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Development and Evaluation of an Onion Peel Based Effervescent Water Purifier Powder

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Abstract
Access to safe drinking water remains a major public health challenge due to microbial and chemical contamination. The present study focuses on the development and evaluation of an eco-friendly effervescent water purifier powder formulated using onion peel, an abundant agricultural waste rich in plant derived compounds.The effervescent formulation was prepared using onion peel powder in combination with citric acid, sodium bicarbonate, activated charcoal, and natural excipients.The prepared powder was evaluated for bioactive properties, plant-derived constituents, microbiological efficacy, and water clarity improvement using soil and sewage water samples. Results demonstrated rapid effervescence, effective pH neutralization, significant reduction in microbial load (up to 93%), and notable decrease in turbidity within four hours of treatment. Phytochemical screening confirmed the presence of tannin, saponins, terpenoids, and cardiac glycosides contributing to antimicrobial activity. The study concludes that onion peel-based effervescent powder offers a cost-effective, sustainable, and efficient solution for point-of-use water purification, especially in resource-limited settings.

Keywords: Onion peel waste; Effervescent water purifier; Agricultural waste utilization; Antimicrobial water purification; Sustainable water treatment.

1. Introduction

Safe and clean drinking water is essential for human survival, yet millions of people worldwide are exposed to contaminated water sources containing pathogenic microorganisms, organic pollutants, and chemical residues. Consumption of unsafe water is directly linked to waterborne diseases such as cholera, typhoid, dysentery, and hepatitis A, particularly in developing countries where access to advanced water treatment technologies is limited.

Conventional water purification methods such as boiling, chlorination, filtration, and ultraviolet treatment are effective but often limited by high cost, energy dependence, chemical by-products, and maintenance requirements. This has led to increasing interest in sustainable and nature-based alternatives utilizing plant materials and agricultural waste.

Onion (Allium cepa) peel is a widely available agricultural by-product generated in large quantities during food processing. Despite being considered waste, onion peel is rich in flavonoid, phenolic acids, tannin, and other bioactive compounds known for antimicrobial and antioxidant properties. These compounds enable onion peel to adsorb pollutants and inhibit microbial growth.

Effervescent formulations offer advantages such as rapid dispersion, ease of application, and uniform release of active compounds in water. By combining onion peel powder with effervescent agents, a user-friendly and effective water purification system can be developed. The present study aims to formulate and evaluate an onion peel-based effervescent water purifier powder and assess its physical, chemical, and microbiological performance.

2. Materials and Methods

Dried onion peels, citric acid, sodium bicarbonate, activated charcoal, corn starch, and stevia were used for formulation. All chemicals were of analytical grade. Nutrient agar media was used for microbial analysis.

Preparation of powder

Onion peels were collected from local vegetable vendors, washed thoroughly with distilled water, and shade-dried followed by oven drying at 50 °C. The dried peels were ground into a fine powder and sieved to obtain uniform particle size.

Formulation of Effervescent Powder

Ingredient	Quantity (g)
Dried onion powder	20 g
Citric acid	25 g
Sodium bicarbonate	25 g
Activated charcoal	01 g
Sweetener (stevia)	1-2 g
Cornstarch	2-3 g

Table 1. Composition of onion peel-based effervescent water purifier powder.

The effervescent water purifier powder was prepared by thoroughly mixing the ingredients in measured proportions as shown in table no 1. The mixture was stored in airtight containers to prevent moisture absorption and was optimized for experimental water purification studies at laboratory scale .

The overall preparation and evaluation process was carried out systematically under laboratory conditions to ensure reproducibility and effectiveness of the developed water purifier powder.

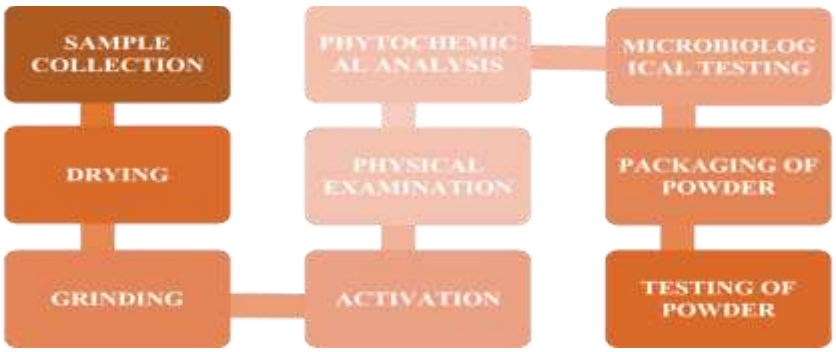

Figure 1. Flow chart depicting the preparation and evaluation of onion peel based effervescent water purifier powder.

Physical Evaluation

The formulation was evaluated for appearance, texture, effervescence time, and pH change before and after treatment using standard procedures.

Bioactive compounds analysis

Qualitative screening was performed to detect tannins, saponins, flavonoids, terpenoids, cardiac glycosides, and reducing sugars using standard chemical test.

Phytochemical test	observation
Tannins	Present
Saponins	Present
flavonoids	Absent
Terpenoids	Present
Cardiac glycosides	Present
Reducing sugars	Present

Table 2. phytochemical analysis of onion peel based water purifier powder

Microbiological Analysis

Soil water and sewage water samples were collected in sterile containers. Total viable count was determined using nutrient agar before and after treatment with the effervescent powder. Plates were incubated at 37 °C for 24 hours and colonies were counted.

Figure 2. Reduction in bacterial colonies in water samples before and after treatment with effervescent water purifier powder.

Colorimeter Analysis

Water samples were analyzed using a colorimeter at 580 nm and 630 nm to assess turbidity reduction over time intervals of 0, 2, and 4 hours.

3. Results and Discussion

Physical Evaluation

The effervescent powder exhibited uniform texture and rapid effervescence within 30–60 seconds. The pH of acidic water samples was neutralized to the acceptable drinking water range (6.5–7.5). Visual clarity of water improved significantly after treatment.

Parameters	Before treatment	After treatment
Appearance	Browinish yellow	Clear water
Effervescence time	Not applicable	1-2 minutes of bubbling

pH	5.7	6.5

Table 3: Physical Parameters of Treated Water.

Assessment for microbial analysis

A substantial marked reduction in microbial load was observed after treatment. Soil water showed a 93% reduction, while sewage water exhibited approximately 90% reduction in total viable count after four hours indicating significant antimicrobial activity of the effervescent formulation.

Colorimetric Analysis

Progressive improvement in water clarity was observed with treatment time. Absorbance values decreased significantly over time, confirming effective removal of suspended particles and organic matter.

The high purification efficiency of the formulation can be attributed to the synergistic action of onion peel phytochemical and activated charcoal. Effervescence enhanced dispersion, improving contact between bioactive compounds and contaminants. The findings support the use of agricultural waste-derived materials for sustainable water purification.

4. Conclusion

The onion peel-based effervescent water purifier powder developed in this study demonstrated effective microbial reduction, pH stabilization, and turbidity removal. The formulation is eco-friendly, economical, and simple to use, making it suitable for rural and low-resource areas. Utilization of onion peel waste also contributes to environmental sustainability. Further studies are recommended for long-term stability and large-scale application.

5. References

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