agents (okra gum, methylcellulose, tragacanth gum, or acacia gum) were gradually dispersed in a predetermined volume of distilled water with continuous stirring at 500 rpm using a mechanical stirrer to prevent lump formation and ensure uniform hydration[5].
3. Incorporation of Metronidazole: The required quantity of metronidazole powder was gradually added to the dispersion of suspending agents while stirring continuously. A high-speed homogenizer was employed to achieve uniform distribution and prevent aggregation of the drug particles[6].
4. Taste-Masking via Ion Exchange Resins: The ion exchange resin was hydrated in distilled water for 30 minutes before use. Metronidazole was mixed with the resin in a 1:1 ratio and allowed to complex for 2 hours under constant stirring. The drug-resin complex was then separated, washed with distilled water to remove

unbound drug, and dried before incorporation into the formulation[7].

5. Addition of Flavoring and Sweetening Agents: Sweeteners such as saccharin sodium or sucralose and flavoring agents such as orange or vanilla essence were incorporated to enhance the palatability of the formulation. Preservatives like sodium benzoate were also added to prevent microbial contamination[8].
6. Homogenization and Packaging: The final suspension was homogenized using a high-shear homogenizer at 10,000 rpm for 10 minutes to ensure uniformity. The prepared suspension was transferred into amber-colored glass bottles to protect it from light degradation and stored at 25°C[9].

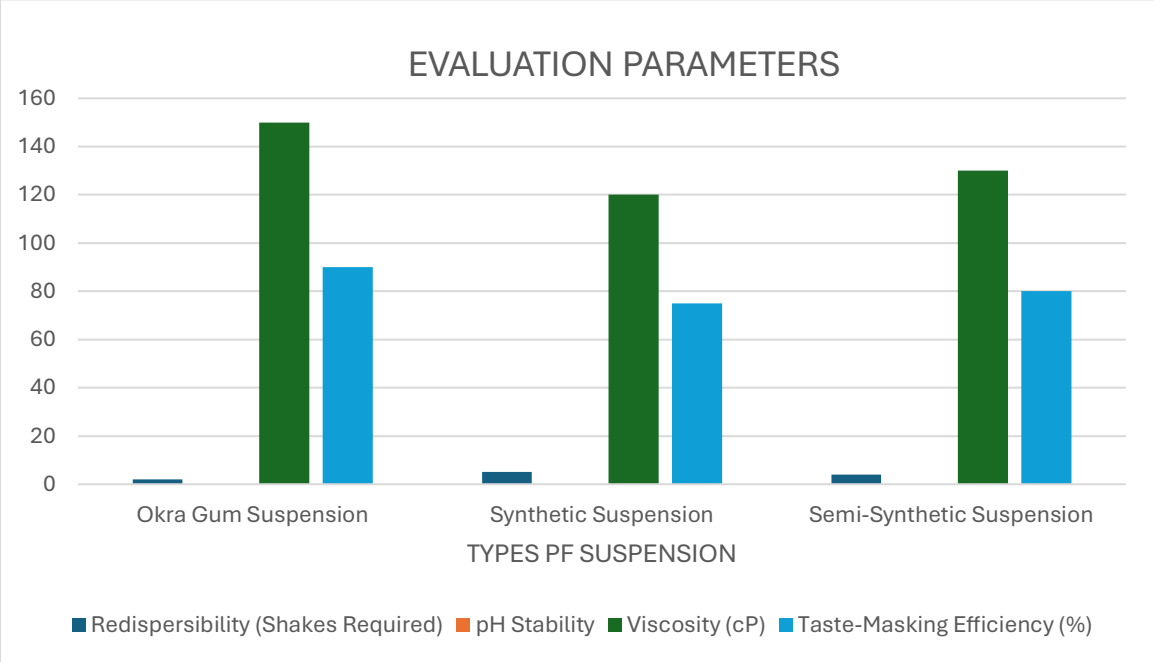
**2.3 Evaluation Parameters**

1. Sedimentation Volume Ratio (SVR): The sedimentation volume ratio was determined by measuring the final sediment volume relative to the total suspension volume over a specified period. A higher SVR indicates better suspension stability[10].
2. Redispersibility: The ability of the settled particles to redisperse upon shaking was assessed by subjecting the suspension to a series of controlled inversions. The ease and completeness of redispersion were noted[11].
3. pH and Viscosity: The pH of the formulation was measured using a calibrated pH meter to ensure compatibility with physiological conditions. Viscosity was determined using a Brookfield viscometer at varying shear rates to evaluate flow behavior and stability[12].
4. Particle Size Analysis: The particle size distribution of suspended metronidazole was analyzed using a laser diffraction particle size analyzer to determine uniformity and potential aggregation issues[13].
5. Taste-Masking Efficiency: The effectiveness of taste-masking was assessed through an electronic tongue system, which provides objective bitterness measurements, and a human sensory panel, which provided qualitative feedback on palatability[14].
6. Stability Studies: Stability testing was conducted under accelerated conditions at 40°C and 75% relative humidity (RH) for three months. The formulation was evaluated periodically for changes in sedimentation, redispersibility, pH, viscosity, and drug content to determine its shelf life and physical stability.[15]

