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THE EFFECTIVENESS OF SAPPAN WOOD EXTRACT (*Caesalpinia sappan L.*) AS AN ALTERNATIVE MATERIAL FOR DENTAL PLAQUE IDENTIFICATION

(*EFEKTIVITAS EKSTRAK KAYU SECANG (Caesalpinia sappan L.) SEBAGAI BAHAN ALTERNATIF IDENTIFIKASI PLAK GIGI*)

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ABSTRACT

The main factor of periodontal disease is dental plaque, which is attached to the surface of the teeth and consists of microorganisms originating from saliva and food debris. Dental plaque has a transparent colour, so a disclosing agent is needed to identify it. Sappan wood (*Caesalpinia sappan L.*) is a plant that contains brazilin and flavonoids that can be used for natural colouring. This study aims to determine the effectiveness of sappan wood extract (*Caesalpinia sappan L.*) as an alternative material for dental plaque identification. The experiment was

conducted by measuring the plaque index of 20 people who did not clean their teeth for 12 hours for two periods. The first period of examination used a tablet disclosing agent, and the second period used 75% sappan wood extract. The research data were analyzed for normality with the Shapiro-Wilk dan Paired T-test. The result showed a significant difference in the mean plaque index score in the first period (1.3470) and the second period (1.0375) ($p<0.05$). It was concluded that staining dental plaque using a disclosing agent is more effective than 75% sappan wood extract (*Caesalpinia sappan L.*)

Keywords: *Caesalpinia sappan L.*; disclosing agent; index plaque

ABSTRAK

Faktor utama penyakit periodontal adalah plak gigi yang melekat pada permukaan gigi terdiri dari mikroorganisme yang berasal dari saliva dan sisa makanan, plak gigi memiliki warna yang transparan sehingga diperlukan disclosing agent untuk dapat mengidentifikasinya. Kayu secang (Caesalpinia sappan L.) merupakan tumbuhan yang memiliki kandungan brazilin serta flavonoid yang dapat dimanfaatkan selaku bahan pewarna alami. Penelitian ini bertujuan mengetahui efektifitas ekstrak kayu secang (Caesalpinia sappan L.) sebagai bahan alternatif pendeteksi plak gigi. Penelitian ini dilakukan dengan mengukur indeks plak 20 orang, yang tidak membersihkan gigi selama 12 jam sebanyak dua periode. Pemeriksaan periode pertama menggunakan tablet disclosing agent dan periode kedua menggunakan ekstrak kayu secang 75%. Data analisis dengan uji normalitas Shapiro-Wilk dan Paired T-Test. Hasil dari penelitian ini menunjukkan adanya perbedaan yang signifikan antara rata-rata skor indeks plak pada periode pertama (1.3470) dan pada periode kedua (1.0375) ($p<0.05$). Disimpulkan bahwa pewarnaan plak gigi menggunakan disclosing agent lebih efektif dibandingkan ekstrak kayu secang 75% (*Caesalpinia sappan L.*)

***Kata kunci**: Caesalpinia sappan L.; disclosing agent; plak indeks*

INTRODUCTION

The prevalence of periodontitis disease was about 95.21%, and the main factor of periodontal disease is the microorganisms that colonize the tooth surface, namely plaque bacteria and the products they produce.[1] Plaque is a layer that sticks to the tooth surface, consisting of microorganisms derived from saliva and food debris, and has a transparent-like translucent white glass colour.[2] To see a dental plaque, a dye called a disclosing agent is needed.

Disclosing agents are compounds in the form of liquid, tablets, or lozenges used to view and identify dental plaque on the tooth surface.[3]. The disclosing agent used erythrosine as its colourant content, which can give a red colour that contrasts the colour on the tooth to see where the plaque is located.[4] Erythrosine is a material that can give a red colour not only for disclosing agents but also for food and has been approved by the Department of Food and Drugs on a specific dose. However, further research also explains that erythrosine has a few side effects, including increasing hyperactivity and allergic reactions such as asthma, headaches, and skin irritation. Therefore, a substitute for this material is needed.[4,5]

Food colouring can be used as disclosing agent material with the condition that it is able to provide colour on dental plaque and does not affect the areas around the teeth or have a long-lasting staining effect. It also does not change the colour of the oral cavity structure and does not have any toxicity effect. In this aspect, fruits and vegetables have long been used as natural colouring agents for food.[6] Many examples of natural colouring materials that are widely used are rosella flower petals (*Hibiscus sabdariffa L.*) which produces a red colour; mangosteen peel extract produces a red to reddish-brown colour; teak leaf extract, which produces a blue colour, whereas in high pH became a violet colour dan red on low pH.[7] Sappan wood (*Caesalpinia sappan L.*) is one of many natural food colourings that produces a red colour.

