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Potential of Lauric Acid, Miristic Acid and Combination Gel as Inhibiting the Growth of Porphyromonas Gingivalis Bacteria in Gingivitis

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Abstract:- Gingivitis is a mild periodontal disease accompanied by clinical symptoms in the form of red gingiva. The incidence of gingivitis in Indonesia ranks second with 96.58%, while in Central Java it is 25.8%. The main cause of gingivitis is the lack of maintaining oral and dental hygiene, marked by the accumulation of plaque and tartar around the teeth which can be removed by regular brushing and scaling using tools and drugs made from chemicals. The chemicals are considered to have side effects when used for a long time. Many people now choose natural ingredients or herbal ingredients. One of the natural ingredients that can be used for treatment is coconut (Virgin Coconut Oil / VCO). The aim of producing VCO as an alternative ingredient for gingivitis therapy (Laboratory study). This research is a laboratory experiment with a post-test only control group research design. VCO gel is made from fresh coconuts which are processed into VCO by natural fermentation, which is then mixed with NaCMC added Treatanolamin (TEA) and dissolved with glycerin to get VCO in gel form. The research subjects were 24 Rattus Norvegicus. divided into 4 groups, namely the lauric treatment group, the myristic acid treatment group, the combined lauric and myristic acid group and the control group. Experimental animals acclimatized for 5 days were induced by Porphyromonas gingivalis bacteria in LPS (Lipopolysaccharide) preparation in the gingival sulcus of the lower right first incisor as much as 0.01 ml. Experimental animals that have experienced inflammation are then treated with VCO gel. During the fourteen days after drug administration, observations were made on the healing of gingivitis by examining swelling, discoloration of the gingiva, bleeding on the gingiva and histopathological examination using a light microscope with 400x magnification. Post-treatment observation, experimental animals were observed or observed for 14 days. The results of observations are recorded in the observation checklist sheet where the examination of the condition of the gingiva is based on the Modified Gingival Index (MGI). Experimental animals were observed or observed for 14 days. The results of observations are recorded in the observation checklist sheet where the examination of the condition of the gingiva is based on the Modified Gingival Index (MGI). Experimental animals were observed or observed for 14 days. The results of observations are recorded in the observation checklist sheet where the examination of the condition of the gingiva is based on the Modified Gingival Index (MGI).Results:virgin coconut oil (lauric acid) is effective against killing and weakening Porphyromonas gingivalis bacteria. Virgin coconut oil (myristic acid) is effective against killing and weakening Porphyromonas gingivalis bacteria, but lauric acid is more effective. Virgin coconut oil (a combination of lauric acid and myristic acid) is effective against killing and weakening Porphyromonas gingivalis bacteria, but more effective than lauric acid and myristic acid. Conclusion: virgin coconut oil is effective as an alternative ingredient to inhibit Porphyromonas gingivalis bacteria in gingivitis. The lauric acid group is more effective than the myristic acid group, combinednor control.

Keywords:- *Gingivitis, Virgin Coconut Oil, Porphyromonas gingivalis bacteria.*

I. INTRODUCTION

Health is the most important element in life, both physically and spiritually. One of the health that needs to be maintained is dental and oral health. Presentation from The Global Burden of Disease Study 2016 regarding dental and oral health problems, especially dental caries is one of the diseases experienced by 3.58 billion people in the world. Periodontal disease is the most common disease experienced by humans, so it ranks 11th. Meanwhile, oral cancer is ranked 3rd in Asia Pacific.

The 2018 Basic Health Research stated that damaged teeth and cavities are the biggest dental problems in Indonesia with a proportion of 45.3%. While the gums are swollen and boils (abscesses) are 14%. According to the Minister of Health Number 89 of 2015, dental and oral health is a healthy condition of the teeth from hard and soft tissues, and elements in the oral cavity that work in eating and speaking activities.

