EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 71, 2651:2657, JULY, 2025
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
CONSERVATIVE DENTISTRY AND ENDODONTICS
Submit Date : 07-04-2025 • Accept Date : 29-04-2025 • Available online: 15-07-2025 • DOI : 10.21608/edj.2025.373618.3440

EFFECT OF VIRGIN COCONUT OIL PULLING VERSUS FLUORIDE MOUTHWASH ON SALIVARY BACTERIAL COUNT IN ELDERLY EGYPTIANS: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Maintaining oral health in elderly individuals is crucial due to their increased susceptibility to dental caries and periodontal disease. This study evaluated and compared the antimicrobial effectiveness of virgin coconut oil (VCO) pulling and fluoride mouthwash (FMW) on salivary bacterial count in elderly Egyptians.

Methods: A randomized controlled trial was conducted involving 72 elderly participants (≥65 years) divided into two groups: Group I received VCO pulling; Group II used FMW. Saliva samples were collected at baseline, 2 weeks, and 4 weeks. Salivary bacterial count (colony-forming units, CFU/ml) was assessed using Mitis salivarius agar. Statistical analysis involved t-tests and repeated measures ANOVA.

Results: Both groups showed a statistically significant reduction in salivary bacterial count over time ($P<0.001$). **VCO showed a significantly greater reduction** than FMW at **each time point** (baseline, 2 weeks, 4 weeks). The **greatest between-group difference** was seen at **4 weeks**, favoring VCO, the mean log CFU/ml was 4.02±0.20 in the VCO group vs 4.22±0.23 in the FMW group ($P = 0.0003$).
Conclusion: Virgin coconut oil pulling is a promising alternative to fluoride mouthwash for reducing salivary bacterial load in elderly individuals. Its natural composition and antimicrobial properties may offer a safer, culturally acceptable oral hygiene practice.

KEYWORDS: Virgin coconut oil, Fluoride mouthwash, Salivary bacteria, Elderly, Oil pulling, Oral hygiene

INTRODUCTION

Oral health is an integral part of general health, particularly in the elderly population, where compromised oral hygiene can significantly affect overall quality of life. With advancing age, there is an increased prevalence of oral diseases such as dental caries, periodontal disease, xerostomia, and oral mucosal lesions due to various physiological, systemic, and behavioral factors (**Petersen &**

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Yamamoto, 2005). Maintaining optimal oral hygiene becomes more challenging due to reduced manual dexterity, cognitive decline, and limited access to professional dental care (**Mojon, 2002**).

Dental plaque plays a pivotal role in the development of caries and periodontal diseases. Therefore, reducing bacterial load in the oral cavity is essential to prevent these conditions (**Marsh, 2005**). Mouthwashes have been widely recommended as adjuncts to mechanical plaque control. Among them, **fluoride mouthwash (FMW)** is known for its caries-preventive effects due to its ability to promote remineralization and inhibit bacterial metabolism (**ten Cate, 1999**).

In recent years, there has been growing interest in **natural and herbal oral care alternatives**. One such traditional practice is **oil pulling**, an ancient Ayurvedic remedy that involves swishing oil in the mouth to promote oral detoxification and hygiene. **Virgin coconut oil (VCO)** has gained particular attention due to its high lauric acid content, which has demonstrated antimicrobial, anti-inflammatory, and antioxidant properties (**Ogbolu et al., 2007**). Lauric acid has been shown to disrupt bacterial cell membranes, reduce adherence of cariogenic bacteria like *Streptococcus mutans*, and inhibit plaque formation (**Verallo-Rowell et al., 2008; Rajeswari, 2016**).

Several small-scale studies have suggested that oil pulling with VCO may reduce oral bacterial load, plaque accumulation, and gingival inflammation (**Peedikayil et al., 2015**). However, the clinical evidence comparing the efficacy of VCO to conventional agents like fluoride mouthwash, especially in vulnerable populations such as the elderly, remains limited. Given the need for cost-effective, culturally acceptable, and safe oral hygiene solutions in older adults, exploring VCO as a viable alternative is both timely and necessary.

The aim of this study was to evaluate and compare the effect of virgin coconut oil pulling versus fluoride mouthwash on salivary bacterial count in elderly Egyptian individuals over a 4-week period.

MATERIALS AND METHODS

Study Design and Participants:

A randomized controlled trial was conducted at Cairo University. Seventy-two elderly participants (≥65 years) were enrolled after meeting inclusion criteria and providing informed consent. Participants were randomly allocated into two groups:

- **Group I (n = 37):** Virgin coconut oil pulling once daily.
- **Group II (n = 35):** Fluoride mouthwash once daily.

Sample size calculation:

A power analysis was designed to have adequate power to apply a two-sided statistical test of the null hypothesis that no difference would be found between different tested groups regarding bacterial count. By adopting an alpha (α) level of (0.05), a beta (β) level of (0.2) (i.e., power=80%), and an effect size (d) of) 0.747) calculated based on the results of a previous study; the total required sample size (n) was found to be (60) cases. The sample size was increased by (20%) to account for possible dropouts to be (72) cases (i.e., 36 cases per group). Sample size calculation was performed using R statistical analysis software version 4.4.1 for Windows (Kaushik, Mamta, et al 2016).

