

The Effectiveness of Natural Virgin Coconut Oil in Periodontal Tissue Regeneration

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ABSTRACT

Background: Periodontal disease is the most common inflammatory disease presents in humans. Data from *Global Burden of Disease* in 1990-2010 shows that periodontal disease, particularly periodontitis, ranks sixth globally with percentage of 11.2% and suffered by approximately 743 million people. While in Indonesia according to the data from RISKESDAS 2018, the prevalence of periodontitis reached 74.1% of the total number of oral diseases experienced by the population. Coconut plant (*Cocos nucifera L*) has great potential to be processed into useful products. Virgin Coconut Oil (VCO) formed by processing coconut flesh into oil is used as medicine and believed to cure various diseases. The advantage of this oil lies in the high level of saturated fatty acids (around 90%), which makes VCO the healthiest oil. VCO is very rich in lauric acid content, ranging 50-70%, which gives VCO a tissue regeneration effect.

Objective: This study aims to discuss the effectiveness of VCO on the regeneration of periodontal soft tissue in periodontitis. **Method:** A systematic study was conducted on the PubMed and Google Scholar databases for clinical trials published in English up until 2021. A preliminary search of the databases resulted in 110 articles. Manual searches of full text articles and other related articles were carried out afterwards. PICO (Population, Intervention, Control, and Outcomes) questions were used in this systematic review. The articles selected were those that focused on the effectiveness of VCO on tissue healing and regeneration. **Literature Review:** Virgin Coconut Oil is proven to speed up wound healing time and has the highest healing rate, due to its ability to moisturize wounds, accelerate cellular metabolism, and has the anti-inflammatory and anti-infection properties in treating chemical burns. VCO with its high lauric acid content can accelerate the tissue regeneration process, where regeneration is often used to describe the formation of new adhesions, cementum, alveolar bone and periodontal ligaments on the site that has previously lost the tooth-supporting tissue structure. Regeneration will result in the replacement of the damaged tissue with the same newly-formed tissue.

Conclusion: Is proven to provide many benefits for daily life, especially in the health sector. Lauric acid, which is abundant in VCO, can stimulate soft tissue that is damaged due to inflammation, also accelerates wound and tissue healing.

Keyword: *Virgin Coconut Oil, Regenerative Therapy, Periodontitis*

INTRODUCTION

Periodontitis is one of the most common diseases in Indonesia, based on the results of the 2018 Ministry of Health's RISKESDAS study, the prevalence of periodontitis reached 74.1% (Ministry of Health 2018). Periodontitis is a periodontal disease characterized by inflammation

of the tissues supporting the teeth. Periodontitis progression is generally caused by plaque bacteria on the tooth surface, where plaque is a thin layer of biofilm containing a cluster of pathogenic microorganisms.^(1,2) Periodontitis if not handled properly, then the interaction between plaque bacteria, their products and the body's response can trigger an inflammatory response that can cause ulceration of the gingiva, damage on connective tissue, loss of alveolar bone, and eventually tooth loss.⁽³⁾

As a country with tropical climate, Indonesia is able to produce roughly 18,3 tons of coconuts each year. Virgin Coconut Oil (VCO) is a popular coconut product that possesses many benefits, made from fresh coconut meat, processed at low temperature to produce a product with low content of water and free fatty acids, is transparent, fragrant, and has a long shelf life of up to 12 months.^(4,5) VCO contains lauric acid and caprylic acid (6-7%) which have the ability to kill bacteria and viruses. Lauric acid in VCO is converted into monolaurin which has antiviral, antibacterial and antiprotozoal properties.⁽⁶⁾ Lauric acid in VCO also has the effect of stimulating fibroblast cells by fibronectin. Lauric acid is associated with the activation of transforming growth factor beta (TGF- β), which is a proliferating growth factor that stimulates fibronectin in the formation of fibrin threads and clots. In a research conducted by Jannah et al., The Effect of Virgin Coconut Oil Application on Increasing the Number of Fibroblasts in Post Tooth Extraction Wounds in *Rattus norvegicus*, showed an increase in the number of fibroblasts in wounds after tooth extraction performed in *Rattus norvegicus*, in which the wound was treated with oral VCO, and VCO was able to increase fibroblasts 0.4 times greater than povidone iodine.⁽⁵⁾

