

## DEVELOPMENT OF NATURAL HAIR DYE PRODUCT

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### Abstract

The objective of this research was to develop natural hair dye containing sappan extract. Sappan powder was extracted with 50% ethanol to obtain dark orangish brown viscous liquid. The developed emulsion consisted of 10% extract without (S1) and with 1% various mordants including aluminium sulfate (S2), zinc sulfate (S3) and aluminium chloride (S4) and dyed on bleached hair tress. The color staining efficacy of each formula was evaluated. All formulas (S1-S4) provided red shade on hair tress and formula with zinc sulfate (S3) gave strongest red color. Then, S3 was further developed by increasing zinc sulfate to 2% (S3-1). This formula showed higher dyeing efficacy than that of S3. The color retention efficacy of dyed hair with S3-1 was evaluated by shampooing 7 times and the results showed that the color fading of hair tresses slightly changed. Moreover, preference test was carried out on 11 volunteers. All volunteers were satisfied for the appearance, color of product, dying duration, dyeing efficacy, hair color and overall. 90.90% of volunteers were satisfied with spreading on hair, color retention, hair smoothness and not damage. 81.82% of volunteers were satisfied hair smooth and not damage. However, only 54.54% of volunteers were satisfied with odor of the product.

Keywords: Hair dye/ Natural hair dye/ Natural extract/ Sappan

## **Introduction**

For centuries the usage of hair coloring was restricted to the fashion needs of a privileged few. Today, people in ever-greater numbers women and men alike change their hair color to make themselves more attractive. There are various reasons for this: to hide white hair, to lighten hair color or add an additional highlight, to remove the yellow look from gray hair, or to enhance the color of the natural gray, and so on. They are four common classifications are temporary, semi-permanent and permanent (Franca et al., 2015). Most of the hair dye ingredients contain allergic substance like *p*-phenylenediamine (PPD) and more which can lead to allergic reaction such as scalp puffiness, itching, swelling and difficulty in breathing. They can also lead to development of some kind of cancer, hay fever, arthritis and leukemia etc. (Dominguez et al., 2001). Therefore, natural hair dye products have been increasing interest. Sappan (*Caesalpinia sappan* L.) is a plant of Leguminosae family and has been used as a source of red color for hair dye. The red colorants in *C. sappan* were identified as brazilin, protosappanin and haematoxylin (Nirmal, Rajput, Prasad and Ahmad, 2015).

However, problems with natural hair dyeing include weak color and difficulties with long-term deposition; therefore, natural dyes are not able to penetrate into the hair deep enough to protect dyed hair from washing or fading. The addition of some substances, such as a mordant can improve hair dyeability. The developer can break chemical bonds and open the hair cuticle, which allows the dye molecules to penetrate deeper into the hair shaft and to bond with hair proteins (Boonsong, Laohakunjit and Kerdchoechuen, 2012). In this study, aluminium sulfate, zinc sulfate and aluminium chloride were used as mordant to enhance staining efficacy of sappan hair dye.

## **Materials and Methods**

### **Plant material**

Sappan (*Caesalpinia sappan*) powder was purchased from Vejpongosot, Bankkok.

### Preparation of extract

The sappan was extracted with 50% ethanol in water in the ratio of 1g : 5ml (plant:solvent) for 1 hour by sonication method. The extract was filtrated by Whatman no.1 filter paper and the solvent was removed by using rotary evaporator to obtain crude extract. The pH value of the extract was measured by pH meter and color was measured by colorimeter.

### Preparation of hair dye cream

Sappan cream as ingredients described in Table 1 was prepared by separately heated part A and B to 75°C and then mixed with homogenizer. The mixture was cooled down to 40-45°C and part C and D were added to cream base and mixed until homogeneous. Part E and F added into cream and mixed until homogeneous.

