ORIGINAL ARTICLE

Optimal Concentration of Food Coloring as Plaque Detector

NANING NUR HANDAYATUN*, VALENTINA NURWATI KAYO, SLAMET RIYADI, KARIN TIKA FITRIA
Department of Dental Nursing of Poltekkes Kemenkes Jambi
Correspondence to Naning Nur Handaaun, *, Email: naning_nh@poltekkesjambi.ac.id*

ABSTRACT

Background: Plaque is the cause of dental caries and periodontal disease. Food colouring with the pink rose colour can be used as a disclosing solution and it is better than common liquid used for plaque detection. It is not yet known the exact concentration of food coloring that can be absorbed to expose the plaque clearly.
Aim: To determine the most effective concentration of the food colouring to visualize the plaque as an alternative for plaque detector and the most comfortable concentration for the respondents. The benefits of research is finding the optimal concentration of food coloring as a disclosing solution to improve oral hygiene community.
Methode: This was an experimental research using rose pink food colouring powder that available in the market. The object of this research was 10 students of the Department of Dental Nursing, divided into two groups, the treatment group and the control group. Common disclosing solution were used for control group, while a solution of food colouring with a concentration of 2.5gr/20ml (A), 5 gr/20 ml (B) and 10gr/20ml (C) without sweeteners and 2.5gr/20ml(D), 5 gr/20 ml (E) and 10gr/20ml (F) with sweeteners (1,25 gr, 2,5 gr and 5 gr of sugar respectively) were used for treatment group. Mann Whitney test were used to define which concentration of the food colouring solution were similar or better than common disclosing solution.
Results: Significant difference were found on colour intensity between treatment and control group except for concentration 2,5 gr/20 ml (p=0,222). But the most intense colour and the most acceptable taste perception were at concentration 2,5gr/20 ml of food colouring with the 1,25 gr (p=0,04)
Conclusion: Solution of 25gr food colouring powder + 1.25 gr sugar / 20 ml is the most optimal concentration as a plaque detector and as the most acceptable taste of respondents.
Key words: Food colouring, disclosing solution, plaque

INTRODUCTION

The most prevalent microbially mediated human diseases worldwide are dental caries and periodontal disease[1]. Dental caries even affecting 80–90% of the world population[2,3]. Acid production by the oral flora within dental plaque is the primary etiological cause of dental caries, while in periodontal disease, the immune-inflammatory response to bacteria in the dental plaque can lead to the periodontal tissue destruction[4,5,6]. In the mouth, however, teeth provide hard, non-shedding surfaces for the development of extensive bacterial deposits in the dental plaque[2,7].

Bacterial plaque was firstly known by an American dentist who practiced in London, J. Leon Williams which in 1897 described it as a gelatinous accumulation of bacteria adherent to the enamel surface in relation to dental caries and in 1899, G.V. Black (1836-1915) used the term gelatinous microbic-plaque[8]. Dental bacterial plaque is a bio film that sticks obstinately to tooth surfaces, restorations, and prosthetic appliances[2,7]. Plaque formation can be divided into several phases, firstly the formation of the pellicle on the tooth surface and then the initial adhesion/attachment of bacteria and finally colonization/plaque maturation[9]. These process can happen in human early life which as teeth start erupt, bacteria start to establish colonies on it surfaces[10]. The biofilms are typically located at retention sites along the gingival margin and extend into the interproximal space[11].

Dental plaque on the supra-gingival is difficult to be identified by bare eyes for both patient and dentist since it has similar color with the tooth surface. Plaque identification may be done by screening the plaque directly from the tooth surface, or using several products that can change plaque color by using a plaque dye solution (disclosing solution), or by using the ability of natural teeth to fluorescence under blue light[7].

Changing the color of dental plaque using disclosing dyes that contrast with the white tooth surface can differentiate the plaque from tooth surface. Dental plaque has the ability to retain a large number of dye substances which can be used for disclosing purposes[7]. Microbial biofilms on teeth become clearly visible after staining with a disclosing solution[11].

The use of disclosing solution can give a great help in promoting oral hygiene throughout the community, or even can used by parents to do a plaque control for themselves or their children. Unfortunately in Indonesia, especially in District of Jambi, disclosing solution are difficult to get and relatively expensive. In Indonesia, the price of food coloring were 40 to 60 times cheaper than disclosing solution, so that will be more affordable for promotive use or personal use. Previous research found that a 0,05% diluted of red food coloring from “Kupu-kupu” brand, can be used as a disclosing agent in vitro. But intra oral condition is different with preconditioned laboratory setting due to the environmental condition such as salivary flow and mucosal or lingual friction.

