

The Efficacy of The Coloring Agents from Black Glutinous Rice on Dental Biofilm Staining

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Abstract

The use of disclosing agents is recommended to identify the degree and location of dental biofilm which will facilitate oral hygiene practice and contribute to oral disease prevention. To search for an alternative disclosing agent with good staining ability and biocompatibility from natural products, this study aimed to investigate the efficacy of coloring agents made from black glutinous rice (BGR) on dental biofilm staining. BGR solution was prepared by boiling rice in water and frozen dry to get the dark purple powder, which was later mixed with water at ratio 1:2 before application. The crossover clinical trial was conducted in 36 volunteers who were classified into 3 groups (n=12/group) according to their ages (18-26, 27-46, and 47-66 years old). Within the same age, the volunteers were randomly divided into 2 subgroups to apply either with erythrosine dye (ED) or BGR solution. After a 2-week washout period, the volunteers switched to apply another coloring agent. The stained dental biofilm was recorded 4 sites/tooth as staining, not staining or could not identify, by the examiner and the volunteers. The results showed that BGR solution specifically stained dental biofilm in dark purple colour, it did not stain adjacent gingival or oral tissues as well as tooth-colored restorations. The volunteers could see and completely detect the stained teeth within 15 minutes before color started gradually fading. Kappa coefficients demonstrated the interrater reliability between the examiner and the volunteers from ED and BGR solution were 0.34 and 0.30, respectively. This indicated the same interval of agreement of both disclosing agents. There was no statistically significant difference between both agents among different aged groups. The analysis of tooth surfaces and tooth locations demonstrated the significant difference between both agents on the mesial surface and lower posterior teeth, respectively (Paired t-test; $p < 0.05$). In conclusion, the coloring agents from BGR can stain dental biofilm with desirable properties. Its efficacy is marginally less than ED but it has some superior features regarding being natural, safe, and specific staining. In the form of powder, it is convenient for households to promote oral hygiene care.

Keywords: Black glutinous rice/ Dental biofilm staining/ Disclosing agent/ Erythrosine

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Introduction

Dental plaque, the initiating cause of dental caries and periodontitis, typically develops in an ordered sequence of events on the tooth surface resulting in a structurally- and functionally-organized biofilm of diverse microbial community embedded in a matrix of polymers of host and microbial origin.¹ After bacterial apposition on the salivary glycoprotein-coded tooth surface, reversible and irreversible adhesion occur by weak, long-range physicochemical interactions and strong, short-range interactions between specific molecules on the bacterial cell surface and complementary receptors in the pellicle, respectively.^{1,2} Subsequently, co-adhesion of later colonizers to already attached early colonizers leads to micro-colony formation and multiplication of the attached micro-organisms. Many oral bacteria produce self-synthesized extracellular polysaccharides

result in the formation of a complex extracellular matrix and an increase in the diversity of the biofilm.^{2,3} The extracellular polymeric substances that form the matrix comprise of carbohydrates, proteins, nucleic acids, and cell wall polymers, such as peptidoglycans and lipids.³ At this stage, dental plaque biofilm tenaciously adheres on tooth surfaces and is impracticable to be removed by rinsing or gargling. Mechanical methods such as scaling and root planing, proper tooth brushing and interdental cleansing are highly effective ways to eliminate dental biofilm.^{4,5}

Since dental biofilm is transparent, colorless, and not easily visible, the use of disclosing agents is recommended to identify the degree and location of dental plaque which facilitates oral hygiene practice and contributes to oral disease prevention.⁶ Historical milestones of disclosing solutions