Diseases in the oral cavity that often occur according to FDI (Federation Dentaire Internationale) are cavities (caries), oral cancer, and disorders of the gums (periodontal). Cavities (caries) are a disease that is often experienced by every human being in the world. Caries can be caused by frequent consumption of sugar, poor dental hygiene, and constraints on access to dental health services. Oral cancer is a cancer that is often found in humans. usually occurs on the tongue, lips, gums, esophagus, roof of the mouth, inside of the cheeks, and the bottom of the mouth. The main cause is the consumption of cigarettes and alcohol. Disorders of the gums (periodontal) is one of the causes of tooth loss. This disorder is characterized by the occurrence of gingivitis, Periodontal is the tissue that surrounds the teeth and has a function as a support for the teeth consisting of gingiva, cementum, alveolar and periodontal connective

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tissue. Disorders of the gums can be caused by a local inflammation of the bacterial infection which manifests as damage to the supporting tissues of the teeth6,7,8. Periodontitis is an inflammation of the supporting tissues of the teeth which is characterized by infiltration of inflammatory cells caused by the presence of toxin products from bacteria thereby destroying the epithelium and the structure of the periodontal tissue, the bacteria is the bacterium P. Gingivalis. with symptoms of pain in the gums can even damage the jawbone, nerves, and tissues around the periodontal5,6,7.

Gingivitis is a mild periodontal disease accompanied by clinical symptoms in the form of red gingiva5,9. The main cause of gingivitis is the lack of maintaining oral and dental hygiene, with a marked buildup of plaque around the teeth10,11. If plaque is left unattended and not cleaned, it will form a pellicle, the mucous membrane of saliva which will cover the teeth so that the gingival margin changes color from reddish to bluish red and enlargement of the gingival contour due to edema and bleeding easily11. Deficiency of niacin (pellagra) can result in inflammation and bleeding of the gums which can cause infection in the mouth10.

Gingivitis in the Americas has a prevalence of up to 82% in young people, 50% in adults, moderate gingivitis category reaches 75%. Meanwhile, the gingivitis rate in Indonesia ranks second with 96.58%, while in Central Java it is 25.8%34. Various kinds of actions are being taken by the government in maintaining and improving the oral and dental health status of the community, namely by teaching the public to brush their teeth properly and to do scaling to remove plaque and tartar that accumulate in the oral cavity so as to prevent the growth of bacteria that cause gingivitis1,12.

Apart from tooth brushing and scaling, there are materials available that can be used as a therapeutic agent for gingivitis, namely chlorhexidine which is an antibacterial with a broad spectrum, low toxicity, and is soluble in water, is bactericidal and is able to overcome the growth of gram-positive and gram-negative bacteria13,14. Chlorhexidine mouthwash is proven to be effective against bacteria in the oral cavity because it reduces the growth of plaque microorganisms. Based on study results (Devi et al, 2018), the application of 0.2% chlorhexidine gluconate was able to reduce and kill porphyromonas gingivalis bacteria. In addition, a study conducted by Sinaredi, et al., showed that chlorhexidine had the strongest antibacterial effect which was able to inhibit bacterial growth15.

The use of chemicals is considered to have side effects when used for a long time. Many people now choose natural ingredients or herbal ingredients. Now the eyes of the world are starting to target the use of natural ingredients that have been applied and proven empirically in Asia, especially Indonesia. The community acknowledges that natural medicines play a role in various efforts to maintain, improve and restore health and treat disease based on the consideration that natural medicines can affect the body's natural defense mechanisms16,17. One of the natural ingredients that can be used for treatment is coconut. Many people consume coconuts without realizing that coconut oil, which is considered only a staple food, is actually rich in benefits, including in the field of dental and oral health. Pure coconut oil or often called Virgin Coconut Oil (VCO) is produced from fresh coconut meat whose manufacturing process goes through relatively low temperatures, so that the essential content of the oil can be maintained16,17. VCO is known for its good benefits for health including, antibacterial, viral, fungal, infection. Saturated fat in VCO is dominated by 44%-52% lauric acid, 13%-19% myristic acid and 7.5%-10.5% palmitic acid. Lauric acid is able to overcome gram-positive and gram-negative bacteria, where the membrane containing fat can destroy and inhibit protein synthesis from bacteria18. In research conducted by Noriko, et al., in the journal Al-Azhar Indonesia Science and Technology Series (2014:

Based on the background that has been described, researchers are interested in conducting research on virgin coconut oil gel as a gingivitis therapy material which is tested in vivo or on experimental animals to determine the antibacterial potential of virgin coconut oil smeared with gel before the gel can be used by humans.