The first chemical reported to stain plaque was iodine but, over the time, a variety of dyes have been used in the disclosing solution on the market, such as fuchsine, erythrosine, merbromin, methylene blue, brilliant blue, crystal violet, gentian violet and fluorescein.[7] Erythrosine also found in the food coloring which allowed by the Indonesia National Agency of Drug and Food Control (BPOM). Previous study by Handayatun, et al. found that the powder food coloring of Bebek Angsa Brand with red color was the most effective to be used as a plaque dye. But the

optimal concentration of the food coloring was not yet to be found.

The aim of this study was to determine the optimal concentration of the food coloring to expose the plaque with the most acceptable taste.

MATERIALS AND METHOD

This study was a true experimental research with post-test control group design. 10 sample which fulfilled the inclusion criteria were chosen using simple random sampling from the population. The population of the research was all dental nurse student of Poltekkes Kemenkes Jambi. The inclusion criterion were all the sample must be caries free, no dental calculus with a healthy periodontal tissue, no allergy and signed the informed consent after listening the research procedure explanation and agreeing to participated.

The food coloring used in this study was powder from Bebek Angsa brand with rose pink color with registered number from the Indonesia National Agency of Drug and Food Control (BPOM). Ethical clearance of this study was approved by the Kesbangpolinmas Jambi.

The food coloring were divided into 6 concentration, labelled A-F. In the A, B and C, food coloring were diluted using water with concentration 2,5 gram/20 ml, 5 gram/20 ml and 10 gram/20 ml respectively. For D, E and F, the amount of food coloring were the same as group A, B and C but sweetener were added with half amount of the food coloring, which was 1,25 gram, 2,5 gram and 5 gram of sweetener respectively.

On day one, all respondents were brushing their teeth until completely plaque free at 7.30 am, then they had the same breakfast meal and had snack later at 9.30 am. At 11.30 am the A food coloring solution were applied to the tooth surface. At 12.00 noon, all respondents were brushing their teeth again until plaque free and had their lunch. Two hours later, at 14.00 pm they had their noon snack and at 16.00 pm, the B food coloring solution were applied.

On day two and three, the procedure were the same but using food coloring C,D, E and F respectively. Between meals or snacks, the respondents were not allowed to eat anything beside what given in the study but allowed to drink with maximum of 4 glasses of water.

Plaque examination were observed using bare eyes with enough light and from 30 cm distance. A double blind examination were attempted by 3 examiners and used a commercial disclosing solution as control. The quality of plaque exposed by the food coloring solution were scored and the taste perception of each food coloring solution were recorded.

Data collected were analyzed using Mann Whitney to determine the most optimum concentration of food coloring solution with the most acceptable taste.

RESULT AND DISCUSSION

The result of examination of differences a plaque color intensity between treatment groups and control group showed in table 1. Table 1 showed that the greatest difference between control group and treatment group at concentration of 2,5 gr food coloring + 1,25 gr sugar/ 20ml aquadest. Two sample different test that are not related for 10 respondents were performed with non-parametric analysis with Mann Whitney Test.

Table 1: Intensity Plaque Colouring With Food Colouring in Various Concentration

	A 2,5grF/20mlW	B 5grF/20mlWl	C 10grF/20mlW	D 2,5grF+1,25gr sugar /20mlW	E 5grF+2,5gr sugar/2mlW	F 10grF+ 5 gr sugar /20mlW
Treatment group	2,9	3,7	2,6	2,9	3,5	2,5
Control group	2,3	2,7	1,7	1,8	2,7	1,5

F* Food Coloring W* aquadest

Table 2: Mann Whiteney Test of Difference Between Plaque olouring Intensity Between Treatment Group and Conrol Group

Treatment group><Control group	Sig.	P
(A)2,5gr F /20ml W >< K1	0,222	p>0,05
(B) 5gr F /20ml W >< K2	0,001	P<0,05
(C)10gr F/20ml W >< K3	0,023	P<0,05
(D) 2,5gr F +1,25gr sugar/20ml W>< K4	0,004	P<0,05
(E) 5gr F + 2,5gr sugar/20ml W>< K5	0,018	P<0,05
(F) 10gr F+ 1,25gr gula/20ml W >< K6	0,003	P<0,05

F* Food colouring W* aquades

The results of the study showed that food coloring with a concentration of 2.5gr / 20ml water, 5gr / 20ml water and 10gr / 20ml water (A,B and C) and with the same concentration and added sugar / sweetener half of the weight of food coloring(D,E and F). Compared to controls, all food coloring dissolved in 20ml of water was clearer in coloring plaque.