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used in dentistry has been started from iodine, brilliant green, crystal violet, Bismarck brown, gentian violet, erythrosine (Red No. 3), fluorescent dyes, two-tone, and three-tone dyes.⁷ Currently, the most popularly used disclosing agent in dental practice is erythrosine dye (ED) due to easy using and its red intensity making good contrast with the tooth surface. However, ED has some disadvantages of unpleasant taste, non-discriminatory staining of the gingival tissues, and is difficult to remove from gingival tissues and oral surfaces. There were also previous studies reported the toxicity of ED such as causing central nervous system depression and thyroid cancer in rats after long term taking.⁹ The recent study has reported the highly cytotoxic of dental disclosing agent containing erythrosine on gingival epithelial cells.¹⁰ Though, the actual risk is extremely small, the FDA (U.S. Food and Drug Administration) banned some uses of the color additive Red No. 3 since 1990, according to the studies have shown that in very high doses it causes cancer in laboratory animals.¹¹

The use of natural dyes can reduce the risk of harm to the body and organ functions. There have been previous studies searching to use plant pigments as alternative disclosing agents such as yellow pigments from turmeric,¹² red–purple pigments from red dragon fruit peel,¹³⁻¹⁴ red-fleshed Pitaya¹⁵ and Gardenia blue.¹¹ However, there are still some weaknesses and obstacles in using these natural color products. Turmeric which contains curcumin pigments has been reported less effective to be used as disclosing agent due to its inconspicuous color and easily dissolved.¹² Red dragon fruit peels which contains anthocyanin pigments in rose-colored did not effectively detect plaque exist on the teeth because of liquid dye dissolved in the water rinse and not attached to the plaque.¹³ Red-fleshed Pitaya exhibited dental plaque staining ability which presented as deep red–purple with stable appearance in a broad pH range, however, the study was conducted *in vitro* and the stain was assessed by a spectrophotometer.¹⁵ In the study aimed to compare eight natural pigments, Gardenia blue showed the highest effective plaque pigmentation with the lowest cytotoxicity; however, further analysis of the persistence of coloration and color contrast between gingival tissue and stained plaque is required.¹¹

Black glutinous rice (*Oryza sativa* linn; BGR), the common local produce in the north and northeast of Thailand, is of interest in the search for an alternative dental disclosing agent with good staining ability and biocompatibility from natural dyes.^{6,7} The bran color of BGR is dark purple due to the coloring pigments called anthocyanins.¹⁶ Anthocyanins are one of the largest and most important group of water-soluble pigments that belong to the flavonoid group.¹⁷ It can stain on carbohydrate substances, therefore, is expected to stain dental biofilm. Dental biofilm has the ability to retain a large number of dye substances because of the polarity difference between the components of the plaque and dyes. The particles are bound to the surface by electrostatic interaction (proteins) and hydrogen bonds (polysaccharides).¹⁵ The main objective of this present study was to elucidate the potential use of the coloring agents from BGR on dental biofilm staining. As disclosing agents are rarely used in the household, most people lack a visual aid to promote self-detecting dental biofilm to evaluate their effective oral hygiene practice, the other objective of this study, therefore, aimed to develop the product in the form that is convenient to be used in the household.

Materials and Methods

Preparation of black glutinous rice solution

Black glutinous rice was harvested during the early winter season in Chiang Rai, Thailand. The extraction of coloring agents was prepared by boiling 1 kilogram of rice in 1 L of water for 10 minutes with constant stirring. The water obtained from the boiled rice was filtered with filter cloth, and frozen dry with a shell freezer to get the dark purple powder. One gram of powder was weighed and put in a zip lock plastic bag and kept in an amber bottle at room temperature without light exposure until use. Before applying, the BGR powder was mixed with water at ratio 1:2 (1 g of powder to 2 ml of water).

Study protocol

This study was approved by Mae Fah Luang University Research and Ethical Committee (EC 20233-22).

