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Exploring The Potential of Adjunctive Use of Virgin Coconut Oil in Periodontal Therapy: A Narrative Review

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Abstract

Background: Virgin Coconut Oil (VCO), obtained naturally without chemical processing, boasts anti-inflammatory, antimicrobial, and antioxidant properties, making it a potential adjunct in treating periodontal diseases like gingivitis and periodontitis. Despite its benefits, research on VCO's specific effects as an adjunct to the treatment of periodontal disease remains limited. ***Aim***: This review aims to explore existing data on VCO's potential in addressing periodontal issues. ***Materials and Method***: PubMed and Google Scholar databases were searched for available literature with the keywords; (periodontal disease OR periodontitis OR periodontal therapy OR periodontium) AND (gingivitis OR gingival disease) AND (virgin coconut oil OR VCO) spanning from 2003 to 2024. This review only included original articles that were fully written in English. ***Results***: A total of seven articles were found on VCO related to periodontology. VCO adjunctive applications were reported to result in further reductions of plaque index, gingival index, inflammatory mediators, and inhibition of periodontal pathogens. ***Conclusions***: From this review, it can be concluded that VCO exerts multiple beneficial effects such as anti-oxidant, anti-inflammatory, healing properties, anti-plaque, anti-gingivitis and anti-bacterial that are beneficial for various periodontal disease management.

Keyword: Anti-bacterial; anti-gingivitis; Anti-inflammatory; anti-oxidant; anti-plaque; periodontal disease; virgin coconut oil

Abbreviations

AQP-3: Aquaporin-3.
APCC: Asian Pacific Coconut Community.
CHX: Chlorhexidine.
CO: Copra Oil.
COX-2: Cyclooxygenase-2.
CTO: Coconut Testa Oil.
FA: Fatty Acid.
FPD: Fixed Partial Denture.
GAG: Glycosaminoglycan.
GIT: Gastrointestinal Tract.
GSH: Glutathione.

IL-6: Interleukin-6.
INOS: Inducible nitric oxide synthase.
LPS: Lipopolysaccharide.
MCFA: Medium Chain Fatty Acid.
MCT: Medium Chain Triglyceride.
NAG: N- acetylglucosamine.
NAM: N- acetylmuramic acid.
NO: Nitric Oxide.
PFM: Porcelain Fused Metal.
RBD: Refined-Bleached-Deodorized.
ROS: Reactive oxygen species.
RT-PCR: Real-Time Polymerase Chain Reaction.
SOD: Superoxide Dismutase.
SRP: Scaling and Root Planing.
TAG: Triacylglycerol.
TNF-α: Tumor Necrosis Factor α.
VCO: Virgin Coconut Oil.

Introductions

Coconut oil is derived from the compression of copra, the desiccated kernel characterized by its approximately 60-65% oil content. Retaining the inherent sweet flavour of coconut, the oil consists of 92% saturated fatty acids in the form of triglycerides. Notably, most (around 70%) of these fatty acids are classified as lower-chain saturated fatty acids, specifically known as medium-chain fatty acids (MCFAs), with a substantial presence of lauric acid ranging from 45-56% (Gopala et al.). Various types of coconut oils, including coconut testa oil (CTO), virgin coconut oil (VCO), and copra oil (CO), are prepared with distinct methods, leading to variations in their physicochemical properties and biological activities (Narayanankutty et al.).

Virgin coconut oil (VCO), obtained by extracting fresh coconut kernel through natural means, stands apart as it undergoes no chemical treatments such as refining, bleaching, and deodorizing, typical of refined-bleached-deodorized (RBD) oil (K. Govindan Nevin and Rajamohan). Srivastava and co-workers described VCO as oil obtained from fresh, mature coconut kernels using mechanical or natural means, with or without heat, but crucially without chemical RBD that could alter the oil's natural content (Srivastava et al.). VCO is nearly colourless with a faint acid aroma, a sweet and salty taste, and a noticeable nutty aroma and flavour (Villarino et al.). VCO is richer in medium-chain triglyceride (MCT), mainly lauric acid, which is more easily hydrolysed and absorbed by some lipases in the human Gastro-Intestinal Tract (GIT) than the long-chain triglyceride (McCarty and DiNicolantonio). VCO was proven to present with anti-oxidant, anti-inflammatory, healing properties, anti-plaque, anti-gingivitis and anti-microbial properties that make it suitable to be used as an alternative adjunct for the treatment of dental diseases, mainly periodontal disease (Dumancas et al.; Rakshitha et al.; Ayob et al.).