Statistical result showed that all solution that used in this research were capable in exposing dental plaque. Statistical analysis showed that food coloring with 2,5 gr/20 ml concentration were the only one that had p value >0,05. Which mean this concentration had no difference ability in exposing plaque compared to the commercial disclosing solution. This showed that although in the treatment group the mean was clearer than the control group but statistically the difference was not significant (Ho was accepted). So that the concentration of 2.5gr food coloring / 20ml of water is the same as the disclosing solution in coloring plaque. According to Fedi et al in the past, iodine, food coloring, Bismark Brown, mercurochromes and basic fuscin were used to color plaque, but currently used is erytrocyn.[12] The composition of the sumba rose pink brand of swan duck

uses erytrocyn coloring so that even in low concentrations (1/8) it can already color plaque as it is a factory-made disclosing solution.

Dental plaque is one of the etiology of dental caries and periodontitis. The similarity color of dental plaque with tooth surface made them hard to distinguish unless using dye.[13] Previous study by Handayatun, Valentina and Mudehir showed that the plaque may appear on a considered clean tooth surface after given the disclosing solution[14]. Dental plaque diagnosis using colored solutions is one of the easiest and fastest ways to diagnose dental plaque, which helps its subsequent removal under permanent control[7].

The main purpose of tooth-brushing with whatever techniques recommended, is to remove dental plaque biofilm from the teeth and the gingival crevice without damaging the teeth and surrounding structures.[15] Proper plaque removal is very important in decreasing gingival inflammation or dental demineralization caused by plaque bacteria.[16] But due to the similarity color that dental plaque had with tooth surface, sometimes patient does not realize that there may be dental plaque left after toothbrushing. Especially on the surface that difficult to access such as margin gingiva, posterior teeth, lingual and palatal surface[15].

Disclosing agents can provide a guide to evaluating the thoroughness of cleaning the teeth. The use of disclosing agents, or disclosants allow the patient to see plaque in the mouth before or after brushing. These agents can give patients a literal road map to remove the plaque properly[15,16]. The importance of disclosing solution could help people to brush their teeth thoroughly or can help during dental health education and at the end of the day it can help to reduce the dental caries and periodontal disease prevalence.

However, if seen that the concentration of 2.5 gr / 20ml added with powdered sugar sweetener (D), it turns out that the results of statistical tests found significantly different color intensity significantly compared to the control group p <0.5. This situation might be caused by the addition of sweeteners causing the solution to become thicker so that it can stick more.

The taste of each food coloring with different concentration was felt by respondents by dipping a cotton bud on sumba and smearing it in the middle of the tongue. The taste that can be accepted by resonant is tasteless and the least preferred is the saltiness. The results of the study in table 3 found that the most tasteless in sumba concentration of 2.5gr / 20ml added 1.25gr sweetener and furthermore was a 2.5 g solution of sumba / 20ml unsweetened water. This is probably because the concentration of sumba which is only 1/8 is a thinner solution and if added sweeteners produce a tasteless taste that can be accepted by the tongue. In a more concentrated solution it produces a thicker, tartier and saltier taste. This is like the case if we feel the cake / drink that has too much color will taste less delicious.

The results of the study are presented in table 2. It was found that food colouring which was more clearly distinguished from the control was food colouring with a concentration of 5gr / 20ml water and the solution found the highest plaque score when compared with other solutions. This also relates to Table 3 that there are differences significant color intensity between the treatment group and the control group (p <0.05). But apparently this solution is less acceptable to respondents because only 10% of respondents said it tastes tasteless while 40% said that the solution was salty. Thus for a solution of 5gr food colouring / 20ml of water it can be recommended for people with a more mature age while for a solution of 2.5gr food colouring / 20ml added sweeteners or should not be used in children

CONCLUSION

Solution of 25 gr rose pink food colouring powder + 1.25 gr sugar / 20 ml is the most optimal concentration as a plaque detector and as the most acceptable taste of respondents.

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