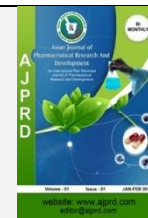


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Research Article

Formulation of Roselle Flower Extract Gel (*Hibiscus sabdariffa* L.) as a Disclosing Solution

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ABSTRACT

Background: Plaque is a soft deposit attached to the teeth consisting of various types of microorganisms from saliva and food waste. Plaque cannot be seen because it is transparent, like the color of translucent white glass. The way to see plaque is to use a contrast material such as a dye (red/purple) in the form of a liquid or gel called a disclosing solution. It is usually found in gel and liquid form. But in use in humans there are many shortcomings because they are expensive, quite expensive and often contain harmful chemicals. One of the herbal plants that can be used as an alternative material as a disclosing solution is Rosella (*Hibiscus sabdariffa* L.) which can be used for its properties in the field of Prevention of Dental and Oral Diseases and has antibacterial and remineralizing effects. Methods: This research is an experimental study on the development of Rosella Flower Extract (*Hibiscus sabdariffa* L.) in the form of a gel in disclosing solution. The research was carried out from June to August 2021 at the Pharmacognosy Laboratory, Department of Pharmacy and Food Analysis, Health Polytechnic of Jakarta II and Dental Health Laboratory, Health Polytechnic of Jakarta I. Disclosing solution prepared from dried Rosella Flowers (*Hibiscus sabdariffa* L.) was obtained as much as 1000 grams. from the Research Institute for Spices and Medicinal Plants, Bogor. Hedonic testing was carried out on 34 students of the Department of Dental Health, Health Polytechnic of Jakarta I. Results: The disclosing solution preparation in the form of a gel from rosella flower extract had good organoleptic test results. The expected red color corresponding to the color of the disclosing solution is at a concentration of 70%. The average pH of the disclosing solution in the form of a gel was 4.95. The average dispersion of the gel preparation is 5.7. 5. The average adhesion of gel preparations at all concentrations is 1.44 seconds. The hedonic test was obtained that most of the respondents had a neutral opinion on all disclosing gel preparations. Conclusion: The preparation of Roselle Flower Extract Gel (*Hibiscus sabdariffa* L.) can be used as an alternative disclosing solution

Keywords: Rosella flower, extract, gel, disclosing solution

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INTRODUCTION

Plaque is a soft deposit that is firmly attached to the tooth surface, consisting of microorganisms that proliferate in an intracellular matrix. Plaque cannot be cleaned simply by rinsing with water but must be actively brushed mechanically using a toothbrush. If plaque is allowed to accumulate around the oral tissues of the grave, it will lead to the formation of tartar, dental caries and gingivitis. Dental caries disease or dental cavity disease is a disease of dental tissue that is most often found in the community. The main cause of dental caries is due to the presence of a soft deposit attached to the teeth containing various kinds of bacteria, called plaque.¹⁻⁴

The most dominant bacteria found in caries-causing plaque is

Streptococcus mutans, a type of acid-producing bacteria that can damage teeth due to the fermentation reaction of carbohydrates including sucrose, fructose, and glucose from food scraps.⁵⁻⁷

Dental plaque cannot be seen directly with the eye because it is transparent, like the color of translucent white glass. The way to see plaque is to use a contrast material such as a dye in the form of a liquid or gel called a disclosing solution. One alternative as a disclosing solution is Rosella (*Hibiscus sabdariffa* L.) because it contains anthocyanin pigments which are dark red in color. The important content contained in some rosella flowers is anthocyanin pigment which forms flavonoids that act as antioxidants. Rosella flavonoids consist of flavanols and anthocyanin pigments. This anthocyanin pigment forms a reddishpurple color in rosella flower petals.⁸⁻¹⁰

Rosella flowers contain important chemicals, including gossypetin anthocyanins, glucoside hibiscin, arginine, legnin, vitamin C, calcium, organic acids, polysaccharides and flavonoids. In addition, rosella flowers also have a fairly high mineral content. In 100 grams of fresh flower petals, rosella contains 160 mg of calcium, 60 mg of phosphorus, and 3.8 mg of iron.¹¹⁻¹³

In many countries, the use and efficacy of rosella in the world of herbal medicine has been widely used and almost all parts of the roselle plant have efficacy as herbal medicine. Rosella plants have an antiseptic, antibacterial, anti-hypertensive, diuretic effect, improve blood circulation, antispasmodic, anthelmintic, treatment of bleeding gums and increase the human body's resistance to disease, etc. Another benefit of the rosella plant is to reduce blood viscosity and as an intestinal antiseptic.^{12,14}

