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DEVELOPMENT OF BEET (*BETA VULGARIS*) SOLUTION AND RED DRAGON FRUIT SOLUTION (*HYLOCEREUS COSTARICENSIS*) AS DISCLOSING NATURAL AND SAFE DENTAL PLAQUE SOLUTION (MATERIAL IDENTIFICATION)

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ABSTRACT

Dental plaque is the cause of gingivitis, namely inflammation of the gums and tooth decay or dental caries. Therefore it is necessary to detect dental plaque, by using a solution material that can color the dental plaque. The solution is beets and red dragon fruit as natural and safe ingredients. The purpose of this study was to identify the effectiveness of beetroot solution and red dragon fruit solution to identify dental plaque by the Quasy Experimental research design. The sample of this research is 142 people, randomly selected, then divided into two groups. Each of 71 people used beetroot solution and 71 people used red dragon fruit solution. Then the dental plaque index was observed. The results showed that the Mann Whittney test showed that the plaque score of the beetroot solution was higher than the plaque score detected by the dragon fruit solution. The plaque index score detected by applying beetroot solution was higher than the plaque index score detected by red dragon fruit. but there are weaknesses in the beetroot solution, which tastes uncomfortable. Beetroot solution is more effective as a plaque detection solution compared to red dragon fruit solution. Meanwhile, the taste for bits is less comfortable. It is recommended to do further research so that it can be used by the community comfortably.

1. Introduction

Dental plaque is the cause of gingivitis [1], [2]. namely inflammation of the gums and tooth decay or dental caries [3- 5]. Even in children, dental plaque can cause severe early childhood caries [6], [7]. Therefore, it is necessary to control plaque that cannot be seen with the eye, so a dye is needed to detect dental plaque, which is a biofilm that adheres tightly to the surface of the teeth and contains cells. It is these microbial

cells that form biofilms [8- 10]. Furthermore, some previous researchers stated that almost 65% of infectious diseases in the oral cavity are associated with plaque growth such as caries and periodontal disease [11].

Dental plaque is difficult to see with the naked eye, a coloring agent is needed. How to see plaque, a coloring agent (red/purple) is used in the form of a liquid called a disclosing solution (identification material) for dental plaque, although there are many sold in the market as plaque detectors, there are still deficiencies and weaknesses, namely contain chemicals including Potassium Iodide, Iodium Crystals, Water [12]. These chemicals can trigger carcinogenicity, so long-term use will cause problems in the body.

In this case, it is necessary to identify dental plaque by using a disclosing solution which so far as a coloring agent contains cariogenic synthetic chemicals, we are trying to replace it with safe natural ingredients, namely beets and red dragon fruit which are cheap and widely sold in supermarkets and traditional markets throughout Indonesia and easily made by the community. To see dental plaque, a fruit juice solution was developed which would be formulated as a natural dye using beets (*Beta Vulgaris*) and red dragon fruit (*Hylocereus costaricensis*). To control the formation of dental plaque by applying beetroot solution [13] or red dragon fruit solution [14] as a dental plaque coloring agent so that plaque can be removed when brushing teeth.

According to data from Riskesdas 2018, province-level data in Indonesia from 35 provinces, the number of population who have dental and oral health problems is still very high, the second is in South Sulawesi, reaching 70%. South Sulawesi occupies the 9th position with a score of 93%, and for this problem, it is expected that children aged ≥ 3 years should brush their teeth properly and well every day. South Sulawesi occupies the first position which is number 8 (eight) [15].

To improve the dental and oral health of the community, especially in the Province of South Sulawesi, it is necessary to recommend a solution of beetroot juice (*Beta vulgaris*) and a solution of red dragon fruit juice (*Hylocereus costaricensis*), both of which are plants that contain natural coloring pigments which have a high betacyanin content. Calcium in dragon fruit [16] will maintain healthy bones and teeth. Also, beets contain minerals such as boron, copper, and magnesium [17]. In beets, they help bones develop normally and increase bone metabolism. This betacyanin pigment produces a contrasting deep red color that can be used as a natural stain [18].

This research will develop beet juice solution and red dragon fruit juice solution as a natural disclosing solution that is safe to use and can be made independently and simply by the community. By utilizing natural potential we can see dental plaque and remove it. Furthermore, plaque buildup which can cause problems in the teeth and mouth and lead to the formation of calculus and gingivitis as well as periodontitis or inflammation of the soft tissues of the teeth does not occur [19].