Periodontal disease can either involve the inflammations of the surrounding soft tissue only, known as gingivitis, or along with the destruction of the soft and hard tissue known as periodontitis. Periodontitis is characterized by progressive destructions of the tooth-supporting apparatus associated with dysbiotic plaque biofilm and host-mediated inflammations (Chapple et al.; Papapanou et al.). Though the properties of VCO are beneficial to be applied as an adjunct for the treatment of periodontitis, it is not commonly practised and investigated yet. This review is focused on the existing data on the effect of VCO in relation to periodontal therapy.

Materials and method

For this narrative review, a comprehensive literature search was conducted on PubMed and Google Scholar using the keywords; (periodontal disease OR periodontitis OR periodontal therapy OR periodontium) AND (gingivitis OR gingival disease) AND (virgin coconut oil OR VCO) spanning from 2003 to 2024. Initially, one reviewer screened the titles and abstracts of articles. Articles that indicated a possible match were obtained for full review for potential inclusion. Randomized controlled trials, cohort studies, case-control studies, case series, animal research and in-vitro research were eligible to be included in this study. However, only original articles, with the use of specifically virgin coconut oil, written entirely in English were considered for inclusion in this review.

Result

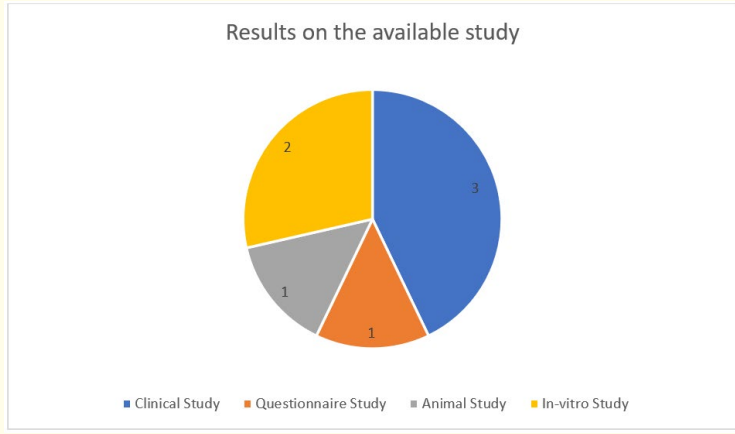

Figure 1: Number of studies available.

The search results revealed a scarcity of studies specifically addressing the use of virgin coconut oil in periodontal therapy. Only seven studies were identified, comprising three human clinical trials, one questionnaire-based study, one animal study, and two in-vitro studies (Figure 1). Notably, none of the three human clinical trials directly focused on subjects with periodontitis. However, these studies did include evaluations of clinical periodontal parameters such as plaque index and gingival index, as well as microbiological assessments of periodontal pathogens.

Saputra and co-workers compare the decrease in plaque index score on fixed partial denture (FPD) abutment tooth when 12.5% VCO was used as a mouthwash twice daily for four days after brushing, to the use of aquades as mouth rinsing (Saputra et al.). Fifteen ml of VCO will be used as a mouth rinse for 30 seconds for each application and the mean plaque index was recorded before and after the interventions. The results reveal a statistically significant difference in plaque index score, before and after usage of 12.5% VCO in the test group ($p<0.001$). When compared with the use of equates, statistically significant differences in the decrease of plaque index were reported, favouring more reductions in the VCO group. More significant plaque index reductions were also reported in the group with regular brushing habits and equigingival margin than subgingival margin. Thus, this study illustrates that the utilization of VCO aids in reducing the plaque index score, particularly at the abutment tooth of fixed partial dentures (FPDs), which are more susceptible to plaque accumulation.