Rosella Flower Extract (*Hibiscus sabdariffa* L.) has an effect in inhibiting the growth zone of *Streptococcus mutans* bacteria. The effect of rosella flower steeping water on the solubility of calcium ions in tooth enamel, showed the results that rosella flower petals steeped water could dissolve calcium ions in permanent teeth. The higher the concentration of steeping water, the smaller the effect of solubility of calcium ions on enamel on permanent teeth. This may be due to the presence of high calcium content in rosella flowers which causes a remineralization effect where the calcium ion from rosella extract is bound to the tooth tissue at high extract concentrations.^{15,16}

Rosella flower extract in inhibiting the growth of *Streptococcus mutans* bacteria showed that the extract in gel and liquid dosage forms had an effect on inhibiting bacterial growth. And gel preparations are more effective than liquid preparations.¹⁷

Based on the above background, as one of the efforts in the field of preventing dental and gum disease using natural ingredients, it is necessary to develop rosella flower extract (*Hibiscus sabdariffa*) in the form of a gel to be used as a Disclosing solution preparation.

METHODS AND MATERIALS

This research is an experimental study on the development of Rosella Flower Extract (*Hibiscus sabdariffa* L.) in the form of a gel in disclosing solution. The research was carried out from June to August 2021 at the

Pharmacognosy Laboratory, Department of Pharmacy and Food Analysis, Health Polytechnic of Jakarta I and Dental Health Laboratory, Health Polytechnic of Jakarta I. A disclosing solution prepared from dried Rosella Flowers (*Hibiscus sabdariffa* L.) was obtained as much as 1000 grams. from the Research Institute for Spices and Medicinal Plants, Bogor. Hedonic testing was carried out on 34 students of the Department of Dental Health, Health Polytechnic of Jakarta I.

This study the research steps were carried out by making rosella flower extract in concentrations of 30%, 50%, 60%, 70%, 80% and then made in disclosing solution preparations, as follows:

Formulation of Dental Disclosing Solution

The formula used in this study is a modification of the disclosing solution formula containing vitamin B12 which was patented by Simone et al (1993). Rosella flower extract content (*Hibiscus sabdariffa* L.) 30%, 50%, 60%, 70%, 80%. The preparation was made in phosphate buffer solution pH 5.3 adjusted to the pH stability of betanin and betacyanin 4-8 and the pH of the Dental disclosing solution trademark ± 5.3 . Formula Dental Disclosing Solution:

1. Rosella flower extract (*Hibiscus sabdariffa* L.): 30%, 50%, 60%, 70%, 80%
2. Glycerin: 15 gr
3. Ethanol 96%: 5 gr
4. Tween 80: 1 gr
5. Na saccharin: 0.01 gr
6. Na Benzoate: 0.5 gr
7. Sodium meta bisulfite: 0.1 gr
8. Buffer pH 5.3 to: 100 gr

Stages of making Dental Plaque Disclosing Solution

1. Dilute the extract with glycerin then add tween 80 then add a little aquades (mass 1)
2. Dissolve Na saccharin and Na benzoate and sodium meta bisulfite in 96% ethanol, dilute with sufficient aquadest (mass 2)
3. Mix period 1 and period 2 then add buffer solution up to 100 grams
4. Add the remaining aquadest stir until homogeneous



Figure 1: Results of the formulation of Disclosing solution gel preparations

Testing the Quality of Disclosing Solution Preparations:

1. Organoleptic Test

Observations were seen directly on the shape, smell and color of the gel disclosing solution made.

2. Homogeneity Test

The homogeneity test was carried out to determine the homogeneity of the gel by looking at the uniformity of the particles in the preparation. The preparation must show a homogeneous arrangement and no coarse grains can be seen.

3. pH testing

The pH test was carried out to determine the level of acidity of the sample preparation.

4. Spreadability Test

The dispersion test was carried out to determine the dispersibility of the gel. The spread of 5 – 7 cm is included in a comfortable semisolid preparation.

5. Adhesive Test

The adhesion test was carried out to determine how long the gel was attached to the surface of the skin so that the active substances in the preparation were absorbed. There are no special requirements regarding adhesion, but it is recommended that the adhesion of semi-solid preparations is more than 1 second.

6. Specific Weight Test

Specific gravity testing is done by measuring the specific gravity using a pycnometer and calculating the specific gravity using a formula. Specific gravity testing is carried out to determine the specific gravity of a preparation. Determination of the specific gravity of a preparation is

done by comparing the measured weight of the preparation with the control weight (water) at the same temperature and volume.