The crossover clinical trial was conducted in 36 healthy volunteers, age 18-66, who were patients of School of Dentistry, Mae Fah Luang University. The volunteers were

classified into 3 groups ($n=12/\text{group}$) according to their age (18-26, 27-46, and 47-66 years old). The inclusion criteria consisted of the presence of at least two anterior teeth per arch and a posterior tooth per quadrant as well as the absence of any oral appliances and history of allergy to any compositions of ED and BGR solution. The exclusion criteria were the persons who were colored-blindness, had hand skill problems, illiterate and uncommunication. Within the same age group, the volunteers were randomly divided into 2 subgroups ($n=6$) to apply with either ED or BGR solution. After a 2-week washout period, the volunteers switched to apply another coloring agent. Before starting the trial, the volunteers had been described about the study, the solution compositions and the detection of dental biofilm staining by using intraoral photographic. The results were recorded as staining, not staining or could not identify. The processes have been repeated until the volunteers felt confident.

Disclosing agent application and evaluation

Before applying the solution, moisture control with gauze and saliva suction was performed, then the disclosing agent was applied twice on the teeth with cotton pellets. After applying, the volunteers briefly spit out without rinsing the water. The stained dental biofilm detection was evaluated, 4 sites/tooth (O' Leary's plaque index, 1972),¹⁸ by the examiner and the volunteer, respectively. The examiner evaluated the dental biofilm staining of the volunteer in supine position whereas the distance between the lamp and working area is 70 cm. and distance between examiner and working area is 30 cm. The volunteers evaluated their own stained teeth in an upright position with the same distance of light setting. They could use a mirror to detect the staining at a distance of 30 cm. After completing each clinical trial, the volunteers responded to the satisfaction questionnaire.

Statistical analysis

The interrater reliability between an examiner and the volunteers of the stained dental biofilm detection was reported as Cohen's kappa coefficient (K). The significant differences of percent agreement in each factor (age, tooth surface, tooth location) between both disclosing agents were determined by the Paired t-test using SPSS windows version 20.0. The satisfaction of using both disclosing agents was

evaluated by Wilcoxon signed ranks test. The statistically significant difference was considered if p-value was <0.05 .

Results

Thirty-six volunteers completed the clinical trials of using two disclosing agents. Both ED and BGR solutions exhibited dental biofilm staining. The dental biofilm stained by BGR solution was detected in dark purple color which was different from ED that was detected in red color (Figure 1). The BGR solution specifically stained dental biofilm deposited on the teeth, it did not stain adjacent gingival or other oral tissues as well as tooth-colored restorations. After BGR applied, the volunteers could see and completely detect the stained teeth within 15 minutes before color started gradually fading and dissolving with water.



Figure 1 The dental biofilm stained by erythrosine dye and black glutinous rice solution

The results of the stained dental biofilm detection from each disclosing agent between the examiner and the volunteers were compared using Cohen's kappa coefficient in which the report of “could not identify” data, either from the

examiner or the volunteers, was excluded from the analysis. The kappa coefficients demonstrated the interrater reliability between the examiner and the volunteers of the stained dental biofilm detection from ED and BGR solution were 0.34 and 0.30, respectively. According to kappa statistics comparing between the two groups of raters, both disclosing agents were at the same interval of agreement of “Fair” (Table 1).

The factors affecting the stained dental biofilm detection were conducted including age, tooth surfaces and tooth locations. Within each disclosing agent, the percent agreement between the examiner and the volunteers showed the trend of better interrater reliability in order of age i.e. young adults > adults > elderly. There was no statistically significant difference when compared percent agreement of the stained dental biofilm detection between both disclosing agents in each aged group (Paired t-test, $p>0.05$) (Table 2).

The analysis of tooth surfaces, which recorded 4 sites/tooth, showed no statistically significant difference of

percent agreement of the stained dental biofilm detection between both disclosing agents except on the mesial surface (Paired t-test, $p<0.05$) (Table 3).

The analysis of tooth locations, which were divided into six sextants, showed no statistically significant difference of percent agreement of the stained dental biofilm detection between both disclosing agents in all tooth locations except in the lower right and left posterior teeth (Paired t-test, $p<0.05$) (Table 4).