Inclusion Criteria:

- Age ≥65 years
- Good general health
- No current antibiotics or antiseptic use
- Willingness to follow protocol

Exclusion Criteria:

- Allergy to coconut or fluoride
- Active oral infections
- Use of other oral hygiene products during study

– Microbiological Analysis:

Pre-Intervention Measures (Standardization Protocol)

Prior to the study, all participants underwent:

1. Professional Oral Prophylaxis:
    - o Full-mouth scaling and polishing to remove plaque and calculus.
2. Oral Hygiene Reinforcement:
    - o Demonstration of modified Bass brushing technique and flossing

Baseline Assessment:

- Saliva samples will be collected from all participants at baseline (before the start of the intervention) to measure initial salivary bacterial counts.
- A questionnaire will be administered to assess baseline oral hygiene habits and preferences.
- **Follow-up Assessments:**
    - o Saliva samples will be collected at the end of weeks 2 and 4 to assess changes in bacterial counts.
    - o A follow-up questionnaire will be administered at the end of the study to evaluate participant satisfaction, preferences, and any side effects experienced during the intervention.

– Laboratory Procedures:

1. Saliva Collection:

1. Participants will provide saliva samples in sterile containers in the morning before any oral hygiene activities.

2. Bacterial Count Measurement:

– Sample Collection:

- Unstimulated whole saliva samples were collected from participants in **sterile, labeled containers** during morning hours, prior to eating, drinking, or performing any oral hygiene activity.
- Approximately **2–5 ml of saliva** was obtained by passive drooling.

– Sample Processing:

- Saliva samples were immediately transported to the microbiology laboratory under **cold chain conditions (4°C)** and processed within **2 hours of collection**.
- Each sample was vortexed briefly to ensure homogeneity.

– Serial Dilution:

- Samples were serially diluted in sterile phosphate-buffered saline (PBS) to obtain suitable colony counts for accurate quantification (typically 10^{-2} to 10^{-4} dilutions).

– Plating and Incubation:

- **100 µl** of each diluted sample was aseptically pipetted onto Mitis salivarius agar plates in triplicate.
- The sample was spread evenly using a sterile spreader to ensure uniform distribution.

– Incubation Conditions:

- Plates were incubated at **37°C for 48 hours** under **5–10% CO_2** atmosphere to promote the selective growth of oral streptococci.

– Colony Counting:

- After incubation, visible colonies were counted manually using a **digital colony counter**.
- Colony morphology consistent with *S. mutans* (raised, undulate margins, and frosted-glass appearance) was specifically noted.
- CFU/ml was calculated by multiplying the colony count by the dilution factor.

– **Data Transformation:**

- Raw CFU/ml values were **log-transformed (log_{10})** to normalize data and reduce variability prior to statistical analysis.

Statistical Analysis:

Data were analyzed using MedCalc (v22). Independent t-tests were used for intergroup comparisons. Repeated measures ANOVA assessed changes over time within each group, followed by Bonferroni post hoc tests. Significance was set at P≤0.05.

RESULTS

Intergroup comparison revealed statistically significant difference between both groups at baseline, after 2 and 4 weeks (P < 0.05). Intragroup comparison showed statistically significant decrease in bacterial count within both groups (P < 0.001). After 2 weeks the log bacterial count decreased with a mean difference of 0.730 (95%CI 0.642-0.819) and 0.604 (95%CI 0.498-0.710) for VCO and Fluoride MW respectively.

Statistical analysis:

Data was analyzed using Medcalc software, version 22 for windows (MedCalc Software Ltd, Ostend, Belgium). Logarithmic transformation was done to bacterial count data. Continuous data was explored for normality using Kolmogrov Smirnov test and Shapiro Wilk test. Continuous data showed normal distribution and was described using mean and standard deviation. Intergroup comparison of bacterial count values was performed using independent t test. Intragroup comparison within each intervention was performed using repeated measures ANOVA followed by Bonferroni corrected pairwise comparisons. The confidence level was set at 95%, with statistical significance of P≤0.05, 80% power and all tests were two tailed

TABLE (1) Demographic data

Group	Age	Gender			Smoking Status		
		Male	Female	Row total (RT)	Yes	No	Row total (RT)
Virgin coconut oil	64.75±9.81	17	20	37 (51.4%)	8	29	37 (51.4%)
		45.9% RT	54.1% RT		21.6% RT	78.4% RT	
		50.0% CT	52.6% CT		61.5% CT	49.2% CT	
Fluoride mouthwash	68.63±10.67	17	18	35 (48.6%)	5	30	35 (48.6%)
		48.6% RT	51.4% RT		14.3% RT	85.7% RT	
		50.0% CT	47.4% CT		38.5% CT	50.8% CT	
Column total (CT)		34	38	72	13	61	72
		47.20%	52.80%		18.10%	81.90%	
Significance level	P = 0.113		P = 0.8247			P = 0.4219	

There was no statistically significant difference between both groups regarding age, gender and smoking status (P > 0.05).