METHOD

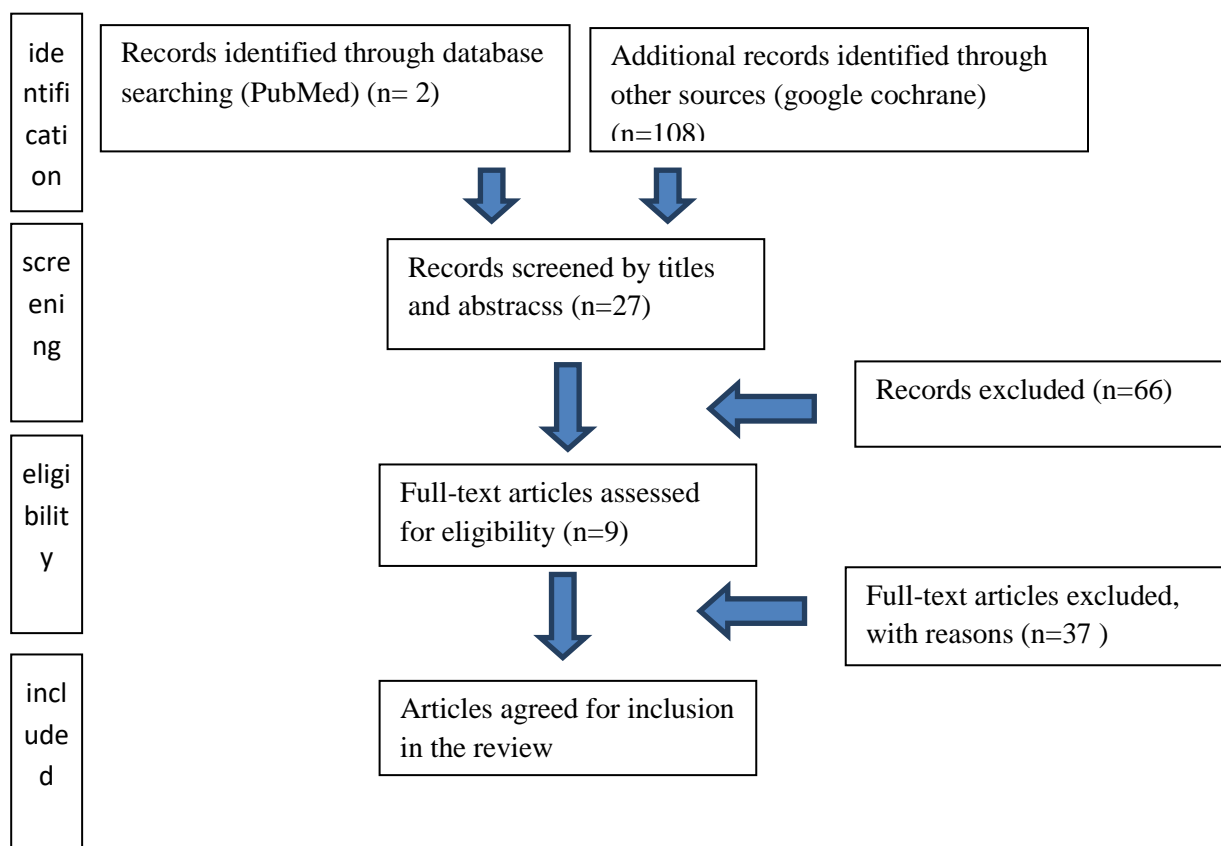
DATA SOURCE

Data search using Google Scholar and Pubmed with English keyword was carried out to determine the research protocol. The search was done to identify articles published in dental journals that focused on VCO and soft tissue therapy. The keywords used were VCO, Periodontitis, and Tissue Regeneration. Search filters were applied to the electronic search to display only English studies that provide full-text articles. Manual searches of published full-text articles and related literature reviews were carried out afterwards.

The inclusion criteria used for this review are English full-text articles published between 2016-2021 and are related to the effect of VCO on periodontal soft tissue regeneration. Meanwhile, the exclusion criteria were articles in the form of systematic reviews, blogs, textbooks, and meta-analysis.