Satisfaction of the studied disclosing agents

The results of the questionnaire demonstrated that the volunteers significantly satisfied with the color aspect of ED (Wilcoxon Signed Ranks test, $p<0.05$). While the similar pattern of satisfaction for both disclosing agents was shown in the other aspects conducted including scent, flavor, and viscosity (Figure 2). It seemed to show higher overall satisfaction with ED than BGR; however, there was no statistically significant difference.

Table 1 The interval of agreement of kappa coefficient (Landis and koch, 1977)¹⁹

Kappa statistic (K)	Interval of agreement
< 0.00	Poor
0.00 - 0.20	Slight
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Substantial
0.81 - 1.00	Almost perfect

Table 2 Comparison of percent agreement of the stained dental biofilm detection between erythrosine dye and black glutinous rice solution in the different aged groups (Paired t – test)

Age group	The interrater reliability of ED	The interrater reliability of BGR solution	t-statistic value	p-value
Young adults (18-26 years-old)	76.35	66.82	1.77	0.10
Adults (27-46 years-old)	66.93	57.75	1.61	0.14
Elderly (47-66 years-old)	61.04	52.51	1.61	0.14

Table 3 Comparison of percent agreement of the stained dental biofilm detection between erythrosine dye and black glutinous rice solution on different tooth surfaces (Paired t – test, * $p<0.05$)

Tooth surface	The interrater reliability of ED	The interrater reliability of BGR solution	t-statistic value	p-value
Mesial	84.8	73.34	2.62	0.01*
Buccal	65.7	58.54	1.9	0.07
Distal	71.18	63.57	1.67	0.10
Lingual	51.82	41.55	1.86	0.07

Table 4 Comparison of percent agreement of the stained dental biofilm detection between erythrosine dye and black glutinous rice solution in different tooth locations (Paired t – test, * $p < 0.05$)

Tooth locations	The interrater reliability of ED	The interrater reliability of BGR solution	t-statistic value	p-value
PQ1	60.54	54.51	1.29	0.21
UA	60.22	53.49	1.9	0.07
PQ2	61.22	54.18	1.17	0.25
PQ3	73.78	60.82	2.43	0.02*
LA	75.93	70.12	1.76	0.09
PQ4	79.39	58.78	3.97	<0.05*

PQ1 = Upper right posterior teeth, UA = Upper anterior teeth,
 PQ2 = Upper left posterior teeth, PQ3 = Lower left posterior teeth,
 LA = lower anterior teeth, PQ4 = Lower right posterior teeth