Indonesian citizens often use sappan wood as natural food colouring on snacks and traditional medicinal drinks. Sappan wood (*Caesalpinia sappan L.*) can be found in tropical areas, grows 500-1000 meters above sea level and is 5-10 meters high. There are scattered crooked thorns all over its stem and branches. The taproot is brown, while the leaves are compound double pinnate with 20-40 cm long and 10-20 pairs of leaflets located opposite of each other. An oval stemless leaf with 10-22 mm length and 3-11 mm width.[8]

Sappan wood (*Caesalpinia sappan L.*) contains active compounds such as flavonoid, alkaloid, brazilin, tannin, saponin, phenyl propane, and terpenoid.[9] Parts of sappan wood that produce bright red and mauve colour and can be used as a natural dye are the stems, bark and pods, while the roots could produce a yellow colour. It is the result of brazilin as an

active compound in sappan wood that gives a natural red pigment. [10,11]

The potential of sappan wood (*Caesalpinia sappan L.*) as a red dye has been widely utilized until now. Hence, in this research, the authors wanted to determine the effectiveness of sappan wood extract (*Caesalpinia sappan L.*) as an alternative material for dental plaque identification.

METHOD

This research is a clinical experiment with a post-test-only control group design. The population in this study was 20 dentistry students from 2018 and 2019 at Mulawarman University, Samarinda. Inclusion criteria: giving consent, not using orthodontic appliances, no restoration on the examined tooth, and not using dentures. Exclusion criteria: unwilling to give consent; allergic to disclosing agent ingredients; having a restoration on the examined tooth; using orthodontic appliances; and using dentures.

This research was conducted in September-December 2022 in several places: Plant identification was carried out at the Plant Anatomy and Systematics Laboratory, Faculty of Mathematics and Sciences, Mulawarman University; Sappan wood was sieved at the Forest Product Industry Laboratory, Faculty of Forestry, Mulawarman University; Sappan wood was extracted at the Pharmacology Laboratory, Faculty of Medicine, Mulawarman University; and Plaque index data collections was carried out at Faculty of Medicine, Mulawarman University.

Several tools and materials were used in this research. Tools consist of scales; microtube 5 ml; oral diagnostic tools (mouth mirrors, dental explorer, periodontal probe); tweezers; nierbekken; toothpaste and toothbrush. At the same time, the material consists of: disclosing agent; 75% concentration of sappan wood extract; ethanol 96%; aquadest; face mask; handscoon; cotton bud; cotton; tissue; vaseline; and stationery.

Sappan wood extract was obtained by drying the wood in sunlight and sieved through the machine. The result was then stored in a container, followed by the process of extraction using a maceration technique using 96% ethanol. Sappan wood extract at a concentration of 75% was obtained by adding 1.25 ml aquadest on a 3.75 gram 100% sappan wood extract.

Before the treatment began, all 20 respondents signed an informed consent. For the first period, respondents were instructed not to clean their teeth for 12 hours after brushing their teeth at night. After that, respondents were given a disclosing tablet and asked to chew and spread it all over the surfaces of their teeth with their tongues. Then, their index plaque was measured. After finishing measuring, respondents can now brush their teeth.

For the second period, all 20 respondents were asked not to clean their teeth again for 12 hours after brushing their teeth at night. After that, 75% sappan wood extract was applied to

the respondents' teeth surfaces in dry condition with a cotton bud, and their index plaque was measured. After finishing measuring, respondents can now brush their teeth.

This research used a plaque index assessment according to the Turesky-Gilmore-Glickman Modification from Quigley-Hein, which assessed all teeth on the facial and lingual or palatal surfaces after giving the plaque colouring agents, with a range of assessments for each tooth surface from 0-5 (Table 1). The individual score is obtained by dividing the total score obtained from the index plaque measure by the number of examined teeth surfaces.