**Table 1** The ingredients of hair dye cream

	Ingredients	S1	S2	S3	S4
A	DI water	q.s to 100	q.s to 100	q.s to 100	q.s to 100
	Butylene glycol	8.00	8.00	8.00	8.00
B	Ceteareth-20, glyceryl				
	Stearate, cetyl alcohol, cetearyl alcohol	22.00	22.00	22.00	22.00
C	Ammonium hydroxide 28%	10.00	10.00	10.00	10.00
D	Sappan extract	10.00	10.00	10.00	10.00
E	Vitamin C	1.00	1.00	1.00	1.00
F	Aluminium sulfate	-	1.00	-	-
	Zinc sulfate	-	-	1.00	-
	Aluminium chloride	-	-	-	1.00

### Evaluation of dyeing efficacy

The human hair tresses were collected from barber shops and bleached with 50% hydrogen peroxide for 48 hours and then shampoo and dry with hair dryer. The bleached hair tresses were dyed with natural hair dye cream (S1-S4) for 30 minutes then shampooing and dried with hair dryer. The color of dyed hair tresses was visually

observed. Then, zinc sulfate was chosen as the best mordant and it was added in higher concentration (2%) in formula S3-1.

### **Irritation test**

Eleven healthy volunteers were participated in this study. The participants were briefed on the study procedures, and each was given written informed consent. The irritation test was done by closed patch test method. According to most hair dye products were applied for 30-45 minutes, in this study, the samples were applied on forearm for 30 minutes (Ho et al., 2005). The test area was thereafter washed off by tap water and subsequently scored by MII technique (Baldissertoo et al., 2018).

### **Sensory evaluation**

Volunteers were answer satisfaction questionnaire after used product. There were ten parameters including appearance, odor of product, color of product, spreading on hair, dyeing duration, coloring efficacy, hair color, hair smoothness and not damage, long lasting color and overall satisfaction. Five scale of satisfaction were 5 = very satisfied, 4 = satisfied, 3 = adequate, 2 = unsatisfied, 1 = very unsatisfied. The results were calculated as percentage of acceptable satisfied.

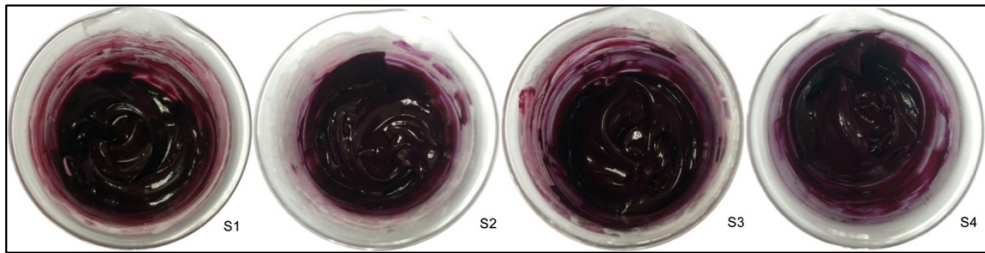
## **Results and discussion**

### **Extraction**

Sappan was extracted with 50% ethanol in water and obtained as dark orangish brown crude extract with  $7.92 \pm 0.92$  yield percent based on plant weight. The pH of extract was  $3.91 \pm 0.02$ .

### **Preparation of hair dye cream**

Sappan creams (S1-S4) appeared as purple-red as shown in **Figure 1**. The pH of creams was range form 10.60-11.50. After centrifuge 5000 rpm for 10 minutes, formulas S1-S4 were not separated therefore they were classified as stable formulas (IFSCC MONOGROD No.2, 1992)



**Figure 1** Appearance of sappan creams S1-S4

The bleached hair tresses were dyed with natural hair dye creams (S1-S4) for 30 minutes then shampooing and dried with hair dryer. Color of dyed hair tresses was shown in **Figure 2**.



**Figure 2** Appearance of 1) bleaching hair 2) dyed hair with S1 3) dyed hair with S2 4) dyed hair with S3 4) dyed hair with S4

S3 showed strongest red color on hair, this formula was chosen for further development by increasing zinc sulfate to 2% (S3-1). The result showed that S3-1 gave darker than S3 as shown in **Figure 3**. Under microscope magnified 40x, the cuticle of the dyed hair were not damaged as shown in **Figure 4**. The color of dyed hair with S3-1 after had no change after shampooing 7 times as shown in **Figure 5**.