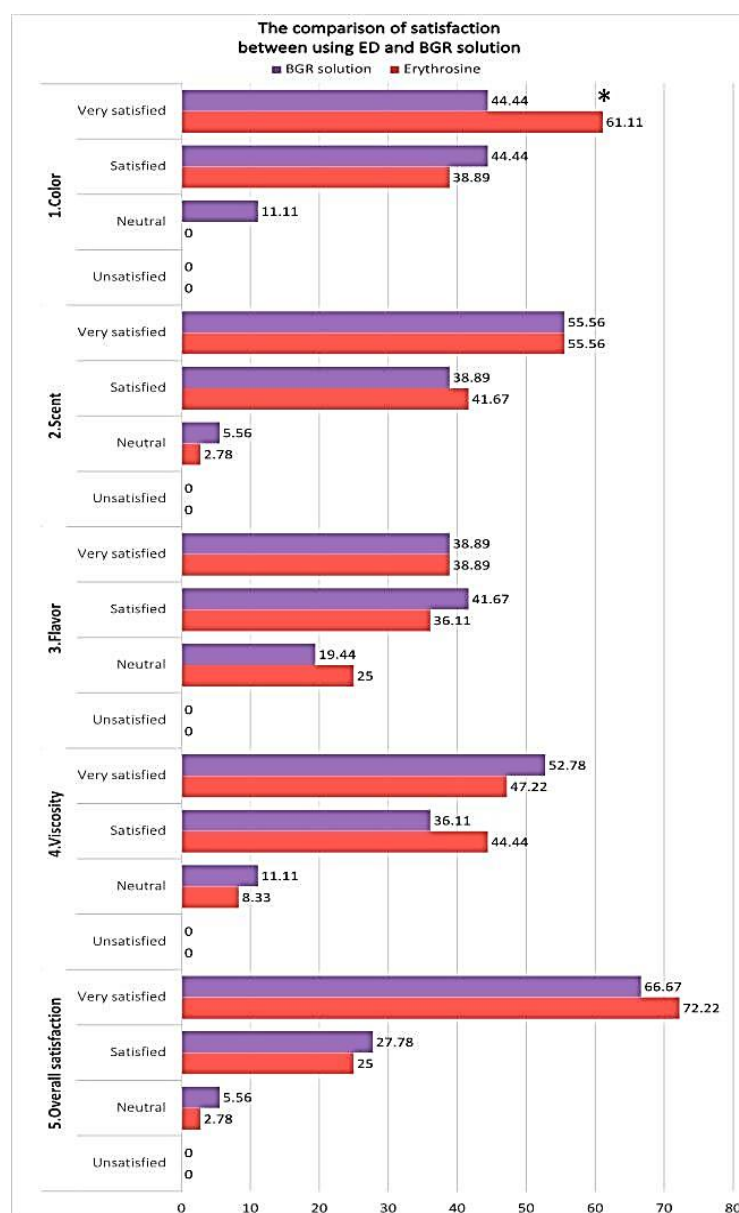


Figure 2 Satisfaction of using erythrosine dye and black glutinous rice solution on dental biofilm staining (Wilcoxon signed ranks test, * $p < 0.05$)

Discussion

The present study has achieved the aim of developing an alternative disclosing agent from natural plant, black glutinous rice, in the form of dehydrated dark purple powder which to be mixed with water before application. In detail, the BGR solution possessed desirable properties in order to be useful as a dental biofilm disclosing agent. Firstly, the dye easily penetrated dental biofilm deposits and could be immediately visible to the user. Secondly, it was not stained adjacent gingival or other oral tissues, as well as resin composite filling. Thirdly, it provided a reasonable amount of time for educating and practicing oral hygiene care before fading. It was also easy to remove from the mouth by rinsing after use. Lastly, it was harmless and non-toxic.

Anthocyanins, enormous pigments in BGR, provide the red to blue colors which are related to their environmental pH. In neutral pH, anthocyanins have a purple hue, appear as red pigment in acidic condition (pH below 3), change to bluish-purple with increasing pH, and to blue pigment in alkaline conditions.²⁰⁻²² In this study, the BGR stained dental biofilm in bluish-purple color possibly due to the pH range in the oral cavity that is, maintained near neutrality (6.7-7.3) and does not fall below 6.3.²³ The intensity of BGR staining was good enough to see but could not compare to the bright red of the ED staining. After BGR applied, the volunteers could see and completely detect the stained teeth within 15 minutes. The volunteers started tooth brushing and it was noticed that the BGR color gradually faded down but it was still able to see. The results were in accordance with previous studies regarding water-soluble properties of natural plant pigments leading to color fade off after applying. In terms of the duration of color intensity in the oral cavity when compared with the synthetic chemical disclosing solutions, however, natural dyes are still less efficient.

The results of the study showed that the kappa coefficient between the examiner and the volunteers after using ED or BGR solution was in the same interval of agreement of “fair”. Since the goal of this study was not to calibrate or enhance the interrater reliability between the examiner who served as the gold standard and the volunteers, this finding simply implies that regardless of disclosing agents

used, the volunteers had the same level of ability to detect the stained dental biofilm. This suggests that in order to promote the practice of oral hygiene, it is necessary to increase the familiarity and proficiency of volunteers in using disclosing agents through repeated training. Furthermore, appropriate inspection tools and optimum light must also be available to increase the ability of the stained dental biofilm detection. Additionally, the percent agreement of ED stained detection was significantly better than BGR solution at the mesial site and lower posterior teeth, which in this point of view, the mesial surface provides a good aspect to distinguish the color intensity and ED provides better contrast while lower posterior teeth are highly clearance areas from saliva and BGR dissolves easier in water than ED. These findings have to be kept in mind when using BGR solution to provide patient education and practice oral hygiene care.