In a separate comparative pilot study, researchers evaluated the effectiveness of VCO in reducing plaque and gingival index scores, as well as its antimicrobial properties against S. mutans. This evaluation was conducted in comparison with the gold standard, chlorhex-

idine (CHX). A total of 40 subjects presented with moderate to severe gingival inflammations were included and divided into the test (VCO) and control (CHX) groups. The gingival index and plaque index, together with the laboratory analysis of *S. mutans* colony count, taken from unstimulated saliva samples were evaluated at baseline and three weeks post-intervention. Throughout the study period, each subject was instructed to gargle with either the 3ml of VCO for the test group and 3ml of CHX for the control group once daily every morning in addition to routine daily brushing. However, the result of this study showed that the gold standard, CHX have significantly more reductions in plaque index than the test group, while the result is almost comparable for gingival index reductions. VCO is not as effective as CHX in reducing the *S.mutans* count, proving the superior antimicrobial effect of CHX than the VCO (Salian et al.).

In addition to assessing periodontal clinical parameters, the effectiveness of VCO was also evaluated for its ability to reduce periodontal pathogens. Dewi and co-workers investigate the effect of 12.5% VCO in reducing the colonization of *Porphyromonas gingivalis* and *Treponema denticola* on the margin of porcelain fused to metal (PFM) crown of 23 subjects (Dewi et al.). The samples of subgingival plaque were taken from a pocket depth of 4mm of all the subjects with PFM crowns. Subjects were then instructed to rinse for 30 seconds with 12.5% VCO twice daily for 4 days, every morning and night, after routine toothbrushing, without rinsing with water afterwards. The overall bacterial count was done using real-time polymerase chain reaction (RT-PCR). The use of VCO as an addition to routine toothbrushing was reported to cause a significant decrease in the amount of *P.gingivalis* and *T.denticola* in the margin of the PFM crown.

The effect of VCO in plaque-related gingivitis populations was assessed in a study by (Rakshitha et al.), using an online distributed questionnaires. The results of this cross-sectional survey involved a sample size of 100 subjects, which presented with signs of gingival inflammations or gingivitis. The majority of the subjects (>50%), agreed that the use of VCO as an oil pulling improved their gingival health, and decreased plaque levels and the inflammation of the gum therefore proving the effectiveness of VCO as an adjunct to the treatment of plaque-related gingivitis.

The anti-inflammatory properties of VCO were also evaluated in a recent animal study conducted by Thahir and co-workers (Thahir et al.2023) In this study, the anti-inflammatory efficacy of VCO was assessed as local drug delivery in the gingival sulcus of lower anterior teeth in 24 male Wistar rats with induced periodontitis. The analysis focused on inflammatory mediators IL-1ß and IL-6. Results were compared with groups receiving metronidazole gel applications and scaling and root planing (SRP) alone. While reductions in IL-1ß and IL-6 levels were observed in all treatment groups, the VCO group showed the highest reduction, although not statistically significant. This study thus suggests the potential beneficial use of VCO as an anti-inflammatory agent in periodontitis treatment.

In vitro studies have yielded conflicting results regarding the efficacy of virgin coconut oil (VCO) against periodontal pathogens. Joshi and co-workers reported resistance of periodontal pathogens to VCO, while Ayob and co-workers demonstrated the opposite. (Joshi et al.) (Ayob et al.) Specifically, Ayob and co-workers found that both fermented and cold-pressed VCO exhibited antibacterial effects against key periodontal pathogens, including P. gingivalis and A. actinomycetemcomitans. (Ayob et al.) These findings suggest the potential utility of VCO as an adjunct in the management of periodontal disease. This highlights the need for further research to elucidate the mechanisms underlying these differing outcomes and to clarify the potential role of VCO in periodontal therapy.

Discussion

Currently available literature shows that the adjunctive use of virgin coconut oil in periodontal therapy is limited. None of the available human studies involved specifically periodontitis subjects and most of the studies applied the VCO in the form of mouth rinsing rather than direct applications to the periodontal pockets, except for the study by Thahir et al. which was done in animals. Also, the adjunctive use of VCO in reducing main periodontal parameters such as periodontal pocket depth cannot be evaluated due to the absence of the study. All the data available also reported only short-term adjunctive effect of the VCO.