**Figure 3** Hair dyed with 1) S3 2) S3-1



**Figure 4** Structure of dyed hair under microscope 40x 1) S3 2) S3-1





**Figure 5** Appearance of dyed hair with S3-1 1) before shampooing 2) after shampooing 7 times

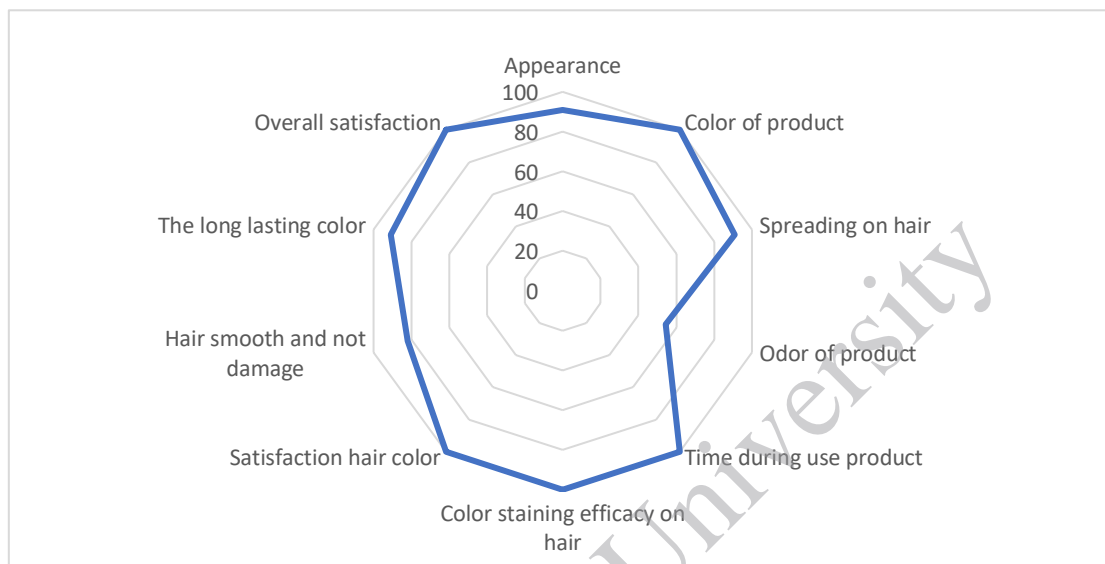
### **Irritation test**

Eleven healthy volunteers were participated in the irritation test which was done by closed patch test method. The samples were applied on forearm for 30 minutes. After the test area was washed off by tap water, MII scores were evaluated. The result found that MII value was 0 which the product was classified as non-irritate.

### **Sensory evaluation**

Volunteers were answer satisfaction questionnaire after used product. There were ten parameters including appearance, odor of product, color of product, spreading on hair, time during use product, color staining efficacy on hair, satisfaction hair color, hair smooth and not damage, long lasting color and overall satisfaction. Five score of satisfaction were 5 = very satisfied, 4 = satisfied, 3 = adequate, 2 = unsatisfied, 1 = very unsatisfied. The results were expressed ad percentage of volunteers who satisfied and very satisfied the product. All volunteers were shown high satisfaction for color of product, time during use product, color staining efficacy, satisfaction hair color and overall satisfaction. More than 90% of volunteers were shown high satisfaction for spreading on hair and long lasting color hair smooth and not damage. Moreover, 80%

of volunteers were high satisfaction for hair smooth and not damage. However, only 54.54% of volunteers were high satisfaction for odor of product as shown in **Figure 6**.



**Figure 6** Percentage of satisfaction

### Conclusion

The plant was extract with 50% ethanol was shown the orangish dark brown color. The emulsion was developed with 10% color extract and 1% different mordants including aluminium sulfate, zinc sulfate and aluminium chloride and evaluated for their color staining efficacy. Sappan cream (S1-S4) provided red color on hair shaft and formula containing zinc sulfate (S3) gave strongest hair color among all formula. S3 was further developed by increasing zinc sulfate to 2% (S3-1) and this formula showed higher dyeing efficacy than S3. The color retention efficacy of S3-1 was evaluated by shampooing 7 times and results showed that the hair tresses had slightly changed. Percentage satisfaction in satisfied (4) and very satisfied (5) shown that most of volunteers were high satisfaction for color of product, time during use product, color staining efficacy, satisfaction hair color, overall, spreading on hair and long lasting color and hair smoothness. However, only 54.54% of volunteers were satisfaction for odor of product.



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