46. Characterization of Lemongrass Extract (Cymbopagon citratus) Nanoemulsion and Its Application as an Antibiofilm Agent in Acrylic Resin

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Original Research

Characterization of Lemongrass Extract (Cymbopagon citratus) Nanoemulsion and Its Application as an Antibiofilm Agent in Acrylic Resin

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Abstract

Background: An antimicrobial agent is needed for denture cleaning, such as lemongrass (LG), which has a bioactive antimicrobial component. **Methods:** This research analyzed LG extract nanoparticles with a particle size analyzer, ZPA, and biofilm formation inhibition on resin acrylic surfaces. **Results:** We found that there is high stability in nanoparticle size, while other concentrations, including chlorhexidine as a positive control, did not show any statistical differences. **Conclusion:** Lemongrass oil nanoemulsion has proved to be an antibiofilm and effective as a denture cleaning agent because of its ability to inhibit Streptococcus mutans and Candida albicans growth.

Keywords: *Acrylic resin, antibiofilm, Candida albicans, Cymbopogon citratus, nanoemulsion, Streptococcus mutans*

Introduction

Poor oral hygiene is the most significant risk factor, which promotes bacterial colonization and adhesion in the denture base and oral cavity to form

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biofilm.[1] Thicker and more complex biofilm organization will contribute to more severe conditions.[2] *Candida albicans* and *Streptococcus mutans* are the commonest fungi and bacteria related to this condition.[3] Thus, we aim to fabricate lemongrass oil nanoemulsion and test its potential against *S. mutans* and *C. albicans* as opportunistic microbes commonly found in denture stomatitis.

Materials and Methods

Five ml of lemongrass oil was mixed and stirred with 5 ml propylene glycol, 5 ml PEG 400, and 10 ml glycerin with 5 ml of chromophore. Particle size was measured at HeNe 4 mW and 633 nm wavelength laser source between 0.6 nm and 9000 nm. A particle size analyzer (PSA) at 25°C temperature was used. Further, lemongrass oil nanoemulsion (LON) was prepared (30 mm of 100% LON stock was serially diluted in 10% DMSO to following concentrations: 100%, 50%, 25%, 12.5%, 6.25%, and 3.125%) and then sterilized using a 0.22 µm pore syringe filter. S. mutans (ATCC-25175) and C. albicans (ATCC-10231) were cultured in Mueller Hinton Broth media for 24 hours at 37°C.

Results

Zeta potential values of 3 LON samples are adequate with the following results: -48.6 mV, -49.2 mV, and -47.4 mV [Figure 1].

The highest percentage value of LON inhibition against *S.mutans* and *C. albicans* biofilm was 95.59 ± 0.54% at 100% concentration. This value was nearly at the same rate as the inhibition value of chlorhexidine 0.2%, which was at 99.61 ± 0.01% [Table 1 and Figure 2].

Discussion

A previous study showed that several essential oil constituents from lemongrass have activity as antimicrobials, including monoterpene (C10H16), diterpene (C20H32), sesquiterpene (C15H24), triterpene (C30H40), p-cymene, menthol, limonene, eugenol, anethole, geraniol, estragole, thymol, γ-terpinene, and cinnamyl alcohol.[4,5] Interaction between *S. mutans* and *C. albicans* can induce severe infection, which is challenging to treat. This interaction also increases the adhesion between species in biofilm and can cause microbial resistance.[6,7] Previous studies showed that bacterial biofilm could be inhibited or removed effectively by the active biology component of herbal plants.[8]

p-Cymene [1-methyl-4-(1-methyl ethyl)-benzene], one of the active constituents in LON, is a combination of mechanical and chemical denture cleaning often failed to remove *C. albicans* from denture biofilm.[9] One of the reasons is extracellular matrix material, which prevented penetration of cleaning agents into deep layer organisms.[10]

Conclusion

LON has proved to be an antibiofilm and effective as a denture cleaning agent because of its ability to inhibit Streptococcus mutans and Candida albicans growth.

Author contributions

VKS: Writing – review and editing, Conceptualization, Project administration; RIS: Writing – review and editing, Conceptualization, Methodology; SN:

Table 1: Biofilm Inhibition Result of *S. mutans* and *C. albicans*

Sample	Inhibition%
LON1	95.59± 0.54^{f}
LON2	89.59±1.00^{e}
LON3	68.07±0.08^{d}
LON4	41.19±1.00^{c}
LON5	27.26±0.18^{b}
LON6	8.01±0.74^{a}
Chlorhexidine 0.2%	99.61±0.01^{g}

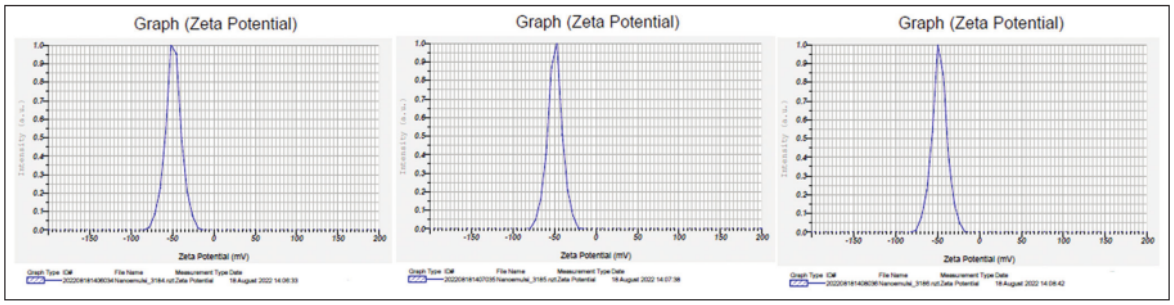

Figure 1: Zeta potential measurement of lemongrass oil

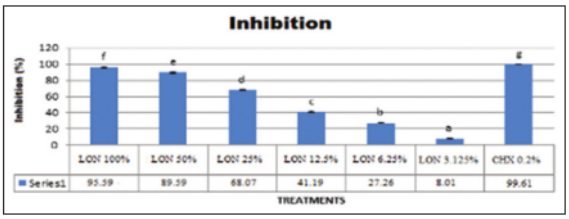

Figure 2: Inhibition percentage of Lemongrass Oil Nanoemulsion (LON) against *S. mutans C. albicans Biofilm*

Writing – original draft, Conceptualization, Methodology; JAVW: Writing – review and editing, Formal Analysis, Methodology; J: Writing – reviewing and editing; WLD: Writing – reviewing and editing; WW: Writing – reviewing and editing; AN: Writing – reviewing and editing.

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Conflicts of interest

There are no conflicts of interest.

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