BGR powder is in the form that is convenient to use in the household, however, according to the sensitivity to light of anthocyanins, it should be kept in an amber container which will help to extend the lifespan. We found that keeping BGR powder in a zip lock plastic bag and an amber bottle at room temperature without light exposure within 3 months, the powder was still able to be used and it deteriorated after 6 months. It is also recommended to apply BGR solution immediately after mixing a powder with water for decreasing degradation by light exposure.²⁴

This study shows that the BGR solution was comparable to ED and could be used interchangeably, supporting the use of natural dyes as disclosing agents to facilitate oral hygiene care in some specific groups that require special caution like children, the elderly and people who have some systemic diseases. Within the limitations of this study, there are some questions to be further investigated. The source of BGR that was used in the study was only a batch of cultivation in the north of Thailand, whether the different places and times of cultivation would produce different results. There may be other methods of anthocyanins pigments extraction to make a pure disclosing agent with high intensity and long-term stability, thus warranting further investigations.

Conclusion

The coloring agents from black glutinous rice can stain dental biofilm with desirable properties. Its efficacy is marginally less than erythrosine dye but it has some superior features regarding being natural, safe, and specific staining. In the form of powder, it is convenient for households to promote oral hygiene care.

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References

1. Marsh PD. Dental plaque as a microbial biofilm. *Caries Res* 2004;38(3):204-11.
2. Cugini C, Shanmugam M, Landge N, Ramasubbu N. The role of exopolysaccharides in Oral Biofilms. *J Dent Res* 2019;98(7):739-45.
3. Jakubovics NS, Goodman SD, Mashburn-Warren L, Stafford GP, Cieplik F. The dental plaque biofilm matrix. *Periodontol 2000* 2021;86(1):32-56.
4. Wang Z, Shen Y, Haapasalo M. Dynamics of Dissolution, Killing, and inhibition of dental plaque biofilm. *Front Microbiol* 2020;11:964.
5. Sälzer S, Graetz C, Dörfer CE, Slot DE, Van der Weijden FA. Contemporary practices for mechanical oral hygiene to prevent periodontal disease. *Periodontol 2000* 2020;84(1):35-44.
6. Fasoulas A, Pavlidou E, Petridis D, Mantzourou M, Seroglou K, Giaginis C. Detection of dental plaque with disclosing agents in the context of preventive oral hygiene training programs. *Heliyon* 2019;5(7):e02064.
7. Datta D, Kumar SGR, Narayanan MBA, Selvamary AL, Sujatha A. Disclosing solutions used in dentistry. *World J Pharm Res* 2017;6:1648-56.
8. Yankell SL, Loux JJ. Acute toxicity testing of erythrosine and sodium fluorescein in mice and rats. *J Periodontol* 1977;48(4):228-31.
9. Jennings AS, Schwartz SL, Balter NJ, Gardner D, Witorsch RJ. Effects of oral erythrosine (2',4',5',7'-tetraiodofluorescein) on the pituitary-thyroid axis in rats. *Toxicol Appl Pharmacol* 1990;103(3):549-56.
10. Jung IH, Yeon KH, Song HR, Hwang YS. Cytotoxicity of dental disclosing solution on gingival epithelial cells *in vitro*. *Clin Exp Dent Res* 2020;6(6):669-76.
11. Kim MH, Lee MH, Hwang YS. Natural blue pigment from gardenia jasminoides Ellis (*Rubiaceae*) as a dental plaque disclosant. *J Dent Hyg Sci* 2021;21(1):38-44.
12. Haryani N, Mahmiyah E, Ayatullah MI. The use of turmeric (extracts and squeeze) to detect plaque on teeth. *J info kesehat* 2019;17(2):169-75.
13. Rezki S, Susatyo JH. The role of red dragon fruit peels dyes in red dragon fruit peels detecting the presence of plaque on teeth [monograph on the Internet] Pontianak: Pontianak International Health Conference (PIHC); 2020 [cited 2021 Dec 8]. Available from: <https://www.scribd.com/document/470419371>
14. Purbaningtyas E. Disclosing agent from red dragon fruit peel as dental plaque indicator. *Odonto Dental J* 2020;7(1):31-8.
15. Amaliya A, Firdaus RT, Rusminah N. Natural pigment of red-fleshed pitaya (*Hylocereus polyrhizus*) as dental plaque disclosing agent- A preliminary study. *Istanbul J Pharm* 2020;50(3):256-61.
16. Sivamaruthi BS, Kesika P, Chaiyasut C. Anthocyanins in Thai rice varieties: distribution and pharmacological significance. *Int Food Res J* 2018;25(5):2024-32.
17. Khoo HE, Azlan A, Tang ST, Lim SM. Anthocyanidins and anthocyanins: colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food Nutr Res* 2017;61(1):1361779.
18. O'Leary TJ, Drake RB, Naylor JE. The plaque control record. *J Periodontol* 1972;43(1):38.

19. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977;33(1): 159-74.
20. Pascual-TeresaMaria S, Sanchez-Ballesta T. Anthocyanins: from plant to health. *Phytochem Rev* 2008;7(2):281-99.
21. Wahyuningsih S, Wulandari L, Wartono MW, Munawaroh1 H, Ramelan AH. The effect of pH and color stability of anthocyanin on food colorant. *Mater Sci Eng* 2017;193:012047
22. Rose PM, Cantrill V, Benohoud M, Tidder A, Rayner CM, Blackburn RS. Application of anthocyanins from blackcurrant (*Ribes nigrum* L.) fruit waste as renewable hair dyes. *J Agric Food Chem* 2018;66(26):6790-8.
23. Baliga S, Muglikar S, Kale R. Salivary pH: A diagnostic biomarker. *J Indian Soc Periodontol* 2013;17(4):461-5.
24. Silva S, Costa EM, Calhau C, Morais RM, Pintado ME. Anthocyanin extraction from plant tissues: A review. *Crit Rev Food Sci Nutr.* 2017;57(14):3072-83.

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การศึกษาประสิทธิภาพการติดสีของสารสกัดจากข้าวท่าในการย้อมแผ่นคราบจุลินทรีย์บนผิวฟัน

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บทคัดย่อ

สีย้อมแผ่นคราบจุลินทรีย์ถูกนำมาใช้เพื่อบอกระดับและตำแหน่งของแผ่นคราบจุลินทรีย์บนผิวฟัน ซึ่งจะช่วยให้ส่งเสริมการดูแลอนามัยช่องปากและช่วยป้องกันการเกิดโรคในช่องปาก เพื่อศึกษาค้นสีย้อมแผ่นคราบจุลินทรีย์ทางเลือกจากธรรมชาติ ที่มีความสามารถในการย้อมติดแผ่นคราบจุลินทรีย์ได้ดีและมีความเข้ากันได้ทางชีวภาพกับเนื้อเยื่อในช่องปาก งานวิจัยนี้มีจุดมุ่งหมาย ในการศึกษาประสิทธิภาพการติดสีของสารสกัดจากข้าวท่าในการย้อมแผ่นคราบจุลินทรีย์บนผิวฟัน สารสกัดจากข้าวท่าถูกจัดเตรียม โดยการต้มข้าวท่าในน้ำและนำมาทำให้แห้งผ่านกระบวนการเยือกแข็งเพื่อให้สารสกัดอยู่ในลักษณะของผงแป้งสีม่วงเข้ม ซึ่งก่อนนำมาใช้งานในช่องปาก ผงสีของข้าวท่าจะถูกผสมกับน้ำด้วยอัตราส่วน 1:2 การศึกษาครั้งนี้เป็นการทดลองแบบไขว้ โดยมีผู้เข้าร่วมวิจัย จำนวน 36 คน แบ่งเป็น 3 กลุ่ม ตามช่วงอายุละ 12 คน ดังนี้ 18-26 ปี 27-46 ปี และ 47-66 ปี ในกลุ่มอายุเดียวกัน ผู้เข้าร่วมวิจัยจะถูกสุ่มแบ่งเป็น 2 กลุ่มย่อย เพื่อรับการย้อมแผ่นคราบจุลินทรีย์ด้วยสารสีอิริโทรซินหรือสารสกัดจากข้าวท่าอย่างใดอย่างหนึ่ง หลังจากได้รับการย้อมสีแรกไป 2 สัปดาห์ ผู้เข้าร่วมวิจัยจะถูกสลับย้อมด้วยสีย้อมคราบจุลินทรีย์อีกชนิด การติดสีของแผ่นคราบจุลินทรีย์ถูกบันทึกโดยผู้ตรวจและผู้เข้าร่วมวิจัย ซึ่งฟัน 1 ซี่ ถูกแบ่งเป็น 4 ด้านและบันทึกผลดังนี้ ติดสี ไม่ติดสี และไม่สามารถระบุได้ ผลการศึกษาพบว่า สารสกัดจากข้าวท่าสามารถย้อมคราบจุลินทรีย์บนผิวฟันได้สีม่วงเข้มอย่างเฉพาะเจาะจง ไม่ติดสีเนื้อเหงือก เนื้อเยื่อช่องปาก รวมถึงวัสดุอุดสีเหมือนฟัน ผู้เข้าร่วมวิจัยสามารถมองเห็นและสังเกตคราบจุลินทรีย์ได้อย่างชัดเจนใน 15 นาทีแรกก่อนสีย้อมจะค่อยๆจางลง ค่าสถิติ Cohen's Kappa coefficients ระหว่างผู้ตรวจและผู้เข้าร่วมวิจัย ในการมองเห็นแผ่นคราบจุลินทรีย์ของสารสีอิริโทรซินและสารสกัดจากข้าวท่า มีค่า 0.34 และ 0.30 ตามลำดับ ซึ่งอยู่ในช่วงความน่าเชื่อถือเดียวกัน นอกจากนี้ยังไม่พบความแตกต่างทางสถิติของการมองเห็นคราบจุลินทรีย์ระหว่าง 2 สีย้อมคราบจุลินทรีย์ในทุกกลุ่มอายุ แต่เมื่อวิเคราะห์ด้านของซี่ฟันและตำแหน่งของฟัน พบว่ามีความแตกต่างทางสถิติของการมองเห็นคราบจุลินทรีย์ระหว่างสีย้อมคราบจุลินทรีย์ทั้ง 2 ชนิด ที่ด้านใกล้กลางและในฟันหลังล่าง (Paired T-test; $p < 0.05$) ผลการศึกษาชี้ให้เห็นว่า สารสกัดจากข้าวท่าสามารถใช้ย้อมแผ่นคราบจุลินทรีย์บนผิวฟันได้ตามคุณสมบัติที่พึงประสงค์ โดยประสิทธิภาพของสารสกัดจากข้าวทาน้อยกว่าสารสีอิริโทรซินเล็กน้อย แต่สารสกัดจากข้าวท่ามีลักษณะบางประการที่โดดเด่น คือ การเป็นสารจากธรรมชาติ ปลอดภัย และมีการติดสีเฉพาะตำแหน่ง ในรูปแบบผงของสารสกัดยังสะดวกต่อการใช้ในครัวเรือน เพื่อส่งเสริมการดูแลสุขภาพช่องปากของประชาชน

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