



Turning Trash into Treasure: Recycling Used Alginate Impression Material into Prophylactic Paste

(Clean Smiles from Cast-Offs)

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DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form, the participants have given their consent for their clinical information to be reported in the journal. The participants understand that their name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

(Received: 27 September 2025 Revised: 05 October 2025 Accepted: 14 October 2025)

KEYWORDS

Recycled alginate, diatomaceous earth, prophylactic paste, antimicrobial activity, dental waste management, Streptococcus mutans, E. coli

ABSTRACT:

Background:

Dental impression materials, particularly alginate, are routinely discarded after use, contributing to significant clinical waste. This study explores a novel approach to recycling used alginate impression material by extracting diatomaceous earth for the formulation of a prophylactic paste.

Aim and Objectives:

To extract diatomaceous earth from used alginate and formulate a prophylactic paste, assessing its basic characteristics (pH and foamability) and antimicrobial efficacy.

Results:

The formulated paste exhibited antimicrobial activity, with a 0.5 cm zone of inhibition against *Streptococcus mutans* and *Escherichia coli*. No inhibition was observed against *Enterococcus faecalis*. The positive control demonstrated a 3 cm inhibition zone, while the negative control showed no microbial inhibition.

Conclusion:

The prophylactic paste derived from recycled alginate demonstrated moderate antimicrobial activity, particularly against *S. mutans* and *E. coli*. This approach highlights the potential for sustainable and cost-effective dental hygiene products utilizing clinical waste.



INTRODUCTION

Alginate impression materials are extensively used in dentistry due to their simplicity, affordability, and effectiveness. However, their disposal post-use adds to the mounting waste burden in dental clinics. A major component of alginate is diatomaceous earth, a naturally occurring silica-based substance known for its abrasive and antimicrobial characteristics. Repurposing this component can serve dual purposes: reducing dental waste and developing innovative oral care products. This study proposes a method to recycle used alginate by isolating diatomaceous earth and using it to create a prophylactic paste, aligning with sustainable dental practices.

AIM AND OBJECTIVES

Aim:

To extract diatomaceous earth from used alginate impression material and formulate a prophylactic paste.

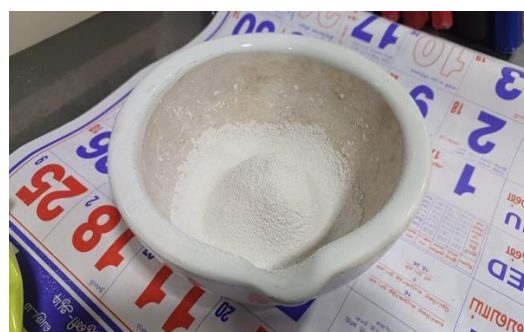
Objectives:

- To characterize the pH and foamability of the formulated paste.
- To evaluate its antimicrobial efficacy against *Streptococcus mutans*, *Escherichia coli*, and *Enterococcus faecalis*.

MATERIALS AND METHODS

1. Extraction of Diatomaceous Earth from Used Alginate

Used alginate impression material was allowed to air-dry for 48 hours. The dried material was then incinerated in a burnout furnace at 800°C for 30 minutes. The resulting ash was finely ground using a mortar and pestle to obtain diatomaceous earth.



2. Formulation of Prophylactic Paste

The paste was prepared using the following ingredients:

- Glycerine
- Sorbitol
- Water
- Liquid paraffin
- Menthol
- Sodium lauryl sulfate
- Calcium carbonate
- Calcium phosphate
- Recycled diatomaceous earth

The ingredients were mixed to achieve a homogenous and stable paste suitable for oral application.

INGREDIENTS USED FOR THE PASTE PREPARATION





RESULTS

Microorganism	Zone of Inhibition
<i>Streptococcus mutans</i>	- 0.5 cm
<i>Escherichia coli</i>	- 0.5 cm
<i>Enterococcus faecalis</i>	- 0 cm
Positive Control	- 3 cm
Negative Control	- No inhibition

The paste demonstrated mild antimicrobial activity against *S. mutans* and *E. coli*, with no inhibitory effect on *E. faecalis*. The positive control confirmed assay reliability.

DISCUSSION

The current study demonstrates a novel method of recycling used alginate impression material to extract diatomaceous earth, which was then incorporated into a prophylactic paste. The paste showed moderate antimicrobial efficacy, specifically against *Streptococcus mutans* and *Escherichia coli*, but not against *Enterococcus faecalis*. These findings have several implications for both dental waste management and the development of sustainable oral care products.