7. Hedonic Test

One of the stages of testing a product formulation of herbal preparations to be studied. In this test, subjects were asked

for their personal responses about their preferences or vice versa for the preparation of disclosing solution from rosella. The hedonic test uses a scale of 1-5 with the following information: 1 = very dislike, 2 = dislike, 3 = neutral, 4 = like, 5 = very like.

RESULTS

Table 1: Organoleptic test table rosella flower extract concentration 30%, 50%, 70%

| Preparation | Form | Smell | Color | Taste |
|-------------------|------------|-----------------|------------|----------------------|
| Gel Base | Semi solid | Odorless | No colored | Taste a little sweet |
| Concentration 30% | Semi solid | Special extract | Brown red | Sour |
| Concentration 50% | Semi solid | Special extract | Brown red | Sour |
| Concentration 70% | Semi solid | Special extract | Black red | Sour |

Table 2: Homogeneity test of rosella flower extract concentration 30%,50%,70%

| Preparation | Homogeneity |
|-------------------|----------------------------------|
| Gel Base | Homogeneous, no coarse grain |
| Concentration 30% | Not homogeneous, no coarse grain |
| Concentration 50% | Not homogeneous, no coarse grain |
| Concentration 70% | Homogeneous, no coarse grain |

Table 3: pH test of rosella flower extract concentrations of 30%, 50%, 70%

| Preparation | pH | Mean |
|-------------------|------|------|
| Gel Base | 5.04 | 4.95 |
| Concentration 30% | 5.39 | |
| Concentration 50% | 4.95 | |
| Concentration 70% | 4.50 | |

Table 4: Dispersion Test of Rosella flower extract concentration 30%,50%,70%

| Preparation | Weighing Weight (g) | Diameter(cm) |
|-------------------|---------------------|--------------|
| Gel Base | 0.5059 | 5.1 |
| Concentration 30% | 0.5080 | 5.9 |
| Concentration 50% | 0.5007 | 5.7 |
| Concentration 70% | 0.5043 | 5.5 |

Table 5: Test of adhesion of rosella flower extract concentration 30%,50%,70%

| Preparation | Weighing Weight (g) | Time (seconds) |
|-------------------|---------------------|----------------|
| Gel Base | 0.50 | 01.00 |
| Concentration 30% | 0.50 | 01.10 |
| Concentration 50% | 0.50 | 01.88 |
| Concentration 70% | 0.50 | 01.33 |

Table 6: Weight Test for Rosella Extract with concentrations of 30%, 50%, 70%

| Weighing | Concentration 30%(g) | Concentration 50%(g) | Concentration 70%(g) |
|-----------------------|----------------------|----------------------|----------------------|
| Empty pycnometer | 15.5576 | 15.5576 | 15.5576 |
| Pycnometer + Aquadest | 25.6507 | 25.6507 | 25.6507 |
| Pycnometer + Sample | 25.3041 | 25.2699 | 24.9719 |

Table 7: Results of Specific Gravity of Rosella Flower Extract

| Preparation of Disclosing Solution | Specific Gravity (g/ml) |
|------------------------------------|-------------------------|
| Concentration 30% | 0.9656 |
| Concentration 50% | 0.9622 |
| Concentration 70% | 0.9327 |

Table 8: Hedonic Test Rosella flower extract (*Hibiscus sabdariffa* L) Gel form

| Concentration | Criteria | | | | | | | | | | Total | |
|---------------|--------------|-----|---------|------|---------|------|------|------|-----------|------|-------|-----|
| | Very dislike | | Dislike | | Neutral | | Like | | Very like | | | |
| | f | % | f | % | f | % | f | % | f | % | f | % |
| 30% | 0 | 0.0 | 11 | 32.4 | 13 | 38.2 | 8 | 23.5 | 2 | 5.9 | 34 | 100 |
| 50% | 0 | 0.0 | 8 | 23.5 | 19 | 55.9 | 5 | 14.7 | 2 | 5.9 | 34 | 100 |
| 70% | 0 | 0.0 | 9 | 26.5 | 19 | 55.9 | 6 | 17.6 | 0 | 0.0 | 34 | 100 |
| Trademark | 3 | 8.8 | 1 | 2.9 | 12 | 35.3 | 13 | 38.2 | 5 | 14.7 | 34 | 100 |