The emergence of VCO as one of the alternative therapeutic options both in the field of medical and dentistry lies in its high contents of lauric acid. In a comparative study conducted by (Suryani et al.), the distinctions between Virgin Coconut Oil (VCO) and con-

ventional coconut oil and palm oil were explored. VCO stood out due to its elevated lauric acid (C12:0) content, ranging from 41% to 54.5%, in stark contrast to 0% in coconut oil and 0.1% in palm oil. Another comparative investigation examining the physicochemical distinctions among various types of Virgin Coconut Oil (VCO) preparations was conducted by (Mansor et al.). The study assessed VCO derived from fresh-dry (grated coconut route), chilling and thawing, enzymatic, and fermentation methods. All produced VCOs met the established physicochemical standards outlined by the Asian and Pacific Coconut Community (APCC) and the Codex Alimentarius Commission. Lauric acid emerged as the predominant fatty acid (FA) in all VCOs, ranging from 46.36% to 48.42%, while the primary triacylglycerol (TAG) identified was LaLaLa (La: Lauric), comprising 17.94% to 19.83% of the total TAG.

Due to high concentrations of lauric acid and phenolic compounds, VCO exerts numerous beneficial pharmacological properties such as anti-oxidant, healing, anti-inflammatory and anti-microbial and healing properties. A study comparing the anti-oxidant capacity between the virgin coconut oil and refined bleached and deodorized coconut oil showed that the VCO presented with better anti-oxidant properties with scavenging activities of 95% and 93% for both fermented and chilling processed VCO while only 83% for the RBD oil (Marina et al.). Arunima and Rajamohan, did an in vivo comparative study on the effect of wet-processed VCO compared to copra oil, olive oil and sunflower oil on the endogenous antioxidant effect in rats. Those male Sprague-Dawley rats were fed 8% level of different types of oil for 45 days along with an additional synthetic diet. The results revealed significantly improved anti-oxidant activity of VCO than other oils (K. G. Nevin and Rajamohan, "Virgin Coconut Oil Supplemented Diet Increases the Antioxidant Status in Rats"). The mechanism of anti-oxidant properties of VCO lies in the high concentrations of lauric acid and phenolic compounds. Lauric acid exhibits anti-oxidant properties by scavenging free radicals and inhibiting lipid peroxidation while phenolic compounds neutralize free radicals and protect the cells from oxidative stress (Sundram et al.)(Marina et al.).

In a study conducted by Vysakh et al., the anti-inflammatory effects of virgin coconut oil's polyphenolic fraction (VCO) were investigated in experimental arthritis, specifically adjuvant-induced arthritis in rats. The study revealed several mechanisms that contribute to the observed benefits of VCO in arthritis. Firstly, VCO reduced the expression of inducible nitric oxide (NO) synthase (iNOS), which led to a significant reduction in nitrite production, indicating a potential role in counteracting NO-induced oxidative damage. Secondly, the expression of cyclooxygenase-2 (COX-2), which is associated with inflammation, was decreased in rats treated with VCO, indicating immunological protection. Thirdly, VCO exhibited an inhibitory effect on tumour necrosis factor-α (TNF-α), a crucial player in rheumatoid arthritis pathology, which supports further research for potential anti-inflammatory medications. Additionally, VCO decreased interleukin-6 (IL-6) expression, which is crucial for cartilage and bone degradation in arthritis, correlating with decreased acute-phase protein production and reduced disease severity. Furthermore, VCO enhanced the activity of glutathione (GSH) and superoxide dismutase (SOD), contributing to cellular membrane integrity, while reducing lipid peroxidation associated with arthritis. Overall, the study highlights the multifaceted anti-arthritic effects of VCO through the modulation of inflammatory mediators and enhancement of antioxidant defence systems (Vysakh et al.).

The anti-microbial properties of virgin coconut oil are dominantly distributed by its components of medium-chain fatty acids, mainly lauric acid and monolaurin. Lauric acid, identified as the predominant component in Virgin Coconut Oil (VCO), exhibits a chemical structure composed of 12 carbon (C), 24 hydrogen (H), and 2 oxygen (O) atoms, with a molecular formula of $C_{12}H_{24}O_2$, categorizing it as a medium-chain fatty acid (MCFA). The structure reveals hydrophilic properties due to the -OH group and oxygen atom in the carbonyl group. These functional groups facilitate the formation of hydrogen bonds with the polar portions on the cell walls of pathogenic microorganisms. Simultaneously, its lipophilic characteristics stem from the lauryl groups, potentially enabling Van der Waals interactions with the non-polar regions on microorganism cell walls. Lauric acid's surfactant properties enhance its interaction with cell walls, demonstrating its potential to inhibit and even eradicate pathogenic organisms. Monolaurin also has both lipophilic and hydrophilic properties from its lauryl and two hydroxyl groups. The presence of these both lipophilic and hydrophilic groups allows monolaurin to have excellent amphiphilic and surfactant properties.