The results of the previous study red dragon fruit solution (*Hylocereus costaricensis*) has a natural coloring that is almost the same as disclosing solutions made from chemicals such as dental plaque coloring agents. So, red dragon fruit juice can replace disclosing solutions made from chemicals [20].

According to [13] beetroot solution (*Beta vulgaris*) can be applied to the surface of the teeth to identify plaque on the teeth, the plaque index value is greater after applying beets, because the beetroot solution contains betacyanin pigment so it is more stable. Based on the above description by knowing the content contained in beetroot (*Beta vulgaris*) and red dragon fruit (*Hylocereus Costaricensis*) for coloring because it

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is easier in the process of controlling dental plaque, the selection of these two fruits as alternative materials that can color dental plaque, it is still it is necessary to carry out clinical trials with a larger sample for the formulation as a natural, safe and easy-to-obtain coloring agent (disclosing solution) as well as a very simple manufacture that can be applied to the community.

2. Methods

This study used a quasi-experimental method with an observational approach using 142 people by means of random sampling, collecting data using examination sheets and observation sheets to measure and identify dental plaque, color, taste, time of applying beetroot and red dragon fruit solution, using a Mann Whitney statistics in identifying dental plaque.

The instruments in this study were instruments that were developed by the researchers themselves, namely:

a. Questionnaire: namely data collected from respondents consisting of two. namely data on the characteristics of respondents including age, education, occupation.

b. Observation sheet, namely: pMeasuring the ability to do smearing using LBB and LBNM to identify dental plaque and also the color and taste of the two materials.

3. Results

This research was conducted at Wara Utara Health Center, Palopo district, a quasi-experimental research type using beetroot solution (*Beta Vulgaris*) and red dragon fruit solution (*Hylocereus Costaricensis*) to identify the presence of dental plaque as a safe natural substance, with a number of samples (*Hylocereus Costaricensis*) 142 people were divided into two treatment groups, namely group 1 (one) 71 people by applying beetroot solution (*Beta Vulgaris*) and 71 people by applying red dragon fruit solution (*Hylocereus Costaricensis*), while the results of the study were as follows:

Table 1. Criteria for Plaque Index Score after Application of Beetroot Solution

No	Plaque score criteria	N	(%)
1	Good	10	14.08
2	Fair	52	73.24
3	Poor	9	12.68
Total		71	100

The table above after applying the beetroot solution, the results obtained show the plaque index score with moderate criteria of 73.24%, meaning that the beetroot solution is more sensitive to plaque.

Table 2. Criteria for Plaque Index Score after Applying Red Dragon Fruit Solution

Plaque staining	Mean± SD	Significant
Beet (*Beta vulgaris*)	2.446 ± 0.9805	0.008
Red Dragon fruit (*Hylocereus costaricensis)*	1.928 ± 1.0748	

The table above after applying the red dragon fruit solution, the results obtained show the plaque index score with moderate criteria of 53.52%, meaning that the red dragon fruit solution is more sensitive to plaque.

Table 3. Comparison of Bitter Fruit Flavors and Red Dragon

Flavour	Bit solution	(%)	Dragon Fruit solutin	(%)
pleasant	39	54.93	57	80.28
unpleasant	32	45.07	14	19.72
Total	71	100	71	100

The table above after applying beetroot solution and red dragon fruit solution, the results obtained show a higher bad taste ratio for beetroot 45.07% than dragon fruit 19.72%.

Table 4. Plaque Score/Index identified using Beet (Beta Vulgaris) and Red Dragon (Hylocereus Costaricensis) solution

No	Plaque score criteria	N	(%)
1	Good	26	36.62
2	Fair	38	53.52
3	Poor	7	9.86
Total		71	100

In the table above, it can be seen that the plaque score detected using beets is higher than that detected by red dragon fruit. The results of data analysis with Mann Whitney showed p=0.008 (p<0.005), meaning that hypothesis 0 was rejected. So it can be concluded that with a 95% confidence level it can be said that the plaque score detected by beetroot solution is higher than the plaque score detected by red dragon fruit.