II. MATERIALS AND METHODS

A. Animal Preparation:

We selected twenty four Rattus novergicus rats from the central animal enclosure (UNISSULA Faculty of Medicine Integrated Biomedical Laboratory), for this study. Animals were randomly divided into four groups (= 6 in each group): treatment (K1, K2 and K3) and control (K4) groups and They were kept in the animal house (UNISSULA Faculty of Medicine Integrated Biomedical Laboratory) During2 weeks, with appropriate acclimatization prior to starting the experiment under controlled lighting conditions (12 hours light/12 hours darkness) and temperature 23 ± 2°C. They are placed

Under ideal laboratory conditions, it was maintained on a standard pellet diet and water ad libitum throughout the experiment. All procedures comply with internationally accepted guidelines for experimental animals on the use and care of laboratory animalsUNISSULA Faculty of Medicine Integrated Biomedical Laboratory.

B. Preparation of Porphyromonas gingivalis bacterial culture:

Using BHI-A and BHI-B media. BHI-A is carried out by heating 3.7 grams of BHI-A with 100 ml of sterile distilled water in an Erlenmeyer tube, heating using an electric stove until homogeneous. Then cover with cotton and sterilize in an autoclave at 121°C for 15 minutes, add 50µl hemin, 10µl vitamin K and 500µl yeast extract and then homogenize. To find out if BHI-A media is sterile, do a sterilization test in an incubator for 24 hours. The BHI-B media was prepared in an Erlenmeyer tube by means of 3.7 grams of BHI-B plus 10 ml of sterile distilled water then heated until homogeneous, covered with cotton and then sterilized in an autoclave at 121°C for 15 minutes. Then add 5µl hemin, 1µl vitamin K and 5µl yeast extract. Then carry out a sterilization test by inserting BHI-B media into the incubator for 24 hours. The

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P. gingivalis suspension was prepared in a test tube by adding 2 ml of BHI-B media with 1 ose of P. gingivalis bacteria. The P. gingivalis suspension was put into the decyclator to get an anaerobic atmosphere, then put in the incubator for 2x24 hours.

C. Animal models:

In this study we developed an animal model of gingivitis induced by Porphyromonas gingivalis bacteria in LPS (Lipopolysaccharide) preparation which was injected into the gingival sulcus of the lower right first incisor as much as 0.01 ml for 14 days. Furthermore, the state of inflammation such as swelling, gingival discoloration and bleeding was observed.

D. Experimental Design:

In this study, a total of twenty four Rattus novergicus were divided into the following four groups which had six rats in each group: treatment (K1, K2 and K3) and control (K4) groups; with details of treatment in K1 (lauric acid), K2 (myristic acid), K3 (lauric acid + myristic acid) and the control group / K1 (Chlorhexidine)

E. Preparation of Virgin coconut oil extract (VCO):

making VCO extract do inLUNDIP Bionano Technolgy laboratory, Prosprovince of Central Java, Indonesia.Making VCO gel is done by taking the compounds in the VCO, the compounds taken are lauric acid and myristic acid. After taking the compound, the next step is to make the gel. The ingredients used in the formulation of VCO gel preparations are Carbapol (1% concentration) as a gel base, this is because Carbapol can dissolve in water, shows high viscosity at small concentrations, works effectively over a wide pH range, is in the form of a transparent viscous liquid . Carbapol can also be dispersed in water to form colloidal solutions which are acidic in nature. In addition, Carbapol is used as a gelling agent. The thickener in the VCO gel preparation formulation is Na CMC with a concentration of 1%. This is because Na CMC is easily dispersed by water and can give a viscous effect. The antioxidant used in VCO gel preparations is BHT at a concentration of 1%, BHT is also used to prevent oxidative rancidity of fats and oils. In addition, BHT can prevent the loss of oil-soluble vitamins. Glycerin concentration of 5% is used as a wetter and moisturizer, because it has a clear color and is odorless, so it is effectively used as a humectant and emollient. The preservative used is Propyl Paraben with a concentration of 0.02%. Propyl parabens are effective over a wide pH range, possessing a broad spectrum of antimicrobial activity. In addition, the preparation of gel preparations does not produce bubbles. PGA concentration of 0.5% is used as an emulsifier, the active substance used is oil, so an emulsifier is needed to combine oil with water. The solvent used Aquadest BHT is also used for the prevention of oxidative rancidity of fats and oils. In addition, BHT can prevent the loss of oil-soluble vitamins. 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is needed to combine oil with water. The solvent used Aquadest