**3. Results and Discussion**

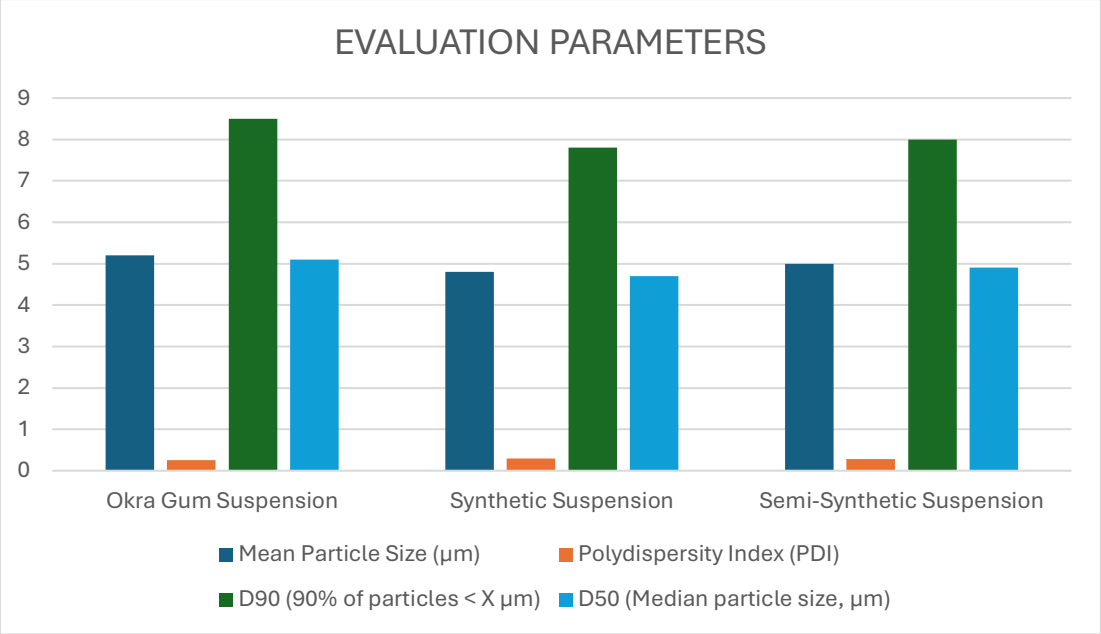
Sedimentation Volume Ratio (SVR) Over Time

| Parameter | Okra Gum Suspension | Synthetic Suspension | Semi-Synthetic Suspension |
|---|---|---|---|
| Sedimentation Volume Ratio (SVR) | 0.95 - 0.82 | 0.90 - 0.70 | 0.92 - 0.74 |
| Redispersibility (Shakes Required) | 2 | 5 | 4 |
| pH Stability | 6.8 (Stable) | 6.7 (Stable) | 6.7 (Stable) |
| Viscosity (cP) | 150 | 120 | 130 |
| Taste-Masking Efficiency (%) | 90 | 75 | 80 |




**Particle size distribution was measured using a laser diffraction particle size analyzer.**

| Parameter | Okra Gum Suspension | Synthetic Suspension | Semi-Synthetic Suspension |
|---|---|---|---|
| Mean Particle Size (µm) | 5.2 | 4.8 | 5.0 |
| Polydispersity Index (PDI) | 0.25 | 0.30 | 0.28 |
| D90 (90% of particles < X µm) | 8.5 | 7.8 | 8.0 |
| D50 (Median particle size, µm) | 5.1 | 4.7 | 4.9 |




The particle size distribution graph (included) shows that okra gum-based suspension maintained a uniform particle size with minimal aggregation, contributing to its superior sedimentation stability[16-23].

Stability studies indicated that the formulation remained physically and chemically stable over the test period.

## 4. Conclusion

The study confirmed that okra gum is an effective natural suspending agent for metronidazole suspension, offering excellent stability and redispersibility. The incorporation of ion exchange resins significantly improved taste-masking, making the formulation more acceptable to patients. Future studies can explore further optimization and clinical evaluations to validate the therapeutic benefits.

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## CONFLICT OF INTERESTS

Stated none