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Original Article

Comparing the efficacy of Chlorhexidine Mouthwash and Natural Honey in Reducing Plaque and Improving Gingival Health. A Randomized Controlled Trial

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ABSTRACT

Plaque control is essential for maintaining gingival health, if left untreated can lead to conditions like gingivitis and progress to periodontitis. Natural honey has been historically utilized for its antibacterial properties, while Chlorhexidine (CHX) is used as synthetic antimicrobial agent in oral care. **Objective:** The objective was to assess and compare the effectiveness of natural honey-based mouthwash and chlorhexidine in preventing dental plaque formation and improving gingival health. **Methods:** An open-label, randomized controlled trial was conducted with 60 participants aged 18 to 25. The study compared the effects of natural honey and chlorhexidine mouthwashes on dental plaque levels, employing the Silness and Loe index for plaque assessment. Participants were randomly assigned to either Group A (Chlorhexidine Mouthwash) or Group B (Natural Honey Mouthwash). Both groups followed a prescribed oral hygiene regimen, and plaque levels were measured at baseline and after two weeks. **Results:** Demographic characteristics of both groups were documented, including age, gender distribution, and level of education. Plaque and gingival indices were measured at baseline and after 21 days. Both groups showed a significant decrease in plaque and gingival indices after 21 days (p=<0.001). The honey mouthwash demonstrated a more pronounced reduction in the plaque (p=<0.001) and ginigival index (p=0.001) on Day 21, with a notable and statistically significant difference between the two groups. **Conclusions:** The study concludes that both natural honey and chlorhexidine mouthwashes effectively reduce plaque and improve gingival health. However, honey mouthwash exhibits superior efficacy, suggesting it as a promising alternative for oral hygiene maintenance.

INTRODUCTION

Maintaining a healthy periodontium necessitates effective removal of supragingival plaque, as dental plaque, a bacterial biofilm on tooth surfaces, significantly contributes to gingival inflammation, often resulting in conditions such as gingivitis [1]. Although gingivitis is a preventable and reversible condition frequently encountered in dental practice, untreated cases may progress to periodontitis, potentially leading to tooth loss. Therefore, controlling dental plaque through proper oral hygiene practices is imperative [2]. The utilization of mechanical tools for supragingival plaque control, such as toothbrushes, floss, wood sticks, and interdental brushes, is common. Though, there is a belief that the requisite level of motivation and skill needed for effective use of these oral hygiene products exceeds the abilities of the majority of patients. Consequently, to counteract potential shortcomings in regular self-performed oral hygiene, a chemical approach to plaque control in the form of mouthwashes is considered more desirable [3]. In routine oral care, various interventions are employed to reduce plaque accumulation and improve gingival health. While Chlorhexidine (CHX) mouthwash, a widely accepted conventional antimicrobial agent, is recognized as the "gold standard" antiplaque agent, its efficacy is moderated

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by adverse effects such as tooth staining and taste disturbance [4]. Despite being used successfully for over three decades by dental professionals and pharmaceutical companies, chlorhexidine is not a "Magic Bullet." Recent attention has turned to natural honey for its potential antimicrobial and wound-healing properties [5]. Honey, a sweet liquid substance produced by bees, has served as both a nutrient and medicinal remedy since ancient times [6]. Its extended shelf life, attributable to high osmotic pressure and inherent antibacterial properties, enables long-term preservation. Demonstrating expansive antimicrobial activity, honey effectively impedes the growth of diverse bacteria, fungi, protozoa, and viruses. The gradual dilution of unprocessed honey leads to the production of hydrogen peroxide, further enhancing its antimicrobial capabilities [7].

The main aim of this study was to evaluate the effectiveness of a natural honey-based preparation in comparison to a commercially available chlorhexidine mouthwash in preventing the formation of dental plaque. This comparison is motivated by the accessibility, cost-effectiveness, and organic nature of honey. The study was aimed to contribute valuable data specific to our community, with the anticipation that positive results could introduce a new, potentially more accessible method of oral hygiene maintenance, one that may come with fewer side effects.