F. Giving Virgin coconut oil extract (VCO):

Experimental animal treatment, control group (given with chlorhexidine) and treatment group (KP) (each given lauric acid gel, myristic acid gel, lauric acid gel and myristic acid gel). Experimental animals acclimatized for 5 days were induced by Porphyromonas gingivalis bacteria in LPS (Lipopolysaccharide) preparation in the gingival sulcus of the lower right first incisor as much as 0.01 ml. Experimental animals that have experienced inflammation are then treated with VCO gel. During the fourteen days after drug administration, observations were made on the healing of gingivitis by examining swelling, gingival discoloration, gingival bleeding, cortisol and histopathological examination using a light microscope with 400x magnification. Post-treatment observation, In experimental animals, observations were made for 14 days on the condition of the gingiva and its cortisol levels. The results of observations are recorded in the observation checklist sheet where to examine the condition of the gingiva based on the Modified Gingival Index (MGI)

G. Post-treatment observation:

After treatment, experimental animals were observed or observed for 14 days on the condition of the gingiva and histopathological examination. The results of observations are recorded in the observation checklist sheet where to examine the condition of the gingiva based on the Modified Gingival Index (MGI)

Score	Inflamation	Apperance
0	Normal	None
1	Mild inflammation	Slight changes in color and texture, but not in all portions of gingival marginal or papillary
2	Mild inflammation	Slight changes in color and texture in all portions of gingival marginal or papillary
3	Moderate	Bright surface inflammation, erythema, edema, and/or hypertrophy of gingival marginal or papillary
4	Severe inflammation	Erythema, edema, and/or marginal gingival hypertrophy of the unit or spontaneous bleeding, papillary, congestion, or ulceration

Table 1: Modified Gingival Index (MGI)

H. Histopathological examination:

Histo examination pathology involves examining sampled tissue under a microscope. Samples can be small pieces of tissue obtained from parts of the body using a technique called a biopsy or samples taken from whole organs or parts of organs taken during surgery. The biopsy performed is to take a small sample from an area of the body. After the tissue you want to examine is obtained, on histopathological examination, the tissue will go through several stages of complete examination, starting from fixation (preservation), macroscopic cutting, then processing until it is ready to become slides or preparations which are then read microscopically to determine the diagnosis.

III. RESULTS AND DISCUSSION

A. Presentation of Data Analysis Description

Serving descriptive data analysis in this study describes the research variables studied, namely:

No.	Group	Sample	Gingival Condition		Average
			0	Normal	
			1-	Mild	
			2	Inflammation	
			3	Moderate	
			4	Severe Inflammation	
1	Lauric Acid Group	L1	1		1.05
		L2	1		
		L3	1,3		
		L4	1		
		L5	1		
		L6	1		
2	Myristic Acid Group	M1	1		1.11
		M2	1,3		
		M3	1		
		M4	1,3		
		M5	1		
		M6	1		
3	Combined Group (Lauric Acid and Myristic Acid)	G1	1		1.27
		G2	1,3		
		G3	2		
		G4	1		
		G5	1,3		
		G6	1		
4	Control Group	K1	1		1.94
		K2	2		
		K3	3		
		K4	1		
		K5	1,6		
		K6	3		

Table 2: Condition of Gingiva After Treatment of All Groups

Based on table 1, the results of the study are interpreted that in the lauric acid test animals, there were 5 rats with good healing of gingivitis, that is, there was no swelling, discoloration or bleeding, while in 1 rat there was still an abnormality, namely there was still swelling. In the Myristic Acid test animals, there were 4 rats with good healing of gingivitis, i.e. no swelling, discoloration or bleeding, whereas in 2 rats there were still abnormalities, i.e. there was still bleeding. In the combination test animals, there were 3 rats with good healing of gingivitis, namely no swelling, discoloration or bleeding, while the other 3 mice still had abnormalities, namely swelling, discoloration and bleeding.