DATA COLLECTION

The data used in this literature review are secondary data. The data were obtained from articles which were then reviewed based on the criteria determined by the authors.



RESULT

After 110 articles were gathered from Google Scholar and Pubmed searches, 66 articles were excluded because they did not meet the criteria desired by the authors, leaving 36 articles that were then reviewed based on their titles and abstracts, after which 27 articles were excluded because they did not match the inclusion criteria. Finally, 9 articles were obtained, reviewed and then entered into the synthesis table.

Table1. Effect of VCO gel application on periodontal soft tissue regeneration

No	Journal reference	Method	Result
1	<p>Francesca Ripari (2020)</p> <p><i>The Role of Coconut Oil in Treating Patients Affected by Plaque-Induced Gingivitis: A Pilot Study.</i>⁽⁷⁾</p>	<p>Materials and Methods The sample of 20 patients was divided into two groups: the study group and the control group. In the study group, coconut oil, in the form of mouthwash, was administered to a sample of patients with gingivitis, aged between 18 and 35. The protocol established a daily application of the product for 30 days, in which the clinical parameters for plaque formation and gingivitis were measured by the plaque index (PI), bleeding index (BI). The control group did not associate the coadjuvant with normal daily oral hygiene procedures and these clinical parameters were evaluated at t0 and after 30 days (t1).</p>	<p>Based on the data collected showed a significant improvement in reducing plaque formation and gingivitis</p>
2	<p>Sandeep R. Varma (2017)</p> <p><i>In vitro anti-inflammatory and skin protective properties of Virgin coconut oil.</i>⁽⁷⁾</p>	<p>Cell lines and its maintenance, chemicals, gas chromatography-FID analysis, cell viability, ELISA for cytokine measurement, ELISA for involucrin and filaggrin, semi-quantitative RT-PCR, skin irritation and phototoxicity assay, UV inhibitory study by reactive oxygen species assay.</p>	<p>The study shows the anti-inflammatory activity of VCO that suppresses inflammatory markers and protects the skin by enhancing the skin's protective function.</p>
3	<p>Ratna sari dewi. atall (2017)</p> <p><i>Effect of 12.5% virgin coconut oil on porphyromonas gingivalis and treponema denticola bacterial colonization.</i>⁽⁸⁾</p>	<p>23 subjects, were patients with posterior porcelain-fused-to-metal crown visiting Faculty of Dentistry Universitas Indonesia dental hospital. Patients signed the informed consent and clinical periodontal examination was done. Patients were</p>	<p>The use of 12.5% virgin coconut oil showed a decrease in the number of <i>P. gingivalis</i> and <i>T. denticola</i> on the margin of the porcelain-fused-to-metal crown.</p>

		asked to gargle twice daily with 12.5% virgin coconut oil, 30cc for 1 min in 4 days. Saliva samples were collected with paper point to calculate the number of <i>P. gingivalis</i> and <i>T. denticola</i> using real-time polymerase chain reaction.	
4	Ummi Aqilah Haron. at all (2017) <i>The Comparative Antimicrobial Effect of Activated Virgin Coconut Oil (AVCO) and Virgin Coconut Oil (VCO) against Dental Caries-Related Pathogens.</i> ⁽⁹⁾	In this study, the researchers compared the antimicrobial effect of AVCO obtained from KL trading, Selangor, Malaysia, and VCO extracted in their own laboratory. The MIC and MBC of each coconut oil against the selected dental caries-related pathogen; <i>Streptococcus mutans</i> , <i>Lactobacillus casei</i> and <i>Candida albicans</i> were determined.	In contrast to a positive finding of AVCO, VCO has shown no inhibitory effect on all tested dental caries-related pathogens. Furthermore, the time killing assay revealed that AVCO showed relatively quick-killing activity at the 8 hours of time for all tested organism. These findings correlate with that of AVCO possess bactericidal activity, thereby allowing the possible classification of the AVCO as being a bactericidal agent.
5	PRIMA ABIGAIL Gayatri (2019) <i>Stability Of Zoledronate Gel Emulsion In Virgin Coconut Oil.</i> ⁽¹¹⁾	ZOL gel emulsion consists of 0.16% ZOL powder, 2% carboxymethylcellulose, 5% VCO, 0.44% sodium benzoate, and 0.009% antioxidant hydroxytoluene, and distilled water. This gel emulsion sample was stored at 25 ° C and 40 ° C for 1 month, and the parameters used for the stability test were pH, viscosity, spreadability, and adhesiveness strength. ZOL gel emulsion was evaluated against this metric on days 1, 7, 14, and 28.	This study found that the ZOL gel emulsion was stable when stored at 25 ° C. Organoleptic values, pH, viscosity, dispersibility, and adhesiveness strength were also stable, and degradation was constant.
6	Siti Fatimah Binti Rahmat (2018) <i>Virgin Coconut Oil, Coconut Milk And Coconut Water Potential In The Remineralization Of Tooth Enamel Surface.</i> ⁽¹²⁾	The research was started by analyzing the elemental content of VCO, CM, and CW using ICP-MS. Following the evaluation of enamel remineralization, the specimens were observed under a scanning electron microscope.	In general, this study aims to determine the potential of virgin coconut oil (VCO), coconut milk (CM), and coconut water (CW) as new alternatives in remineralizing the surface of tooth enamel. The results showed that VCO and CM left a protective layer over the enamel surface, while the control did not show any changes in the enamel surface morphology.