Lauric acid and monolaurin's reported antibacterial activity against both gram-negative and gram-positive bacteria can be attributed to their amphiphilic nature. The proposed mechanism is that their attack on bacterial cell membranes, characterized by an exposed

lipid bilayer, leads to membrane damage and potential leakage of cytoplasmic fluid containing vital organic compounds and enzymes. This leakage diminishes bacterial cell activity, ultimately resulting in cell death in gram-negative bacteria. The neutral nature of lauric acid and monolaurin allows them to easily permeate bacterial membranes without steric hindrance, making them effective against gram-negative bacteria (Nitbani et al.).

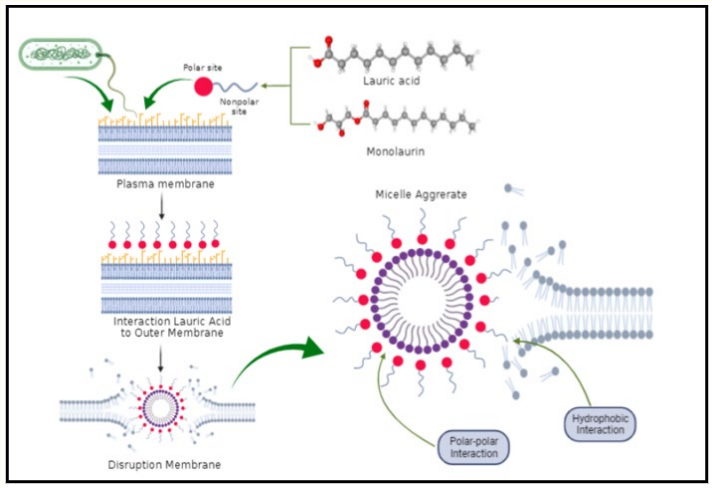

Figure 2: The anti-bacterial effect of lauric acid and monolaurin against Gram-negative bacteria (Adapted from Nitbani et al., 2022).

Against gram-positive bacteria, lauric acid and monolaurin target the cell wall, the outermost layer responsible for maintaining cell structure and preventing the entry of foreign compounds. The breakdown of the cell wall involves disrupting glycoside bonds connecting N-acetylmuramic acid (NAM) and N-acetylglucosamine (NAG) compounds. Under normal conditions, transpeptidase enzymes catalyse the formation of new peptide bonds, creating a rigid structure for peptidoglycan.

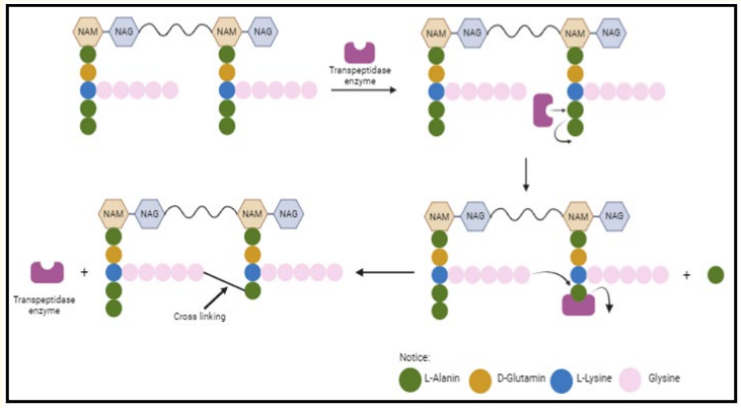

Figure 3: Mechanism of peptidoglycan synthesis. (Adapted from Nitbani et al., 2022).