Judging from the average condition of the gingiva, it is known that after the treatment, the average condition of the gingiva is in a mild to normal inflammation condition. The best healing occurred in the lauric acid group with an

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average value of 1.05 which means that all treated animals with gingivitis experienced good healing (the gingiva was in normal condition). Next came the myristic acid group with an average of 1.11, the combined group with an average of 1.27 to the control group with an average of 1.94.

No	Group			
	A Control	combined	A Laurat	A Myristat
1	41	26	224	92
2	27	21	191	65
3	18	26	99	30
4	10	23	121	44
5	14	22	119	22
Total	110	118	754	253

Table 3: Description of Histopathology Results

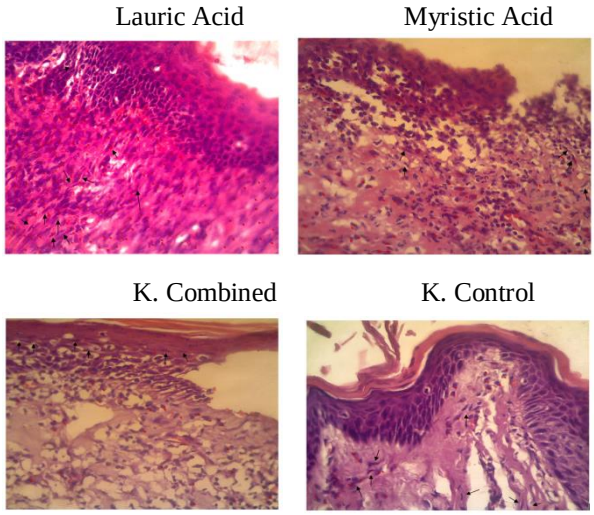

Image 1: Histopathological Results

Based on the experimental results above, it is known that the highest increase in the number of fibroblasts occurred in the lauric acid group with a total number of 754, these results indicate that the healing of gingivitis in the test animals occurred well. In the control group there were 110 fibroblasts, in the myristic acid group there were 253 and in the combined group there were 118.

B. Inferential Data Analysis Presentation

Inferential data presentation in this study is intended to prove virgin coconut oil as an alternative ingredient for gingivitis therapy.

- The mean value, standard deviation, normality test and homogeneity test.

Group	Average condition of gingivitis (X ± SD)	Normality Test (p-value)	Homogeneity Test (p-value)
K. Laurat	1.05±0.13	0.072	0.074
K. Miristat	1.11±0.17	0.052	
K. Combination	1.27±0.38	0.100	
K. Control	1.94±0.90	0.200	

Table 4: Calculation of Average Gingivitis Conditions

The normality test was carried out using the Shapiro-Wilk test, it was found that all data were normally distributed with a significance value of p>0.05. The homogeneity test was carried out by the Levene's test, the results showed that all data was homogeneous with a significance value of homogeneity p>0.05 and a Levene statistic value of 5.964. Based on table 4.6 above, it can be seen that the mean value of healing the gingivitis condition in the group treated with lauric acid was (1.05 ± 0.13), while the mean value was in the myristic acid group (1.11 ± 0.17), a combination of lauric acid and myristic (1, 27 ± 0.38), control group (1.94 ± 0.90).

- Effect of virgin coconut oil as an alternative ingredient for gingivitis therapy
  The results of research data analysis in the form of one-way ANOVA statistical test values are presented in table 4.

Group	*p-values*one-way ANOVA
K. Laurat	0.001*
K. Miristat	
K. Combined	
K. Control	

Table 4: Effect of virgin coconut oil as an alternative ingredient for gingivitis therapy

Based on the results of the oneway ANOVA test, p <0.05, it was concluded that the hypothesis in this study was accepted, namely the use of virgin coconut oil gel has the potential to inhibit porphyromonas gingivalis bacteria.

Group		Post Hoc p-values
K. Laurat	M	0.802
	G	0.185
	K	0.039*
K. Miristat	L	0.173
	G	0.593
	K	0.058
K. Combination	L	0.200
	M	0.233
	K	0.414
K. Control	L	0.039*
	M	0.058
	G	0.198

Table 5: Significant Differences Between Groups on Gingivitis Conditions

The results of the post hoc analysis showed a significant difference between the lauric acid group and the control group with a p-value of 0.039, while the other groups showed no difference with a p-value > 0.05.