		<p>e. The specimens were demineralized using a demineralization solution at pH 4.01 for 7 days then reacted with VCO, CM, and CW as remineralization solutions for 14 days. Distilled water was used as a control during the study. Observations using SEM / EDX.</p>	
7	<p>Putri Dafriani, et al (2020) <i>Virgin Coconut Oil (VCO) Accelerated Wound Healing Process in Diabetes mellitus (DM) Patients With Diabetic Ulcer in dr. Rasidin Hospital, Padang, Indonesia.</i>⁽¹²⁾</p>	<p>This research is a quasi-experimental research carried out in the Inpatient Installation of Dr. Rasidin Hospital Padang, West Sumatera, Indonesia. The study participants were diabetic ulcer patients who were divided into 2 groups, 8 patients in the control group and 8 patients in the intervention group. The control group was given wound care using 0.9% NaCl and the intervention group was treated with 0.9% NaCl plus VCO.</p>	<p>There were significant differences in the wound surface between the control group and the intervention group. VCO helps wound healing by reducing the surface area of the wound.</p>
8	<p>Jansen Silalahi, et al (2019) <i>The Activity of Hydrolyzed Virgin Coconut Oil to Increase Proliferation and Cyclooxygenase-2 Expression towards on NIH 3T3 Cell Line in Wound Healing Process</i>⁽¹³⁾</p>	<p>The sample used was Virgin Coconut Oil (VCO). VCO was partially hydrolysed using lipase from <i>Rhizomucormieheito</i> produce hydrolysed VCO (HVCO) composed of free fatty acids, 2-monoglycerides. The acid value was determined. The effect of HVCO on proliferation was evaluated using the MTT method. Wound healing assay was established by a cell migration method, and COX-2 expression was determined using RT-PCR.</p>	<p>HVCO is proven to be effective in increasing cell proliferation and wound healing process. The activity of Hydrolyzed Virgin Coconut Oil increases the proliferation and expression of Cyclooxygenase-2 against the NIH 3T3 cell line in the wound healing process.</p>
9	<p>Dian Ika Perbina Meliala, et al (2019) <i>The Role of Coconut Oil to</i></p>	<p>Coconut oil used in this study was virgin coconut oil (VCO) and VCO hydrolysed by <i>Rhizomucormiehei</i> (HVCO). NIH 3T3 cells (5×10^5 cells/well) were</p>	<p>VCO and HVCO increase the expression of MMP-9, PDGF-BB, dan TGF-β1 in NIH3T3 cells and therefore, coconut oil active in the wound healing process. HVCO is more than active than VCO.</p>