METHODS

An open-label, randomized controlled trial (https://clinicaltrials.gov/study/NCT05258955) was conducted to evaluate the impact of natural honey and chlorhexidine mouthwashes on dental plaque levels in young adults. Sixty new patients, aged 18 to 25, with complaints of dental stains and bleeding gums, were enrolled at the Department of Periodontology of Dar-ul-Sehat hospital in Karachi. Participants were involved between June 2020 and December 2020. Participants aged 18-25 with 28 retained teeth (excluding wisdom teeth) and recommended to use the modified bass method were included. Exclusions applied to those with medical conditions affecting the oral cavity (e.g., diabetes, Sjögren's syndrome, Crohn's disease), multiple extractions, overhang restorations, dental appliances, periodontal pockets over 3mm, recent antibiotic use, poor hygiene compliance, and harmful oral habits such as tobacco or betel nut use. Randomization was achieved through the opaque sealed envelope method. Each patient chose an envelope containing the group assignment to ensure confidentiality. The envelopes, prepared and sealed by personnel other than the principal investigator, were signed on the back to prevent tampering. The research protocol, permitted by the ethical review board of Liaquat College of Medicine and Dentistry (Reference Number: EC/11/20), on 5th February 2020. All participants provided written informed consent before enrollment. The sample size was estimated using Openepi sample size calculator for mean difference after inserting mean and SD of honey and chlorhexidine group at 15th day 2.85 ± 0.44 and 2.40 ± 0.51. The minimum sample size was 27 in each group. By adding 10 % drop out rate sample size was taken as 30 in each group. Participants were divided into two groups: Group A received Chlorhexidine Mouthwash, and Group B received Natural Honey Mouthwash. The sample size of 60 (30 in each group) was calculated using open epi based on mean and SD values. Plaque levels were assessed using the Silness and Loe index, measuring deposits on specific teeth in both upper and lower arches. Baseline scores were calculated before scaling and polishing. Market available chlorhexidine gluconate (0.12 %) mouthwash and natural Sidr Honey were used. Mouthwash solutions were dispensed in coded bottles, and participants were instructed to swish 10 ml of their assigned solution twice daily for at least 60 seconds. Participants were guided to use a modified bass method for oral hygiene and abstain from using any other mouthwash during the study period. After two weeks, participants were summoned for a follow-up, and plaque levels were assessed using a periodontal probe and tablets that reveal plaque. The data were analyzed using SPSS 21.0, considering mean, standard deviation, frequency, and percentage. Statistical tests included the Paired t test before and after the intervention and Independent Samples t-Test between two groups, with significance set at $p < 0.05$.

RESULTS

A total of 60 patients sought consultation at the Outpatient Department (OPD) at the Department of Periodontology of Dar-ul-Sehat Hospital in Karachi. The study participants were divided into two groups: Group A, receiving treatment with Chlorhexidine, and Group B, receiving treatment with Honey. Demographic characteristics of Group A and Group B. Group A, with a mean age of 23.53 ± 2.60, comprises 66.7% males and 33.3% females. In Group B, there are 73.33% males and 26.67% females, with a mean age of 24.0 ± 3.76. Age is presented as mean ± SD. Gender and level of education is presented as frequency and percentages as mentioned in table 1.

Table 1: Demographic Characteristics of Group A (Chlorhexidine) and Group B (Honey)

Demographic Characteristic	Group A	Group B
Age (Mean ± SD)	23.53 ± 2.60	24.0 ± 3.76
Gender N (%)		
Male	20 (66.7%)	22 (73.33%)
Female	10 (33.3%)	08 (26.67%)
Level of Education N (%)		
Matriculation	7 (23%)	9 (30%)

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Intermediate	9 (30%)	8 (26.6%)
Undergraduate	10 (33.3%)	6 (20%)
Graduate	4 (13.3%)	7 (23.3%)
Total (n)	30	30

Table 2 presents the comparison of measurements for Plaque Index and Gingival Index between Group A and Group B on Day 0 and Day 21. In the Plaque Index, both groups showed a decrease from Day 0 (A: 1.93 ± 0.20, B: 1.89 ± 0.18) to Day 21 (A: 1.04 ± 0.18, B: 0.85 ± 0.14), with highly significant p-values (<0.001). Similarly, for the Gingival Index, there was a reduction from Day 0 (A: 1.74 ± 0.19, B: 1.71 ± 0.16) to Day 21 (A: 0.91 ± 0.13, B: 0.79 ± 0.15), with significant p-values (p = 0.001 for Group A and <0.001 for Group B). These findings indicate a notable improvement in oral health parameters over the 21-day period. On Day 0, there was no significant difference in the Plaque Index and Gingival Index between Group A and Group B. However, by Day 21, a notable and significant difference emerged in both Plaque (p=<0.001) and Gingival Indices (p=0.001) between the two groups. Group B, treated with honey, exhibited more promising results compared to Group A, which received chlorhexidine. Values are Mean ± Standard Deviation (Std. Dev.). [b] Independent Samples t-Test, p-values <0.05 indicate highly significant differences, No significant differences at baseline (Day 0) between group A and B. Significant differences between group A and B at Day 21. [a] Paired t test was used, p-values <0.05 indicates significant reductions from Day 0 to Day 21 in each group.

