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Comparative evaluation of coconut oil, sesame oil, and saline rinsing on the salivary load of Streptococcus Mutans: A single-session randomized controlled trial

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Abstract
Introduction: Oil pulling, an ancient Ayurvedic oral hygiene practice, has garnered modern interest for its potential systemic and local health benefits. Due to its lauric acid content, pure coconut oil is recognized for its potent antimicrobial properties.
Aim: This study evaluated the immediate impact of oil pulling using pure coconut oil on the salivary count of Streptococcus mutans (*S. mutans),* comparing its effectiveness against sesame oil and a saline rinse.
Materials and Methods: A randomized controlled concurrent parallel-triple blinded clinical trial was conducted. Thirty participants (students aged 20-23 years) were randomly divided into Group A (coconut oil), Group B (sesame oil), and Group C (saline). Unstimulated saliva was collected immediately before and after the 10–15 minute swishing procedure to analyze S. mutans Colony Forming Units (CFU) per ml of saliva. Data analysis was performed using appropriate statistical tests, with a significance level set at (P<0.05).
Conclusion: Both coconut oil and sesame oil were found to be effective, economical adjuncts for oral hygiene, demonstrating a significant and comparable reduction in salivary S. mutans load relative to the saline control.

Keywords: Coconut oil, dental caries, sesame oil, Streptococcus mutans

Introduction

The traditional practice of oil pulling, historically known as "Kavalagraha" or "Kavala
Gandoosha" in ancient Ayurvedic texts like the "Charaka Samhita", involves swishing oil in the mouth for potential oral and systemic health benefits [1, 2, 3]. This technique employs edible vegetable oils as antimicrobial agents to inhibit bacteria, fungi, and other microorganisms in the oral cavity [4]. The practice gained renewed modern attention through the work of Ukrainian physician Fedor Karach in 1992 [5].

Oil pulling typically utilizes edible oils such as sesame, sunflower, coconut, olive, and almond oil. It is promoted as a complementary remedy for strengthening oral tissues, reducing halitosis, and preventing decay [2, 3]. Coconut oil, widely available and commercially popular in many regions, is particularly favored because its high concentration of lauric acid has been demonstrated to possess potent antimicrobial action against bacteria, viruses, and fungi [5, 6].

The human mouth contains over 400 microbial species normally sustained in a balanced state [7, 8]. However, frequent consumption of fermentable carbohydrates disrupts this ecological equilibrium, promoting the growth of acid-tolerant bacteria that initiate dental caries [9, 10]. The primary bacterial agent implicated in the initiation and progression of dental decay is
Streptococcus mutans [11, 12, 13], owing to its highly acidogenic and acidophilic nature [14].

Given the high cost associated with treating infectious oral diseases, oil pulling offers an inexpensive method for primary prevention [15, 2]. While various oils have previously shown efficacy in reducing gingivitis, plaque [14, 16, 17, 18, 19], and halitosis, scientific investigation into the immediate, single-session effect on S. mutans counts remains essential.

Therefore, this study was conducted to:

1. Assess the immediate effect of oil pulling therapy with pure coconut oil on the salivary S. mutans count.
2. Compare the effect of oil pulling therapy with coconut oil against sesame oil (a commonly studied oil) and saline.

Materials and Methods

Study Design and Ethical Considerations

This investigation was structured as a randomized controlled parallel-group, triple-blind clinical trial. The specific methodology followed was based on the framework established in a previous study by Pavithran *et al.* [13]. The study strictly complied with ethical guidelines for human experimentation, specifically the Declaration of Helsinki (as revised in 2013). Prior to recruitment, approval was secured from the Institutional Review Board. All participants provided informed consent after receiving a detailed explanation of the study's purpose, procedures, and potential risks. Anonymity of all subjects was maintained throughout the research.

Study Population and Sampling

A convenience sample consisting of thirty subjects, all students between the ages of 20 and 23 years, was recruited. Strict criteria were used to exclude participants: subjects were not included if they had taken antibiotics or used antimicrobial mouthwash within the preceding 7 or 15 days, respectively, or if they were smokers (current or past), undergoing orthodontic treatment, possessed a dental prosthesis, or had a known allergy to the test oils. Participants were allocated using a simple random lottery method into three separate groups of ten (1:1 allocation ratio). Group A (Experimental) used Pure Coconut oil; Group B (Positive Control) used Sesame oil, recognized for its *S. mutans* reduction effects [16]; and Group C (Negative Control) used Saline (0.9% Sodium Chloride) to serve as a baseline rinse comparison. All three solutions were dispensed in identical, coded containers to ensure blinding.

Intervention Materials and Procedure

The clinical intervention was completed in a single session, a timeline justified by existing literature demonstrating measurable microbial changes after a single application [20]. Participants arrived without performing their usual morning oral hygiene. First, subjects provided a Baseline Saliva Collection (Pre-Intervention) of 2 ml of unstimulated saliva was collected via the spitting method. Next, for the Oil Pulling Procedure (Intervention), 10 ml of the assigned coded substance was distributed. Participants swished the substance thoroughly on an empty stomach for 10–15 minutes, avoiding gargling [20]. The substance was then expectorated, and the mouth was rinsed with water. Finally, following a 2-minute rest period, a Post-Intervention Saliva Collection of 2 ml of unstimulated saliva was collected.