The results showed that in the lauric acid test animals, there were 5 rats with good healing of gingivitis, that is, there was no swelling, discoloration or bleeding, while in 1 rat there was still an abnormality, namely there was still swelling. The mean value of healing gingivitis in the group treated with lauric acid was (1.05 ± 0.13), this means that virgin coconut oil (lauric acid) is effective in inhibiting Porphyromonas gingivalis bacteria.

Virgin Coconut Oil or virgin coconut oil contains medium-chain fatty acids which are easily digested and oxidized by the body thereby preventing accumulation in the body. In addition, it turns out that the content of antioxidants in VCO is very high, such as tocopherols and beta-carotene. These antioxidants function to prevent premature aging and maintain the vitality of the body. The main components of VCO are about 90% saturated fatty acids and about 10% unsaturated fatty acids. VCO saturated fatty acids are dominated by lauric acid. VCO contains ± 53% lauric acid and about 7% caprylic acid. Both are medium chain fatty acids commonly called Medium Chain Fatty Acid (MCFA). Meanwhile, according to Price (2004) VCO contains 92% saturated fat, 6% monounsaturated fat and 2% polyunsaturated fat (Arisanti, 2020).

Pure coconut oil contains lauric acid which functions as a precursor of monolaurin which can modulate immune cell proliferation. Lauric acid (C-12) is the main component in coconut oil which can reach 46.64 - 48.80% (Karouw, et al., 2016).

VCO is made without refining, without heating, or with minimal heating, so this oil has a high lauric acid content (45-53%). Lauric acid is a saturated fat with a medium chain or called medium chain triglycerides (MCT). Coconut oil triglycerides in the body are broken down into diglycerides, monoglycerides and free fatty acids. These monoglycerides and free fatty acids have antimicrobial properties. The most effective free fatty acids are lauric and capric acids with their monoglyceride compounds (Ariyani et al, 2021).

Virgin coconut oilhas physical and chemical characteristics. The physical and chemical properties of VCO include water content, free fatty acids, color, iodine number, saponification number, and peroxide value. Coconut oil or VCO, based on the fatty acid content, is classified into lauric acid oil because it contains the highest lauric acid when compared to other fatty acids. Based on the level of unsaturation expressed by the Iod number (Iodine Value), coconut oil can be included in the non-drying oils group because the oil number ranges from 7.5 to 10.5 (Suaniti et al, 2014).

In the human body, lauric acid is converted to monolaurin, which is a monoester that has been studied for its antiviral, antibacterial and antifungal activities. The antibacterial activity of monolaurin fatty acids is influenced by pH, which is a determining factor for bacteria to die or only get activated. moderate (lactate) minimum pH of 6.5 has been able to kill bacteria (Sulastri et al, 2016).

Until now, VCO is known to have the ability to moisturize wounds, accelerate cell metabolism, anti-inflammation, and anti-infection in chemical burns. Virgin Coconut Oil is proven to speed up wound healing time and has the highest percentage of healing against chemical burns inRattus Novergicusdone on the 18thtail Sprague-Dawleywith excision wounds, which proves that VCO is able to increase the proliferation of collagen fiber density (Sumiasih et al, 2016.

These statements support the results of the study where most rats experienced good healing and only 1 rat was still in a state of swelling. This incident could be caused by the short duration of the treatment which was only carried out for 14 days and the concentration of lauric acid used. Researchers assumed that the longer the treatment or the longer the duration of the treatment, the better the effect on healing gingivitis in rats. The results of the study were supported by the histopathological results obtained where the highest increase in the number of fibroblasts occurred in the lauric acid group with a total of 754, these results showed that the healing of gingivitis in the test animals occurred well.

