Antibacterial Effectiveness of a Mixed Paste of Aloe Vera Powder (*Aloe barbadensis Miller*), Calcium Hydroxide, and Omeprazole Against *Enterococcus faecalis*: An In Vitro Study

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Background

Root canal failure is often caused by *Enterococcus faecalis*, a resistant bacterium that survives even in calcium hydroxide [$Ca(OH)_2$]. Omeprazole enhances $Ca(OH)_2$ efficacy by disrupting *E. faecalis* defenses, while Aloe vera offers natural antibacterial and biocompatible properties.
This study explores the synergy of Aloe vera, $Ca(OH)_2$, and omeprazole, introducing a more effective, safe, and practical intracanal medicament.

Objectives

This study evaluates the antibacterial effectiveness of Aloe vera powder combined with calcium hydroxide against *E. faecalis* compared to single-paste formulations. It also examines the efficacy of Aloe vera with omeprazole and assesses whether the combination of Aloe vera, calcium hydroxide, and omeprazole provides superior antibacterial activity over single or dual-component formulations.

Methodology

This laboratory study evaluates the antibacterial efficacy of Aloe vera and proton pump inhibitors combined with calcium hydroxide against *Enterococcus faecalis* using a post-test control group design

Materials


Calcium Hydroxide Powder

Omeprazole Powder


Powdered Freeze-Dried Aloe Vera

1. Zone of Inhibition Test

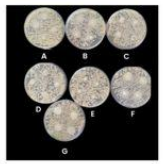
This study used the agar diffusion method (well and disc techniques) to assess *E. faecalis* inhibition. Bacterial cultures (McFarland 0.5) were inoculated onto BHIA media. Test material was applied in 5 mm wells or on discs soaked for 15 minutes. Calcium hydroxide served as a positive control. After 24-hour incubation at 37°C, inhibition zones were measured with a 0.01 mm precision caliper (triplicate tests).

2. Direct Contact Test

The antibacterial activity was tested using the Direct Contact Test (DCT) on a 96-well microtiter plate. E. faecalis (10 µL) was inoculated onto hardened test material, with untreated wells as controls. After incubation (37°C, 100% humidity) for 2, 5, 20, and 60 minutes, BHIB was added, homogenized, and serially diluted for CFU/mL counts on BHIA after 24 hours. Tests were performed aseptically in triplicate.

Results

Inhibition Test

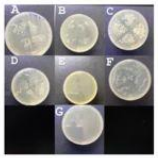


Result of inhibition test in agar well plates. A: Calcium hydroxide; B: Omeprazole + calcium hydroxide; C: Aloe vera + omeprazole; D: Omeprazole; E: Aloe vera; F: Aloe vera + omeprazole + calcium hydroxide; G: Aloe vera + calcium hydroxide

Graph of Inhibition Zone Test Results

The MIX group (Aloe vera + $Ca(OH)_2$ + Omeprazole) showed the largest inhibition zone, indicating the strongest antibacterial effect. The CH group ($Ca(OH)_2$) was more effective than LB+CH, OME+CH and LB+OME but less than MIX. The LB (Aloe vera) and OME (Omeprazole) groups had the smallest inhibition zones, making them the least effective. These findings suggest that combining Aloe vera, $Ca(OH)_2$, and Omeprazole enhances antibacterial activity against E. faecalis.

Direct Contact Test



Result of Direct Contact Test in Agar Well Plates. (A) Aloe vera + Calcium hydroxide; (B) Omeprazole + Calcium hydroxide; (C) Aloe vera; (D) Aloe vera + Omeprazole; (E) Calcium hydroxide; (F) Omeprazole; (G) Aloe vera + Omeprazole + Calcium hydroxide

Graph of Direct Contact Test Results

Groups	Colony Forming Units (CFU/mL)			
	2 Minutes	5 Minutes	20 Minutes	60 Minutes
LB	336 X 10^5*	285 X 10^5 *	245 X 10^5	148 X 10^5
OME	259 X 10^5 *	224 X 10^5	182 X 10^5	135 X 10^5
CH (K+)	0	0	0	0
LB+OME	238 X 10^5	214 X 10^5	176 X 10^5	88 X 10^5
LB+CH	137 X 10^5	118 X 10^5	86 X 10^5	50 X 10^5
OME+CH	109 X 10^5	77 X 10^5	45 X 10^5	19 X 10^5
MIX	0	0	0	0

Notes:
*TNTC (*Too Numerous To Count*)
Table of Mean CFU Results from Direct Contact Test

The results align with the inhibition zone test, confirming that the Aloe vera + Omeprazole + $Ca(OH)_2$ combination had the strongest antibacterial effect, followed by $Ca(OH)_2$ alone. Combination groups outperformed individual Aloe vera and Omeprazole treatments.

Conclusions

The Aloe vera + $Ca(OH)_2$ combination is more effective than Aloe vera alone but less than $Ca(OH)_2$. Combining Aloe vera and Omeprazole enhances antibacterial activity, while Aloe vera + $Ca(OH)_2$ + Omeprazole shows the highest efficacy.
Further research should optimize concentrations, test other bacteria, and explore clinical applications for root canal treatment.

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