Microbiological and Statistical Analysis

The "before" and "after" saliva samples were immediately transported and processed in the Microbiology Department. Specimens were subjected to serial dilution, and 100 µl of the diluted sample was spread onto Mitis Salivarius Bacitracin Agar [20]. The culture media was incubated at (37°C) for 48 hours in a candle extinction jar [21]. S. mutans colonies, appearing as small convex deep blue colonies, were identified, confirmed by Gram stain and fermentation tests. The final outcome measure was the Colony Forming Units (CFU) per ml of saliva, counted with a Digital Colony Counter. The participants, principal investigator, and analyzer all remained blinded to the group allocation. For statistical analysis, a Paired *t*-test was used to compare the mean CFU/ml before and after the intervention within each group. ANOVA was applied for comparisons of reduction between the groups, followed by Tukey's HSD post hoc analysis. Statistical significance was set at $P<0.05$.

Results

Consistent with the study design, the findings reflect the immediate effect of a single-day intervention.

Table 1: Mean CFU/ml of S. mutans Before and After Intervention (n=10 per group)

GROUP	Intervention	Baseline Mean (CFU / ml) ± SD	Post-Intervention Mean. (CFU / ml) ± SD	Change in Mean CFU / ml	*P* - value (Within - Group)
A	Coconut Oil	$7.8 \times 10^5 \pm 1.2 \times 10^5$	$3.5 \times 10^5 \pm 0.8 \times 10^5$	4.3×10^5	< 0.001 Significant
B	Sesame Oil	$8.1 \times 10^5 \pm 1.5 \times 10^5$	$3.8 \times 10^5 \pm 0.9 \times 10^5$	4.3×10^5	< 0.001 Significant
C	Saline	$7.9 \times 10^5 \pm 1.1 \times 10^5$	$7.5 \times 10^5 \pm 1.0 \times 10^5$	0.4×10^5	**0.35** Not Significant

Reduction in S. mutans CFU Count (Within Groups)

A statistically significant reduction in the mean S. mutans CFU count was observed after a single day of oil pulling with both pure coconut oil (Group A, $P<0.001$) and sesame oil (Group B, $P<0.001$). As anticipated, saline (Group C) showed no statistically significant reduction ($P=0.35$).

Comparison Between Groups

The ANOVA test confirmed no statistically significant difference in the S. mutans CFU count among the groups at baseline. However, a significant difference was observed in the CFU count after the intervention. Post hoc analysis showed that the reduction in the Coconut Oil group was statistically significant when compared to the Saline group. Crucially, there was no statistically significant difference between the reduction observed in the Coconut Oil group and the Sesame Oil group.

Discussion

The findings indicate that both coconut oil and sesame oil are effective in reducing the salivary S. mutans count after a single application. This efficacy is likely due to the mechanical cleansing action of swishing, potentially enhanced by the processes of saponification and emulsification of the oil, aiding in detoxification of the oral cavity [22]. This supports previous research demonstrating that even a short duration of oil pulling can reduce oral microorganisms [20, 21]. The significant reduction observed with coconut oil is primarily attributed to its high lauric acid content, a substance confirmed to have potent antibacterial activity against S. mutans [21, 23]. The fact that coconut oil was statistically superior to saline confirms that the observed effect is intrinsic to the oil itself, extending beyond simple mechanical rinsing. When comparing the two oils, sesame oil, containing effective unsaturated fatty acids like linoleic and oleic acids, also showed significant antimicrobial activity [16, 23]. The finding that the S. mutans reduction in the coconut oil group and the sesame oil group was not statistically different suggests that both oils offer comparable immediate, short-duration benefits [24]. The minimal, non-significant reduction seen with the saline group further reinforces that the significant effects observed in the oil groups are due to the oil's properties.

Conclusion

In conclusion, a single session of oil pulling with both pure coconut oil and sesame oil demonstrated a significantly greater reduction in the salivary count of Streptococcus mutans compared to the saline control. The efficacy of coconut oil was statistically comparable to that of sesame oil. Oil pulling presents itself as a promising, safe, and economical home remedy to supplement routine oral hygiene. Given the acute effect established here, future research is highly recommended to assess the long-term *in vivo* effect of coconut oil pulling on the oral S. mutans population over a minimum duration of two weeks.

Limitations and Future Directions

The present study, while successful in demonstrating the acute effect of oil pulling, is subject to several methodological limitations that guide future research. The most significant drawback is the single-session design, which only captures immediate microbial reduction and fails to account for the crucial long-term or cumulative effects on S. mutans populations, plaque, and gingival health. Furthermore, the limited sample size (n=10 per group) restricts the broad generalizability of the findings, and the lack of an active chemical control (such as Chlorhexidine) prevents us from benchmarking the clinical efficacy of oil pulling against current standard care practices. To address these limitations, future research should transition to extended, longitudinal randomized controlled trials lasting a minimum of two weeks. These subsequent studies must integrate objective clinical parameters like the Plaque Index and Gingival Index alongside microbiological counts to

assess the sustained benefits of coconut oil pulling. Additionally, research should aim to standardize the optimal dose and frequency of the procedure and perform direct comparisons against prescription mouthwashes to firmly establish its place as a reliable and economical adjunct therapy in comprehensive oral hygiene regimens.

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