The research results are in line with several studies that have been conducted including, Sumiasih et al. (2016) stated that virgin coconut oil (VCO) has the property of accelerating wound healing, in the research conducted it was proven that the average wound healing in the control group was 6 to 8 days while in the treatment group it was 4 to 5 days. Differences in the healing of the control and treatment groups were analyzed using the Mann Whitney Test statistic, the results of which were that the treatment group healed faster than the control group. It can be concluded that wound healing treated according to APN standards plus VCO is faster than those treated according to APN standards alone. Thahir et al. (2021) stated thatVirgin Coconut Oil is proven to accelerate wound healingtime and has the highest healing rate, because of its ability to moisten wounds, speed up cellular metabolism, and has anti-inflammatory and anti-infectious properties in treating chemical burns. VCO with its high lauric acid content can accelerate the process of tissue regeneration, where regeneration often occurs is used to describe the formation of new adhesions, cementum, alveolar bone and periodontal ligament in places that have previously lost the tooth supporting tissue structure. Regeneration will result in replacing damaged tissue with the same new tissue. and stimulate the formation of soft tissue damaged by inflammation, and accelerate wound healing.

The results showed that in the lauric acid test animals, there were 4 rats with good healing of gingivitis, that is, there was no swelling, discoloration or bleeding, while in 2 rats there were still abnormalities, namely bleeding. The mean value of healing gingivitis in the group treated with myristic acid was (1.11 ± 0.17) higher than lauric acid, this could mean that virgin coconut oil (myristic acid) was effective against killing and weakening Porphyromonas gingivalis bacteria, but more effective than gingivitis. laurate. In line with the histopathological results on myristic acid of 253, less compared to lauric acid which is equal to 754, Virgin coconut oil(VCO) can be used as an antimicrobial, immune system, good cholesterol, super antibiotic, good for pregnant and lactating women, maintaining heart and blood vessel health, osteoporosis, diabetes mellitus (diabetes), liver, cancer, helping to lose weight, increase stamina, maintain healthy skin, and maintain healthy hair. Pure coconut oil (Virgin coconut oil/VCO) is a processed coconut product that goes through a short processing process, so it can retain the natural components of coconut (Dayrit et al., 2007). This natural

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component of coconut can function as an anti-inflammatory, analgesic, and antipyretic, due to its ability to reduce transudate formation, granuloma formation, and serum alkaline phosphatase activity (Itahphuak et al., 2010). Pure coconut oil also has an antimicrobial effect (Shilling et al., 2013). The antimicrobial effect of VCO has been shown to inhibit Pseudomonas aeruginosa (ATCC 25619), Staphylococcus saureus (ATCC 29737), Staphylococcus epidermidis (ATCC 12228) and Propionibacterium acnes (ATCC 6918) (Silalahi et al., 2014). Apart from being an antibacterial, VCO is also effective against several species of fungi, such as Candida albicans, Candida glabrata, Candida tropicalis, Candida parapsilosis, Candida stellatoidea, and Candida krusei (Ogbolu et al., 2007).

The content of myristic acid in virgin coconut oil (myristic acid) is 16.0-21.0 lower than lauric acid. Based on the content of fatty acids, coconut oil or VCO is classified into lauric acid oil because it contains the highest lauric acid when compared to other fatty acids, so in this study it was proven that lauric origin was more effective in wound healing with the lowest average than myristic acid.

The results showed that in the combined group test animals there were 3 mice with good healing of gingivitis, namely no swelling, discoloration or bleeding, while the other 3 mice still had abnormalities, namely swelling, discoloration and bleeding. The mean value of healing gingivitis in the group that was treated with a combination of lauric acid and myristic acid was (1.27 ± 0.38) higher than lauric acid and myristic acid, this could be interpreted as virgin coconut oil (a combination of lauric acid and myristic acid). effective against killing and weakening Porphyromonas gingivalis bacteria, but more effective against lauric acid and myristic acid.

Compared to the control group, the combined treatment of lauric acid and myristic acid was more effective in attenuating Porphyromonas gingivalis bacteria. In line with the histopathological results obtained showing that the highest increase in the number of fibroblasts occurred in the lauric acid group with a total number of 754, these results indicated that the healing of gingivitis in the test animals occurred well. In the control group there were 110 fibroblasts, in the myristic acid group there were 253 and in the combined group there were 118.