	<i>Increase Expression of MMP-9, PDGF-BB, and TGF-β1 in NIH-3T3 Cell Line.</i> ⁽¹⁴⁾	seeded in ninewellsandincubatedforovernight, thendividedintothreegroups . Eachgroupconsistedofthree wells. Group onewithouttreatment, grouptwoadded VCO, andgroupthreeadded HVCO andthenincubatedforovernight. One well in eachgroupwasadded MMP-9, PDGF-BB, and TGF- β 1 andincubatedonehour. Finally, expressionsof MMP-9, PDGF-BB, and TGF- β 1 were detectedusingimmunocytochemistrymethod.	
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LITERATURE REVIEW

Periodontitis

Periodontitis is defined as an inflammatory disease of the tooth-supporting tissue, caused by certain microorganisms where these organisms produce a number of virulence factors and induce host inflammatory mediators, causing inflammation that extends into the tissue and potentially resulting in progressive damage to the periodontal ligament and alveolar bone with increased probing depth, recession, or both, causing mobility and eventually tooth loss. The severity varies between individuals, regardless of the degree of bacterial infection, suggesting that a regulated host inflammatory response may contribute to the presence of microorganisms.⁽¹⁶⁻¹⁸⁾

Etiology of Periodontitis

The etiology of periodontitis comes from a group of bacteria, especially gram-negative and anaerobic bacteria, which colonize the sub-gingival region. Specific bacteria such as *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola*, *Aggregatibacter actinomycetemcomitans*, *Prevotella intermedia*, *Fusobacterium nucleatum*, which to this day is termed “Red complex” bacteria (*P. gingivalis*, *Tannerella forsythia*,

Treponemadenticola) are the primary etiological factor in periodontal disease, specifically most common in chronic periodontitis.^(18,19)

Pathogenesis of Periodontitis

The pathogenesis of periodontitis involves not only microorganisms in plaque, but also several factors associated with the host. In the early stages of periodontitis, inflammation occurs in gingiva as a response to bacterial attack. Red complex bacteria will trigger the immune response, namely neutrophils, macrophages, lymphocytes in the gingival tract, to fight against periodontal pathogens and endotoxins, maintain the host tissue and control the bacterial development.⁽²⁰⁾

The mechanism of tissue damage occurs through immune response, and is not a direct consequence of bacteria presence. Macrophages are not the dominant feature in advanced lesions, where they only account for 5% of the cells. Fibroblasts when stimulated by the inflammatory cytokines IL-1, IL-6, TNF- α , PGE2, will produce Matrix Metalloproteinases (MMPs) which is a family of proteinases that aims to degrade the extracellular matrix. Collagen molecules are broken down into smaller ones, which are then denatured in the extracellular environment or phagocytosed by surrounding fibroblasts.⁽²⁰⁾

Treatment for Periodontitis

Treatment for periodontitis generally falls into two categories: 1) Procedures to stop the progression of the disease, namely the initial phase therapy consisting of scaling, root planing, oral hygiene improvement, and occlusal adjustment if needed. 2) Procedures to regenerate structures damaged by the disease. Supportive maintenance of periodontal therapy after active treatment is essential to achieve maximum results. Attempts to suppress the subgingival microbiota as much as possible, supports the repair and regeneration of the periodontium. In various short- and long-term clinical studies, the administration of drugs combined with supragingival plaque control has proven to be effective.^(21,22)

Tissue Regeneration

Regeneration is the process of regrowing and reconstructing tissue from a lesion, to restore the initial shape and function of the tissue affected by the lesion. Regeneration is often used to

describe new formation of cementum, adhesions, alveolar bone and periodontal ligament on the surface where the tooth-supporting tissue structure is missing. Regeneration will result in replacement of the damaged tissue with the same tissue structure. In periodontal tissue, the damaged epithelium is replaced by epithelium, whereas connective tissue and periodontal ligaments is replaced by connective tissue.⁽²³⁾

Virgin Coconut Oil (VCO)

Coconut oil is rich in medium-chain fatty acids and shows good digestibility (Che Man & Marina, 2006). The term VCO refers to oil obtained from fresh and ripe raw coconut fruit, mechanically or naturally, with or without the use of heat, and without chemical refining (Villarino, Dy, & Lizada, 2007). Unlike RBD (*Refining, bleaching, and deodorizing*) coconut oil which is specially made for cooking purposes, VCO is currently being marketed as functional oil. Since it was first introduced, virgin coconut oil has attracted the public attention. Information about the beneficial properties of VCO spreads rapidly.⁽²⁴⁾