Lauric acid and monolaurin, acting similarly to the mechanism of penicillin, potentially inhibit the transpeptidase enzyme's active site by forming bonds with its nucleophilic side. This disruption leads to the loss of peptidoglycan rigidity, triggering bacterial cell lysis (Nitbani et al.). In summary, the antibacterial efficacy of lauric acid and monolaurin arises from their amphiphilic properties, enabling them to interact effectively with bacterial cell membranes and cell walls, disrupting crucial structures and processes that are essential for bacterial survival.

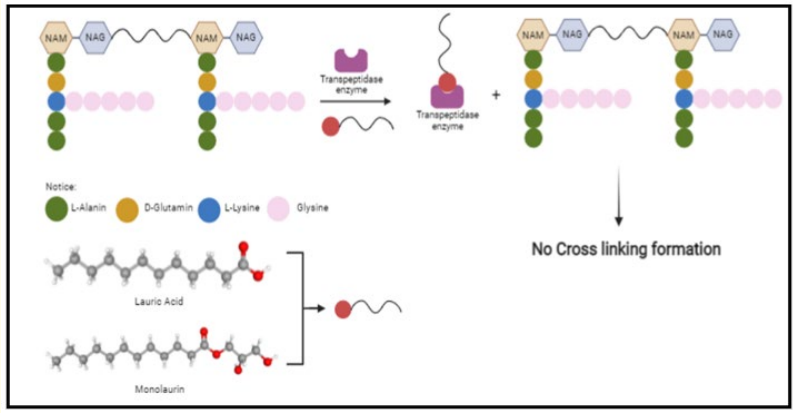

Figure 4: The inhibition mechanism of peptidoglycan synthesis by lauric acid and monolaurin. Adapted from (Nitbani et al., 2022).

Topical applications of virgin coconut oil (VCO) are also effective in promoting wound healing. In a study conducted on rats by Nevin and Rajamohan in 2010, it was observed that the application of VCO on dermal wounds resulted in significant positive effects on both intracellular and extracellular matrix components, as well as the antioxidant profile, thereby enhancing cutaneous wound healing. The granulation tissue from VCO-treated animal groups exhibited significantly higher total collagen content, indicating improved extracellular matrix formation which is crucial for wound healing. Cross-linking of collagen was also observed in VCO-treated animals, leading to greater wound strength. In addition, the total protein content of VCO-treated wounds was significantly higher, reflecting active synthesis and deposition of matrix proteins. The histopathological examination revealed enhanced fibroblast proliferation in VCO-treated wounds, indicating accelerated healing. The study suggests that the biologically active components present in VCO, such as antimicrobial fatty acids and antioxidant polyphenols, collectively promote a favourable wound environment and help in expediting the healing process (Nevin and Rajamohan et al.).

Conclusions

This review leads to the conclusion that VCO can be advocated as a valuable adjunct for the treatment of periodontal disease. Its established antioxidant, anti-inflammatory, healing, anti-plaque, and anti-gingivitis properties, along with its significant antibacterial activity, make it particularly beneficial. Further research is needed to assess its efficacy as a potential adjunctive agent in periodontal therapy.

Acknowledgement

Nil.

Conflict of interest

There is no conflict of interest.