Coconut oil or VCO, based on the fatty acid content, is classified into lauric acid oil because it contains the highest lauric acid when compared to other fatty acids. The myristic acid content in virgin coconut oil (myristic acid) is 16.0-21.0%, while the lauric acid content is 43.0-53.0%. in this study a combination was carried out with the same composition, the results proved to be effective in killing and weakening Porphyromonas gingivalis bacteria, but more effective with lauric acid and myristic acid with the full composition. According to existing theory, the main component of VCO is about 90% saturated fatty acids and about 10% unsaturated fatty acids. VCO saturated fatty acids are dominated by lauric acid. This natural component of coconut can function as an anti-inflammatory, analgesic, and antipyretic. because of its ability to reduce transudate formation, granuloma formation, and serum alkaline phosphatase activity (Itahphuak et al., 2010). Virgin coconut oil also has antimicrobial effects

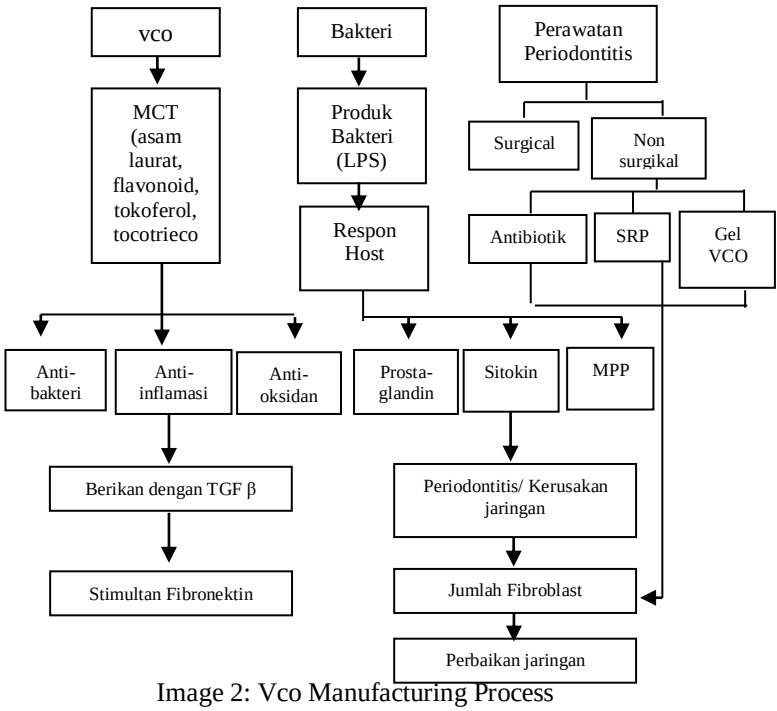

Image 2: Vco Manufacturing Process

IV. CONCLUSION

The results showed that virgin coconut oil was effective as an alternative ingredient to inhibit Porphyromonas gingivalis bacteria in gingivitis. This is proven by:

- In the lauric acid test animals, there were 5 rats with good healing of gingivitis, i.e. no swelling, discoloration or bleeding, whereas in 1 rat there were still abnormalities, i.e. there was still swelling. The mean value of healing gingivitis in the group treated with lauric acid was (1.05 ± 0.13), this means that virgin coconut oil (lauric acid) is effective in killing and weakening Porphyromonas gingivalis bacteria.
- In the myristic acid test animals, there were 4 rats with good healing of gingivitis, i.e. no swelling, discoloration or bleeding, whereas in 2 rats there were still abnormalities, i.e. there was still bleeding. The mean value of healing gingivitis in the group treated with myristic acid was (1.11 ± 0.17) higher than lauric acid, this could mean that virgin coconut oil (myristic acid) was effective against killing and weakening Porphyromonas gingivalis bacteria, but more effective than gingivitis. laurate.
- In the combined group test animals, there were 3 mice with good healing of gingivitis, namely no swelling, discoloration or bleeding, while the other 3 mice still had abnormalities, namely swelling, discoloration and bleeding. The mean value of healing gingivitis in the group that was treated with a combination of lauric acid and myristic acid was (1.27 ± 0.38) higher than lauric acid and myristic acid, this could be interpreted as virgin coconut oil (a combination of lauric acid and myristic acid). effective against killing and weakening

Porphyromonas gingivalis bacteria, but more effective against lauric acid and myristic acid.

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