Current researches have shown that VCO has the ability to moisturize wounds, accelerate cellular metabolism, and has the anti-inflammatory and anti-infection properties in chemical burns. Virgin coconut oil has been shown to speed up wound healing time and has the highest percentage of healing effect on chemical burns in *Rattus Novergicus*. Research conducted on 18 Sprague-Dawley with excision wounds, proved that VCO was able to increase fibroblasts proliferation so that the density of collagen fibers increased, and helped accelerate the tissue regeneration process.^(5,25)

DISCUSSION

Indonesia is a country with the largest coconut plantation area in the world, reaching 3.7 million ha. The coconut plant has many benefits from its roots, stems, leaves, fruit, to the midrib.⁽²⁶⁾ Virgin Coconut Oil (VCO) is produced from processed coconut flesh which is known to have the ability to moisturize wounds, accelerate cell metabolism, and has the anti-inflammatory and anti-infection properties in treatment of chemical burns. VCO has been shown to speed up wound healing time and has the highest percentage of healing against chemical burns in *Rattus novergicus*. Research conducted on Sprague-Dawley mice with excised wounds proved that VCO was able to increase fibroblasts proliferation, thus increased the collagen fibers density

and helped accelerate the tissue regeneration process.^(27,28) Similar result was also shown in a study conducted by Ratna Sari et al. (2017) where the number of *P. gingivalis* and *T. denticola* were decreased after gargling with 12.5% VCO for 4 days.^(6,8)

Regenerative therapy is a field of biotechnology that combines various aspects and treatment strategies, including the use of cells produced, in order to increase, restore, or replace a damaged or missing tissue, effectively repairing the tissue both structurally and functionally. Regenerative medicine includes the use of growth factors, biomaterials, and stem cells.^(29,30) In periodontal tissue, regeneration is a continuous physiological process, in which under normal conditions new cells and tissues are constantly being formed to replace mature and dead cells and tissues.⁽³¹⁾

The Medium Chain Triglyceride (MCT) content in VCO in the form of lauric acid, flavonoids, and tocopherol, is anti-inflammatory and can prevent infection and excessive cell damage. Lauric acid in VCO is also associated with the activation of TGF- β cytokines which will stimulate fibronectin in fibrin clots formation, which then become the framework for re-epithelialization and proliferation of fibroblasts, which can accelerate the healing process in inflammation.⁽⁵⁾ Research conducted by Jansen Silalahi (2019), by applying VCO topically to wounds, obtained faster healing as indicated by decreased epithelialization time, increased fibroblast proliferation, and higher collagen turnover resulted in faster wound healing.^(13,25) Research conducted by Putri Dafriani (2020) on inpatients with diabetes mellitus ulcers, compared the administration of 0.9% NaCl and NaCl combined with VCO, the results then showed a reduction in wound surface area in the combination group of NaCl and VCO, which proved that VCO has an effect on dermal and epidermal healing, and provides strength to the epithelial tissue.^(12,32,33,34,35,36,37)

In a trial done by Dian Ika Perbina Meliala, et al. (2019), the use of Virgin Coconut Oil (VCO) and VCO hydrolyzed with *Rhizomucormiehei* (HVCO) resulted in the increased expression of MMP-9, PDGF BB, and TGF-1 β in NIH3T3 cells, suggested that coconut oil is active in the wound healing process. Whereas in the study conducted by Ummi Aqilah Haron, et al. (2017), VCO has shown no inhibitory effect on all tested dental caries-related pathogens. Furthermore, the time killing assay revealed that AVCO showed relatively quick-killing activity at the 8 hours of time for all tested organism. These finding correlates with that of AVCO possess bactericidal activity, thereby allowing the possible classification of the AVCO as bactericidal agent.^(9,14)

CONCLUSION

Periodontitis can cause damage to both the soft and hard tissues in the oral cavity. VCO is believed to provide many benefits for daily life, especially in the health sector. Lauric acid, which is abundant in VCO, can stimulate soft tissue that is damaged due to inflammation. Further and detailed research is needed regarding the benefits of VCO in healing inflamed tissue.

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