DISCUSSION

Various studies that discuss the benefits, efficacy and effectiveness of rosella flowers have been explored and the results are known both for general health and in the field of dental and oral health. Rosella plant (*Hibiscus sabdariffa* L.) is a type of shrub that is easy to grow in the environment and is not a seasonal plant because it can produce flowers almost all year round. Rosella plant is also an herbal plant, every part of which has health benefits because it is rich in chemical compounds that are beneficial for health. The preparations that are often found in the community are rosella tea drinks which give a fresh sensation, slightly sour and bright red and thick. The red to purplish color is due to the presence of anthocyanin pigments in rosella flower petals which have antioxidant properties. In the field of dental health, rosella flower extract has an anti-bacterial effect against streptococcus mutans.¹⁸⁻²⁰

To develop the benefits of rosella flower extract in the field of preventing dental and oral diseases, one of them is by making disclosing solution preparations. Disclosing agent or disclosing agent is a material or substance used to reveal or show plaque that is clearly visible to the eye. Plaque is a soft deposit or layer that adheres to the tooth surface. The function of the disclosing agent solution is so that the plaque attached to the teeth can be seen clearly due to the nature and color of the transparent plaque. Disclosing solution preparations on the market are usually available in gel and liquid form. Besides the price is quite expensive, it also sometimes contains harmful chemicals.^{21,22}

By looking at the advantages and efficacy of chemical compounds contained in rosella flowers, including anthocyanin pigments that give bright red and even purplish red colors to the petals, rosella flowers have the potential to be investigated as a disclosing solution material. The research to develop gel and liquid rosella flower extract as a disclosing solution preparation is a follow-up study that has previously been carried out by researchers on the antibacterial effect on streptococcus mutans. Streptococcus mutans is the predominant bacteria found in the plaque layer. In addition, it has been investigated the effect of calcium ion solubility by steeping rosella flowers, which shows that the higher the concentration of steeping rosella flowers, the smaller the solubility effect of calcium ions.¹⁷

With reference to the ideal disclosing agent requirements, the research was continued by developing an appropriate formulation of roselle extract in the form of a gel as a disclosing solution preparation. The development of this rosella flower extract was investigated by observing the physical and chemical properties of the disclosing solution

preparation of the rosella flower extract using Organoleptic Test and Hedonic Test in gel form.

Organoleptic test results with direct observation of the shape, odor, color and taste of rosella flower extract both gel preparations in concentrations of 30%, 50% and 70% have the same odor and taste. However, there is a slight difference in the color of the preparation at a concentration of 30% and 50%, but at a concentration of 70%, the gel form has the same color, namely blackish red.

Homogeneity test was carried out to determine the homogeneity of the gel by looking at the diversity of particles in the preparation. A good preparation must show a homogeneous arrangement and no coarse grains are visible. From the observations, the preparation that gives homogeneous results and there are no coarse grains is the disclosing preparation in the form of a gel at a concentration of 70%.

The pH test was carried out to determine the level of acidity of the sample preparation. From the closed preparation, the average pH of the gel form was 4.95 and the liquid was 4.68. The average pH of the Gel form is higher than that of the liquid form. This is in accordance with the required pH, namely pH 4-8.

Spreadability test was carried out to determine the dispersibility ability of the gel. The spreadability included in the comfortable semisolid preparation is 5-7 cm. From the observations made, the results showed that the average dispersion of the gel preparation was 5.7. This means that gel preparations can be included in the convenient category of semisolid preparations.

Adhesiveness test was carried out to determine how long the gel was attached to the tissue surface so that the active substance in the preparation was absorbed. The recommended time for semisolid or gel preparations is more than 1 second. From the observations made, the average adhesion of gel preparations at all concentrations was 1.44 seconds. This is a highly recommended time.

Specific gravity testing is to determine the specific gravity of a preparation. The results of the observations showed that the lowest specific gravity was in the gel preparation with a concentration of 70%, which was 0.9327.

The hedonic test for disclosing solution preparations from roselle flower extract in the form of Gel on 34 respondents from Table 8 shows that most of the respondents gave a neutral impression on each preparation at 30%, 50%, 70% gel concentrations and trademark preparations.

CONCLUSIONS

Based on the results of the study, it can be concluded that there is the preparation of Roselle Flower Extract Gel (*Hibiscus sabdariffa* L.) can be used as an alternative disclosing solution

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CONFLICT OF INTEREST

The authors declare that they have no conflict interests.

ETHICAL CLEARANCE

This research has received ethical approval from the Research Ethics Committee, Health Polytechnic of Jakarta INo.045/KEPK/VII/2022.

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