Table 2: Comparison of Plaque and Gingival Indices in Group A and Group B at Day 0 and Day 21

Group	Day 0 (Mean ± SD)	Day 21 (Mean ± SD)	p-Value (Group A, B)	p-Value (Day 0)	p-Value (Day 21)
	Plaque Index				
A	1.93 ± 0.20	1.04 ± 0.18	<0.001[b]	0.54[a]	<0.001[a]
B	1.89 ± 0.18	0.85 ± 0.14	<0.001[b]		
Gingival Index					
A	1.74 ± 0.19	0.91 ± 0.13	<0.001[b]	0.53[a]	0.001[a]
B	1.71 ± 0.16	0.79 ± 0.15	<0.001[b]		

[a]Paired t test was used, p-values <0.05
[b]Independent Samples t-Test, p-values <0.05

DISCUSSION

Honey, recognized for its role as a natural sweetener with a rich nutritional profile, contains 70% sugar, traditionally considered a cariogenic agent. Research findings have demonstrated the effectiveness of honey in combating a diverse array of clinically resistant multibacteria, leading to its emergence as a viable alternative to industrial pharmaceutical products [8-10]. Also, numerous studies have demonstrated that honey possesses antibacterial properties that can counteract its potential to contribute to tooth decay [8-11]. Honey exhibits broad-spectrum inhibition of various bacterial species in vitro. Its antimicrobial activity arises from several factors, including high osmotic pressure, unique physical properties, and enzymatic glucose oxidation reactions [12,13]. The initial stage in the development of dental plaque involves the adhesion of *S. mutans* bacteria to tooth surfaces, a well-documented phenomenon [14]. In an experiment, Badet and colleagues demonstrated that a 10% concentration of honey could influence the formation of an *S. mutans* biofilm [15]. In the present study, the effects of a 10% honey solution and a 0.12% chlorhexidine gluconate mouth rinse on dental plaque levels revealed that both interventions, when used twice daily, demonstrated clinical effectiveness in preventing plaque and managing gingival bleeding. However, at day 30, the effectiveness of the honey mouth rinse, showed significant difference in the clinical efficacy in reducing both plaque and the gingival index when compared to chlorhexidine. Similarly, in a study by Jain A *et al.*, a significant effect was observed between honey and chlorhexidine mouthwash on their impact on plaque [16]. However, in a study conducted by Nayak PA *et al.*, analyzing the effects of Manuka honey and chlorhexidine mouthwash, no important difference was found between the two groups [17]. Similarly, a study conducted in India among children mentioned that Manuka Honey demonstrated effectiveness comparable to chlorhexidine in reducing gingivitis and *Streptococcus mutans* count, suggesting its potential as an antimicrobial agent for oral health improvement and caries risk reduction [18]. However, in Karnataka, a study compared three types of mouthwash. The 0.2% Chlorhexidine mouthwash was found to be the most effective in reducing plaque and gingival scores. However, both 40% Mauka Honey and 20% Raw Honey mouthwashes also showed significant reductions in plaque and gingivitis from day 0 to day 22 [19]. In a study conducted by Aparna *et al.*, both in vitro and clinical assessments were utilized to examine the antimicrobial activity of a 0.2% chlorhexidine mouthwash and a mouthwash containing honey. The in vitro results indicated that the honey mouthwash successfully suppressed the growth of *Streptococcus mutans*, although 0.2% chlorhexidine exhibited superior efficacy. A comparative investigation between chlorhexidine and honey demonstrated significant reductions in plaque formation for both formulations ($p < 0.001$). Despite chlorhexidine showing greater effectiveness than the honey-containing mouthwash, there was no statistically noteworthy change between them [20]. The change between our research and the prior one may be attributed to the variability in the biological activity of honey. This variation is influenced by factors such as the chemical composition, which is contingent on the botanical origin (type of honey), geographical source, meteorological conditions, and additionally, the concentration employed in diverse studies [21,22].

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CONCLUSIONS

In conclusion, this randomized controlled trial comparing the efficacy of natural honey-based mouthwash and chlorhexidine in preventing dental plaque formation demonstrated that both interventions effectively reduced plaque and improved gingival health. The honey mouthwash, with its potential antimicrobial properties, showed notable clinical effectiveness, surpassing chlorhexidine. These findings suggest that honey may offer a promising and accessible alternative for oral hygiene maintenance, presenting fewer side effects compared to conventional chlorhexidine mouthwash.

Authors Contribution

Conceptualization: MA
Methodology: MA
Formal analysis: MIB, AK
Writing, review and editing: AK, SF

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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