TABLE (2) Mean and SD of log bacterial count (CFU/ml) for intergroup comparison between interventions with each follow-up and intragroup comparison within each intervention between follow-up periods:

Variable	Virgin coconut oil		Fluoride mouthwash				
	Mean	SD	Mean	SD	Difference	95% CI	P value
Baseline	4.75[a]	0.06	4.82[a]	0.04	0.075	0.049 to 0.101	<0.0001*
2-Weeks	4.33[b]	0.16	4.46[b]	0.12	0.1305	0.062 to 0.198	0.0003*
4-Weeks	4.02[c]	0.20	4.22[c]	0.23	0.2015	0.096 to 0.306	0.0003*
P value	<0.001*		<0.001*				

Means that do not share the same letter vertically are statistically significant, * corresponds to statistically significant

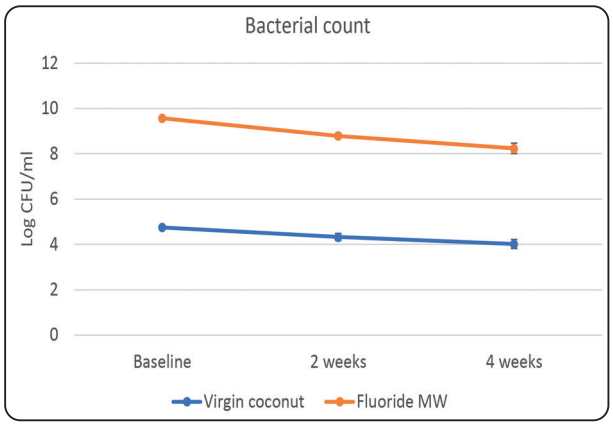

Fig. (1) Line chart showing change in bacterial count within each group through time

DISCUSSION

The current randomized controlled trial provides robust evidence supporting the effectiveness of **virgin coconut oil (VCO) pulling** as a viable alternative to **fluoride mouthwash (FMW)** in reducing salivary bacterial count among elderly Egyptian individuals. Our findings demonstrated that while both interventions significantly reduced bacterial load over the 4-week period, VCO showed a greater reduction at all time points, with statistically significant differences between the groups observed at baseline, 2 weeks, and 4 weeks ($P < 0.05$).

The antimicrobial action of VCO is largely attributed to its high content of **lauric acid**, a medium-chain fatty acid with proven antibacterial, antiviral, and antifungal properties. Lauric acid exerts its antimicrobial effect by **disrupting bacterial cell membranes and inhibiting biofilm formation**, particularly of *Streptococcus mutans*, a key pathogen involved in dental caries and plaque formation (**Narasimhan et al., 2022**). These findings are consistent with earlier studies showing that oil pulling with VCO can significantly reduce the *S. mutans* count in saliva and improve oral hygiene indices (**Peedikayil et al., 2015; Jauhar et al., 2021**).

The greater efficacy of VCO compared to fluoride mouthwash is particularly noteworthy. While fluoride is widely accepted for its **remineralizing and cariostatic effects**, its direct antimicrobial action is relatively modest (**Ten Cate, 2013**). FMW works primarily by **interfering with bacterial metabolism and inhibiting acid production**, but it may not significantly reduce total bacterial load to the extent observed with potent antimicrobials like VCO (**Kowalczyk et al., 2023**).

The elderly population presents unique challenges for oral hygiene maintenance. Factors such as **decreased manual dexterity, cognitive**

decline, polypharmacy, and dry mouth contribute to the accumulation of dental plaque and increased bacterial colonization (**Cury & Tenuta, 2021**). Therefore, simple, effective, and culturally acceptable interventions are needed. Oil pulling, a traditional Ayurvedic practice, fits this profile well. Its **low cost, ease of use, and natural composition** may enhance compliance in older adults who are often reluctant to use chemical-based products (**Shanbhag et al., 2023**).

Interestingly, the significant difference in bacterial count between the two groups was observed **as early as two weeks**, suggesting that VCO may exert **rapid antimicrobial effects**. This aligns with recent microbiome studies showing that lipid-based antimicrobial agents can alter oral bacterial composition within days (**Zhou et al., 2022**). However, long-term sustainability of these effects remains to be fully investigated.

Despite promising results, several limitations should be acknowledged. The study was conducted over a relatively short duration (4 weeks), and **long-term effects on oral health outcomes**, such as caries incidence or periodontal status, were not assessed. Furthermore, **microbial identification was limited to CFU counting on Mitis salivarius agar**, without molecular or genomic characterization of microbial shifts. Future studies incorporating **next-generation sequencing** could offer a more comprehensive understanding of the changes in the oral microbiome.

CONCLUSION

In conclusion, this randomized controlled trial highlights the potential of virgin coconut oil pulling as a safer, effective, and culturally acceptable alternative to fluoride mouthwash for reducing salivary bacterial loads in elderly individuals. As oral health remains crucial for the overall well-being of the elderly, integrating VCO into oral hygiene practices may serve as a beneficial strategy in managing oral health and preventing disease.

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