References

1. Ayob Yuliana., et al. "Antibacterial Effects of Fermented and Cold Press VCO against Aggregatibacter Actinomycetemcomitans and Porphyromonas Gingivalis". Journal of International Dental and Medical Research 13.3 (2020): 969-74.
2. Chapple Iain LC., et al. "Periodontal Health and Gingival Diseases and Conditions on an Intact and a Reduced Periodontium: Consensus Report of Workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions". Journal of Clinical Periodontology 45 (2018): S74-S84.
3. Dewi Ratna Sari., et al. "Effect of 12.5% Virgin Coconut Oil on Porphyromonas Gingivalis and Treponema Denticola Bacterial Colonization". International Journal of Applied Pharmaceutics 9.2 (2017): 32-35.
4. Dumancas Gerard G., et al. "Health Benefits of Virgin Coconut Oil". Vegetable Oil: Properties, Uses and Benefits (2016).
5. G Gopala Krishna A., et al. Coconut Oil : Chemistry , Production and Its Applications - A Review.
6. Joshi Vinayak, et al. "A Comparative Evaluation of the Effect of Virgin Coconut Oil and Chlorhexidine Mouthwash on Periodontal Pathogens-An Invitro Microbial Study A Comparative Evaluation Of The Effect Of Virgin Coconut Oil And Chlorhexidine Mouthwash On Periodontal Pathogens". International Journal of Current Research (2017).
7. Mansor TST., et al. "Physicochemical Properties of Virgin Coconut Oil Extracted from Different Processing Methods". International Food Research Journal (2012).
8. Marina AM., et al. "Antioxidant Capacity and Phenolic Acids of Virgin Coconut Oil". International Journal of Food Sciences and Nutrition 60.2 (2009): 114-23.
9. McCarty Mark F and James J DiNicolantonio. "Lauric Acid-Rich Medium-Chain Triglycerides Can Substitute for Other Oils in Cooking Applications and May Have Limited Pathogenicity". Open Heart 3.2 (2016): e000467.
10. Narayanankutty Arunaksharan., et al. "Virgin Coconut Oil Maintains Redox Status and Improves Glycemic Conditions in High Fructose Fed Rats". Journal of Food Science and Technology, vol. 53, no. 1, Journal of Food Science and Technology (2016): 895-901.
11. Nevin KG and T Rajamohan. "Effect of Topical Application of Virgin Coconut Oil on Skin Components and Antioxidant Status during Dermal Wound Healing in Young Rats". Skin Pharmacology and Physiology 23.6 (2010): 290-97.
12. KG Nevin and T Rajamohan. "Virgin Coconut Oil Supplemented Diet Increases the Antioxidant Status in Rats". Food Chemistry 99.2 (2006): 260-66.
13. Nevin K Govindan and Thankappan Rajamohan. "Wet and Dry Extraction of Coconut Oil: Impact on Lipid Metabolic and Antioxidant Status in Cholesterol Coadministered Rats". Canadian Journal of Physiology and Pharmacology 87.8 (2009): 610-16.
14. Nitbani Febri Odel., et al. "Antimicrobial Properties of Lauric Acid and Monolaurin in Virgin Coconut Oil: A Review". ChemBioEng Reviews 9.5 (2022): 442-61.
15. Papapanou Panos N., et al. "Periodontitis: Consensus Report of Workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions". Journal of Clinical Periodontology (2018): S173-S182.
16. Rakshitha VS., et al. "Effect of Virgin Coconut Oil in Plaque Related Gingivitis". Journal of Pharmaceutical Research International 33 (2021): 354-64.
17. Salian Varsha., et al. "Efficacy of Virgin Coconut Oil and Chlorhexidine as an Oral Antimicrobial: A Comparative Pilot Study". World Journal of Dentistry 10.4 (2019): 295-300.
18. Saputra Leo., et al. "Effect of 12.5% Virgin Coconut Oil (Cocos Nucifera) Mouthwash on Plaque Index of Fixed Prosthetic Denture Users". International Journal of Applied Pharmaceutics 9.2 (2017): 41-44.
19. Srivastava Yashi., et al. "Virgin Coconut Oil as Functional Oil". Therapeutic, Probiotic, and Unconventional Foods, Elsevier Inc (2018).

20. Sundram K, Sambanthamurthi R and Tan YA. "Palm fruit chemistry and nutrition". In A. Gunstone & R. J. Hamilton (Eds.), Palm oil: Production, processing, characterization, and uses. AOCS Press. (2nd ed.) (2017): 147-186.
21. Suryani Suryani., et al. "A Comparative Study of Virgin Coconut Oil, Coconut Oil and Palm Oil in Terms of Their Active Ingredients". Processes 8.4 (2020): 1-11.
22. Thahir Hasanuddin., et al. "Effectiveness of Virgin Coconut Oil in Periodontal Treatment via Analysis OF IL- 1β and IL-6". Journal of Pharmaceutical Negative Results 14.1 (2023): 113-22.
23. Villarino Blanca J., et al. "Descriptive Sensory Evaluation of Virgin Coconut Oil and Refined, Bleached and Deodorized Coconut Oil". Lwt 40.2 (2007): 193-99.
24. Vysakh A., et al. "Polyphenolics Isolated from Virgin Coconut Oil Inhibits Adjuvant Induced Arthritis in Rats through Antioxidant and Anti-Inflammatory Action". International Immunopharmacology 20.1 (2014): 124-30.

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