The obtained data were analyzed statistically by a computer statistics program and

was subjected to the Shapiro-Wilk normality test, then followed by the Paired T-test to see the difference between the two measurement results

Table 1. Plaque Index Score Criteria according to the Turesky-Gilmore-Glickman Modification from Quigley-Hein

Plaque Index Score	Criteria
0	No plaque
1	There are separate patches of plaque on the cervical margin of the tooth.
2	There is a thin layer of plaque up to 1 mm thick at the cervical margin of the teeth.
3	There is a layer of plaque, more than 1 mm, but up to 1/3 of the crown.
4	There is a layer of plaque, more than 1/3, but not more than 2/3 of the crown.
5	There is a layer of plaque covering the entire surface of the teeth.

RESULT

The graph of plaque index measurement using a disclosing agent and 75% sappan wood extract (*Caesalpinia sappan L.*) for all 20 respondents can be seen in Figure 1.

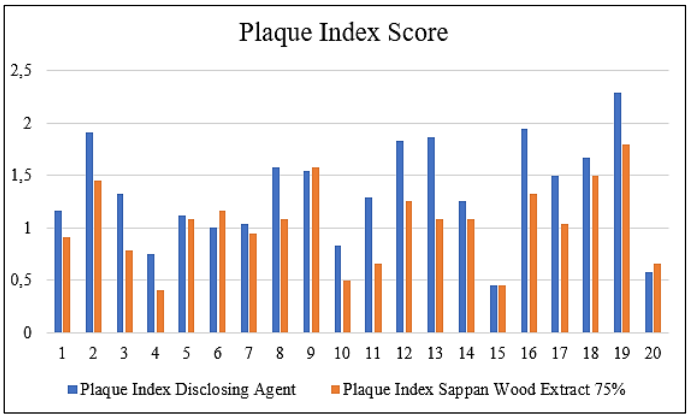

Figure 1. Plaque index score result.

Figure 1 shows that the highest plaque index score for disclosing agents was in respondent number 19, with a score of 2,29. Meanwhile, the highest plaque index score of 75% sappan wood extract was in respondent number 19, with a score of 1,79.

Table 2. Distribution of plaque index criteria using a disclosing agent

Plaque Index	Category	N	% (Percentage)
0	Very Good	0	0
0.1-1.7	Good	15	75
1.8-3.4	Fair	5	25
3.5-5	Bad	0	0
Total		20	100

Based on Table 2 with the disclosing agent, there were 15 respondents (75%) who were in the good category with a plaque index value between 0.1-1.7 and 5 (25%) who were in the medium category with a total index score plaque between 1.8-3.4.

Table 3. Distribution of plaque index criteria using 75% sappan wood extract

Plaque Index	Category	N	%
0	Very Good	0	0
0.1-1.7	Good	19	95
1.8-3.4	Fair	1	5
3.5-5	Bad	0	0
Total		20	100

Table 3, using 75% sappan wood extract (*Caesanpinia sappan L.*), shows that 19 (95%) had a plaque index score in the good category with a plaque index value range of 0.1-1.7 and one respondent (5%) is in the medium category with a plaque index value range of 1.8-3.4.

Table 4. The difference between plaque index score disclosing agent and 75% sappan wood extract (*Caesalpinia sappan L.*)

Plaque Stain	Plaque Index Score	P values
Disclosing Agent	1.34 ± 0.49	
75% Extract Sappan Wood (*Caesalpinia sappan L.*)	1.03 ± 0.38	0.001*

Paired T-test, * $p < 0.05$

The result of the Shapiro-Wilk normality test showed that the data is distributed normally ($p>0.05$), so the data can be continued with the parametric Paired T-test.

In Table 4, the Paired T-test result showed that the plaque index score with the disclosing agent is (1.34 ± 0.49) while 75% extract sappan wood is (1.03 ± 0.38) with $p<0.001$. It is concluded that there is a significant difference between plaque index measurement using a disclosing agent and 75% sappan wood extract (*Caesalpinia sappan L.*)

DISCUSSION

This study aims to determine the effectiveness of sappan wood (*Caesalpinia sappan L.*) as an alternative disclosing agent on index score. Still, the highest distribution of disclosing agents and sappan wood extract was in the good category. This

research contradicts Pramudina's (2019) study, which states that the highest distribution was in the fair category.[12]

The result of this study shows differences in the knowledge of dental and oral health of both respondents. Skripsa et al. (2021) stated that although knowledge is a domain that significantly contributes to shaping the degree of dental and oral health, knowledge alone is not enough. Supportive attitudes and actions are also needed in influencing the degree of dental and oral health.[13]

The research on this 75% sappan wood extract study has not yet succeeded in replacing the disclosing agent as it showed a significant difference, which makes this 75% sappan wood extract less effective than the disclosing agent.

