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Natural color extraction for painting

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Abstract

This study aimed to find the alternative choice which is apart from artificial color in creating artwork by comparing the colors of plants extracted by the different solvents and durability of colors from plants on various types of water colored paper between 200 gsm and 300 gsm. The plants were divided into three groups of the providing colors including red from roselle (*Hibiscus sabdariffa* L.) and sappan (*Caesalpinia sappan* L.), yellow from *Coscinium fenestratum (*Goetgh*.)* Colebr and the fruit of gardenia (*Gardenia jasminoides* J.Ellis) as well as blue from butterfly pea (*Clitoria ternatea* L.) and hom (*Strobilanthes cusia (*Nees*)* Kuntze*)* by the process of extraction with the solvents between water (H_2O) and ethanol (C_2H_5OH) in ratio of 1:5 (plant: solvent). Then, painting these on two different type of paper is in order to comparing the durability of color including hue, saturation, and brightness by using the digital image colorimeter (DIC) in measuring the color value. The result revealed that the sappan provided the finest saturation and brightness on 300-gsm water colored paper in red group. Besides, the sappan extracted by water provides the finest saturation on the same type of paper. For yellow group, the gardenia fruit in ethanol solvent provide the finest saturation and brightness on 300-gsm water paper. Additionally, *Coscinium fenestratum* extracted by water (H_2O) and ethanol (C_2H_5OH) provides the finest hue in equal on 200-gsm water paper. Lastly in blue group, butterfly pea in ethanol solvent provides the finest hue and brightness on 200-gsm water paper as well as hom provides the finest saturation on the in common paper. Finally, this study offers a method for selecting plants that provide accurate colors, and guide the process of color extraction for art that are suitable for future developments in painting materials.

Keywords: Extraction, Natural color, Painting, Color value

1. Introduction

The color effects on feeling and on visibility are an important component of the creation of an artwork creation as well as an essential part of a creative work of design and advertising. Besides, color remains one of the most significant elements that influences the feeling and the decision related to its choice is paramount. For example, red expresses the feeling of danger, hotness, and prohibition, while green appears easy, natural, and relaxing. Thus, colors influence us in daily life. At present, in art painting, colors are used depending on the intention, the expression as well as the expertise of the artist, which is mostly from the synthesis of color selections. Chiubang [1] stated that every color nominates the mind of human; color and human are inseparable. Everyone has an opinion about a favorite or non-favorite color. This is because every human being has an emotion upon the deep connection and familiarity to colors of all kinds: the most favorite, neutral, and the least favorite ones. In the usage of color in daily life, a person with sophisticated taste frequently matches colors suitably with time, occasion, culture, weather, trends and fashion. Apart from colors on clothing, the furniture and vehicles are also implicated. However, their influences affects the mood of people, depend on a variety of factors including race, environment, personal idea, gender, age, education and experience. These aspects generate distinct emotions in reaction to color in different people. The most important element determining the quality of color is the pigment, which is extracted from various resources including organic and artificial pigments, or natural nonliving substances such as soil, rock, and mineral, directly used or transformed through chemical process. Organic pigments derived from plants and animals are utilized in color solvent; synthetic pigments for color creation are obtained through synthesis especially from bitumen, and other materials or chemical reaction. [2] In addition to the hue itself, the texture is the other important component of art creation. The artist must discern suitable texture to be able to bring out the best of contrast and harmony, for the purpose of a specific expression in the artwork through idea, feeling, as well as imagination of the artist.

The color extraction of plants for creation of artwork is an interesting alternative because this is the way to seek out the color from the easy to find plants in local area. Thus, the study of suitable solvent in plant extraction, extraction process, and effective ration in extraction will be beneficial mainly in the usage. The theory of substances and colors extraction from plant will used liquid reagent or solvent in this process describing by Indranupakorn [3] in term of the purpose of plant extraction. The theorist provides an example in herb extraction which is able to be implemented in various methods. The solvents being able to use in this process firstly is water (H_2O). The extraction by mentioned substance is easy and popular with the qualification of being good, easy to look for, and low-cost. Besides, Chochai [4] also reveals the discussion of cotton dying that the dye extracted is orange. Furthermore, the dye provide a deep shade of color after boiling. Thus, the extraction by water (H_2O) and heat is a method for increasing the deeper shade of color texture. This is also in accordance with Tuisakda & Khamnuansin [5] stated that in the natural extraction, the bark with astringent from the over 5-year plants is selected and chopped or grinded. Then, boiling in the water or stewing approximately from 1 to 2 hours for lead the latex of plants out and get the more required intensity of color texture.

The color extraction from plants also has a limit in term of the deep color shade even that is the same kind of plant. Nonsi, Chinawong, and Pongkham Community Research Team [6] stated that there are 2 methods: soaking (cold dyeing) and boiling (hot dyeing) for the color extraction from plants in dyeing clothes by using water as a solvent. However, soaking will provide non-durable and unclear colors. In contrast with the boiling, this is because it takes more time and spends more in color absorption. Regarding the boiling of cotton,that is a heat usage in gaining the speed in color transpiration of plants and effectiveness in color absorption on cotton yams.