Table 5. Comparison of the color of beets and red dragons

Intensitas	Beet	(%)	Red dragon fruit	(%)
> 3 menit	35	49.30	40	56.34
< 3 menit	36	50.70	31	43.66
Total	71	100	71	100

The table above after applying beetroot solution and red dragon fruit solution, the results obtained show a non-contrasting ratio of 28.17% beets and 22.54 red dragon fruit so that the results obtained are not very small in contrast.

Table 6. Comparison of the intensity of beets and red dragon fruit

Contrast/ no	Beet	(%)	Red dragon fruit	(%)
Contrast	51	71.83	55	77.46
No contrast	20	28.17	16	22.54
Total	71	100	71	100

The table above after applying the beetroot solution and red dragon fruit solution, the results obtained show a comparison of the intensity > 3 minutes of beetroot 49.30% and red dragon fruit 56.34% so that the results are not very small contrast.

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4. Discussion

After staining the dental plaque using a coloring agent disclosing solution, the beetroot solution and dragon fruit solution did not have a significant difference, because beets and red dragon fruit contain a lot of betacyanin pigment which is purplish red (red-purple). Betacyanin has a lot of research on the effectiveness of coloring plaque so it is a dye that has the potential to become a natural dye and is safe for health compared to synthetic dyes [13], [18], [21].

Staining of dental plaque using coloring materials occurs due to bonds between atoms in a compound with intermolecular interactions or forces, namely the force that binds atoms in a molecule due to chemical bonds, the glycoprotein contained in dental plaque is a protein that contains chains of oligosaccharides that are linked to glycans by covalent bonds [22]. This makes dental plaque have the ability to hold large amounts of aqueous substances used as dental plaque coloring, related to the interaction between dental plaque and coloring materials due to the difference in polarity between the dental plaque components and the solution.

The sample group before the intervention was instructed to eat the biscuits given by the researcher with the aim that new dental plaque formed which was soft was left a few minutes later the bacteria found in saliva would proliferate on the surface of the teeth and the bacteria were part of the dental plaque. After the sample ate the biscuits after 15-20 minutes, the beetroot solution and red dragon fruit solution were applied to each group, then the observation sheet was filled out and the plaque score index calculation was checked, observations were also made on the color, time and taste. The plaque index score was then analyzed using the Mann Whitney statistical test to determine the difference in effectiveness between beetroot solution and red dragon fruit solution as a natural and safe dental plaque identification agent.

In the table above, it can be seen that the plaque score detected using beets is higher than that detected by red dragon fruit. The results of data analysis with Mann Whitney showed $p=0.008$ ($p<0.005$), meaning that hypothesis 0 was rejected. So it can be concluded that with a 95% confidence level it can be said that the plaque score detected by beetroot solution is higher than the plaque score detected by red dragon fruit.

The results of the normality test for PHP score data showed a value of $p = 0.008$ ($p <0.05$), meaning that the PHP score data was not normally distributed. Therefore data analysis was continued by using the Mann Whitney statistical test to find out whether there were significant differences between beet (*Beta Vulgaris*) and red dragon fruit (*Hylocereus Costaricensis*) solutions in identifying plaque on teeth.

Staining using beetroot solution with red dragon fruit solution meets the requirements as a safe natural dye because it can give color to dental plaque and does not affect the condition of the teeth and the area around the tooth tissue, does not change the color and structure of the mucosal tissues of the mouth, cheeks, lips and tongue and poses a danger if swallowed and does not cause allergies because its ingredient (fruit) is natural and safe for consumption.

The plaque index score on applying beetroot solution for analysis using the Mann Whitney statistical test showed $p=0.008$ ($p<0.005$), meaning that the 0 hypothesis was rejected, which means that there was a significant difference between dental plaque scores on applying beetroot solution and red dragon fruit solution. whereas in the observations for color and time there was no significant difference, only the taste of basting the beetroot solution and the red dragon fruit solution preferred the taste to the beetroot solution.

5. Conclusion

The plaque index score detected by applying beetroot solution was higher than the plaque index score detected by red dragon fruit. but there are weaknesses in the beetroot solution, which tastes uncomfortable.

Clinical significance

Beetroot solution is more effective as a plaque detection solution compared to red dragon fruit solution. Meanwhile, the taste for bits is less comfortable. It is recommended to do further research so that it can be used by the community comfortably.

List of abbreviations: NA

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