The same research has been conducted by Oktaviani and Haryani, (2015), who compared beetroot and disclosing agent and Erwin *et al*. (2021), which compared Kesumba seed (*Bixa Orellana*) and disclosing agent. Both researchers stated the same result where there is a significant difference between disclosing agent and their specific variable.[14,15]

On the other hand, this research contradicted Manggiri's (2018) study that stated there is no significant difference between disclosing agent and super-red dragon fruit juice (*Hylocereus costaricensis*) and Salma (2021) study where there is also no significant difference between disclosing agent and 100% sappan wood extract (*Caesalpinia sappan L.*). It is due to a difference in research method, where, in Manggiri (2018), the super-red dragon fruit juice was from mashed super-red dragon fruit and filtered five times to produce clear dragon fruit juice. Meanwhile, in Salma (2021), sappan wood was macerated twice with 96% ethanol and diluted with ethanol.[16,17] In this study, maceration was used once, and aquadest was used for dilution.

Following Lestari's (2014) statement, the yield or ratio of the extract produced from a plant extraction varies for each treatment depending on each solvent used. This statement aligns with Krisnawati (2019), who showed that there was a significant difference between the yield of sappan wood extract (*Caesalpinia sappan L.*) with ethanol and aquadest solvent types where ethanol solvent has a higher value compared to aquadest solvent. According to Muthiah *et al*. (2017), ethanol solvent has a lower polarity level than aquadest. Therefore, ethanol is a suitable solvent for relatively less polar compounds.[7,18,19]

Sappan wood pigment is obtained from brazilin. Brazilin is a class of flavonoids, such as isoflavonoids, which

produce reddish-brown and dark red when dissolved in hot water.[20] Brazilin can produce a pale yellow when mixed with ether and alcohol. Oxidized brazilin will quickly form a brownish-red colour; the formation of brazilein causes the red colour.[21]

Apart from brazilin, there are anthocyanins, which are natural dyes belonging to the flavonoid group and produce a red colour. Anthocyanins are amphoteric compounds which can react in acidic or alkaline conditions.[22] The colour produced by anthocyanins is influenced by the proper solvent and concentration so that during extraction, it will produce colours with better quality.[23]

The colouring agents in sappan wood extract and disclosing agent can identify plaque on teeth because of the bonds between atoms in a compound with intermolecular forces, namely the force that binds a number of atoms in a molecule due to chemical bonds. Dental plaque contains glycoproteins containing oligosaccharide chains that bind glycans with covalent bonds so that the plaque can hold sappan wood extract solution and disclosing agent. In addition, there is a difference in polarity between the plaque components and the solution, which creates an interaction between the plaque and the staining material.[16]

Disclosing agent materials are indeed explicitly produced to function as a plaque colouring agent in dental and oral medical procedures. According to Chowdari (in Manggiri, 2018), disclosing agents are used to visualize and identify dental plaque on the tooth surface, so seeing transparent bacterial plaque for oral hygiene instructions, evaluation, and research is beneficial.[16]

Disclosing materials will be able to maintain plaque staining even though there is rinsing activity after applying the material. According to Putri and Herijulianti (2013), disclosing is sometimes disliked because of its unpleasant taste. Disclosing can give the mucosa colour for several hours. The difference in these results indicates the effectiveness of the disclosing material to be more accurate in providing an overview of plaque examination results. Oktaviani and Haryani (2015) stated that the more plaque scores obtained, the better the dye solution in colouring and sticking to the plaque surface because it can show the location and staining of the plaque. The less the plaque score obtained, the less the solution or dye adheres to the plaque surface.[24,14]

CONCLUSION

Staining using a disclosing agent is more effective than 75% sappan wood

extract (*Caesalpinia sappan L.*) with aquadest as dilution solvent against dental plaque.

CONFLICT OF INTEREST

The author declared no conflicts of interest or potential commercial background in this research.

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