Diatomaceous earth (DE), a natural siliceous sedimentary rock, is primarily composed of fossilized remains of diatoms. It is widely recognized for its abrasive properties and is commonly used in polishing and cleaning agents. In dental materials, DE contributes to the consistency and handling of impression materials and toothpaste abrasiveness. Prior studies have highlighted its mechanical cleaning action and minor antimicrobial properties due to its porous surface and ability to disrupt microbial cell walls through desiccation and physical abrasion [1,3].

The antimicrobial results in this study align partially with prior investigations. The inhibition zones observed against *S. mutans* and *E. coli* suggest that DE-containing formulations can interfere with certain bacterial colonization, especially those involved in early plaque formation. *S. mutans* is a primary agent in dental caries, and its inhibition is a desirable feature in prophylactic products [4]. *E. coli*, although not a typical oral pathogen, serves as a model for Gram-negative organisms in laboratory studies. The lack of activity against *E. faecalis*, a Gram-positive facultative anaerobe known for its resistance to various antimicrobial agents and presence in endodontic failures, highlights a limitation of the current formulation. *E. faecalis* is known to survive in harsh environments, including high pH, and often forms resilient biofilms [5,6].

The moderate efficacy compared to the positive control (zone of inhibition: 3 cm) suggests that while recycled DE-based formulations may not yet match the potency of commercial antimicrobial agents, they offer a promising baseline for eco-conscious dental products. Combining DE with other bioactive compounds, such as essential oils (e.g., tea tree oil or thymol), zinc oxide, or herbal extracts, may enhance



antimicrobial spectrum without compromising biocompatibility [7,8].

Additionally, the environmental impact of dental materials is becoming a growing concern. Studies estimate that a significant proportion of dental waste is composed of impression materials, which are non-biodegradable and add to the clinic's ecological footprint [9]. Recycling used alginate not only reduces waste but also supports the global movement toward green dentistry and circular bioeconomy. The use of incineration followed by grinding for DE recovery is relatively simple and can be scaled in institutional settings with appropriate safety protocols.

Foamability and pH are important characteristics in oral care products. While not elaborated in the present results, optimal pH ensures the product is neither erosive to enamel nor conducive to bacterial proliferation. Sodium lauryl sulfate and calcium carbonate in the formulation likely contribute to the cleansing action and foaming, enhancing patient acceptability [10].

From a materials science perspective, the heat treatment of alginate likely removes organic residues, leaving behind siliceous material with high surface area. This thermal decomposition at 800°C is consistent with calcination protocols used to derive silica-rich residues from biogenic materials, increasing both purity and antimicrobial potential [11].

The white powder recovered post-incineration of alginate represents a highly versatile material. In addition to its incorporation into the prophylactic paste, the pure powder shows promise as a standalone tooth powder, offering a minimal-ingredient, dry formulation option. Historically, tooth powders were common before the widespread adoption of toothpaste, and they are still used in many regions for their simplicity and longer shelf life.

The physical characteristics of the recovered powder—fine particle size, abrasiveness, and non-hygroscopic nature—make it an ideal candidate. Unlike commercial powders that often contain synthetic additives, this material is entirely derived from recycled dental waste, supporting both biocompatibility and eco-friendliness. Moreover, the natural silica content of

diatomaceous earth provides a mild scrubbing effect without damaging enamel when used properly [1,3].

Its reusability in both wet (paste) and dry (powder) forms adds to the economic and practical appeal. Future directions could include adding natural flavoring agents (e.g., mint, clove, or neem extract) to improve user experience and exploring its cleaning efficacy in clinical settings.

CONCLUSION

Recycling used alginate impression material for the development of prophylactic paste is both environmentally and economically beneficial. The formulated paste demonstrated moderate antimicrobial effects, particularly against *S. mutans* and *E. coli*, indicating its promise as a sustainable oral hygiene product. Further studies may help enhance its antimicrobial spectrum and optimize its formulation.



Further research should explore:

- Cytotoxicity and biocompatibility of the formulated paste on oral tissues.
- Optimization of the particle size and concentration of recycled DE.
- Inclusion of synergistic antimicrobial agents.



- Comparative cleaning efficacy with commercial prophylactic pastes.

The successful extraction of a white powder from used alginate opens a new avenue for dual-purpose recycling—as a base for both prophylactic paste and tooth powder. The standalone use of the powder offers a minimalistic, sustainable, and cost-effective alternative for oral hygiene, especially in resource-limited settings. This further reinforces the value of alginate recycling in promoting green dentistry and innovative product development.

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