In addition, color in plant, flower, and fruit becomes popular in extracting for dyeing and painting i.g. beetroot, mulberry, carrot, butterfly pea, pandun, and etc. These are able to be extracted for color usage in creation of artwork. However, the disadvantage of extraction by water (H_2O) is the spoilage from microorganism, bacteria, and fungus. This effects on the preservation of this kind of color from because water (H_2O) extraction also provides inert substances such as sugar and flour which is the good food for microbe and causes the spoilage.

Ethanol (C_2H_5OH) is a better and more expensive solvent comparing with the water (H_2O). This popular substance has a qualification of antimicrobial. The usage of ethanol in herbal extraction must be fermented in closed container in suitable ratio of extractor for 7 days, as setting by pharmacopoeia, or until the whole solution appearing. The advantage of ethanol is being a reactant or solvent in cosmetic production, medicine, and perfume. This substance could be mixed to make the beverage and used in sterilizing or cleaning the wound e.g. 75% alcohol. Apart from that, this could inhibit the growth of the bacteria cells including virus, fungus, and microbes. A research of Srisukong, Kanlayaporn & Hanpakphum [7] explores the effects of the crude extracts from the stems and the flowers of the *Cyperus alternifolius* L. and the roots and the leaves of the water hyacinth to inhibit the growth of three species of *Staphylococcus aureus*, *Bacillus subtilis and Escherichia coli.* by using Hexane, dichloromethane, ethanol and methanol as the extraction solvents with maceration process. It is found that the ethanol crude extract from the flowers of Cyperus alternifolius L. could inhibit the growth of *Bacillus subtilis* and the ethanol crude extract from the stems of *Cyperus alternifolius* L. exhibited the highest activity.

The usage of the natural color is basically the decreasing of chemical usage as well as gaining the notion of these different and easy to find in local area plants including red group: sappan (*Caesalpinia sappan L.*) and roselle (*Hibiscus sabdariffa*), yellow group: *Coscinium fenestratum (Goetgh.) Colebr* and the fruit of gardenia (*Gardenia jasminoides* J.Ellis), blue group: butterfly pea (*Clitoria ternatea* L.) and hom (*Strobilanthes cusia (*Nees*)* Kuntze*).* These is used for examining the suitable color value in creating an artwork and being the portion of plants selection which does not destroy the vital organ of each plant. Moreover, the realization of plant advantages will lead to the symbiosis between human and nature, local wisdom, as well as the plant preservation. Likewise, natural color from plants is another alternative which could be recreated the artworks.

2. Materials and methods

2.1 *Solvent*

For comparing the plant colors extracted, two solvents including water (H_2O) and ethanol (C_2H_5OH) are used in ration of 1:5 (plant: solvent).

2.2 *Plant*

These following plants are divided into 3 group as natural colors providing:

Red roselle (*Hibiscus sabdariffa* L.)(fruit)**,** sappan (*Caesalpinia sappan* L.)(stem)
Yellow gardenia (*Gardenia jasminoides* J.Ellis)(fruit)**,** *Coscinium fenestratum* (Goetgh.) Colebr (vine)
Blue butterfly pea (*Clitoria ternatea* L.)(flower)**,** hom (*Strobilanthes cusia* (Nees*)* Kuntze) (brunch and leaf) (firstly fermented by local process before implementing in extraction process)

2.3 Colored paper

For comparing the plant colors forming the durability on the different type of paper, 200-gsm and 300-gsm water colored paper are used to clarify and accomplish the result of this experiment.

2.4 *Plants preparation*

The collected plants will be chopped or grinded and divided into 3 groups as providing colors. Then, the extraction with two solvent including water (H_2O) and ethanol (C_2H_5OH) is implemented respectively. For using water (H_2O) as solvent, 100 g. of plant is boiled with 500 ml. of water (ratio of 1:5) in 100 ℃ for 30 minutes. Then, chilling for 7 days. Lastly, 200 and 300-gsm water colored paper is impregnated by the extracted colors for 5 seconds and aerating for 24 hours. For ethanol (C_2H_5OH), 100 g. of plant is soaked with 500 ml. of ethanol (ratio of 1:5) and collected in the closed container for 7 days. Lastly, 200 and 300-gsm water colored paper is impregnated by the extracted colors for 5 seconds and aerating for 30 minutes.

2.5 *The usage of digital image colorimeter (DIC)*

After the process of aeration, the 200 and 300-gsm water colored paper with the extracted natural color is measured the RGB value [8] (R = Red (255,0,0), G = Green (0,255,0), B = Blue (0,0,255)), hue (0.00 -1.00), saturation (0.00 -1.00), and brightness (0.00 -1.00) by the digital image colorimeter [9]. (protected by a Thailand Petty Patent since 2016 and received silver medal from 45th International Exhibition of Inventions of Geneva, Switzerland, 2017)

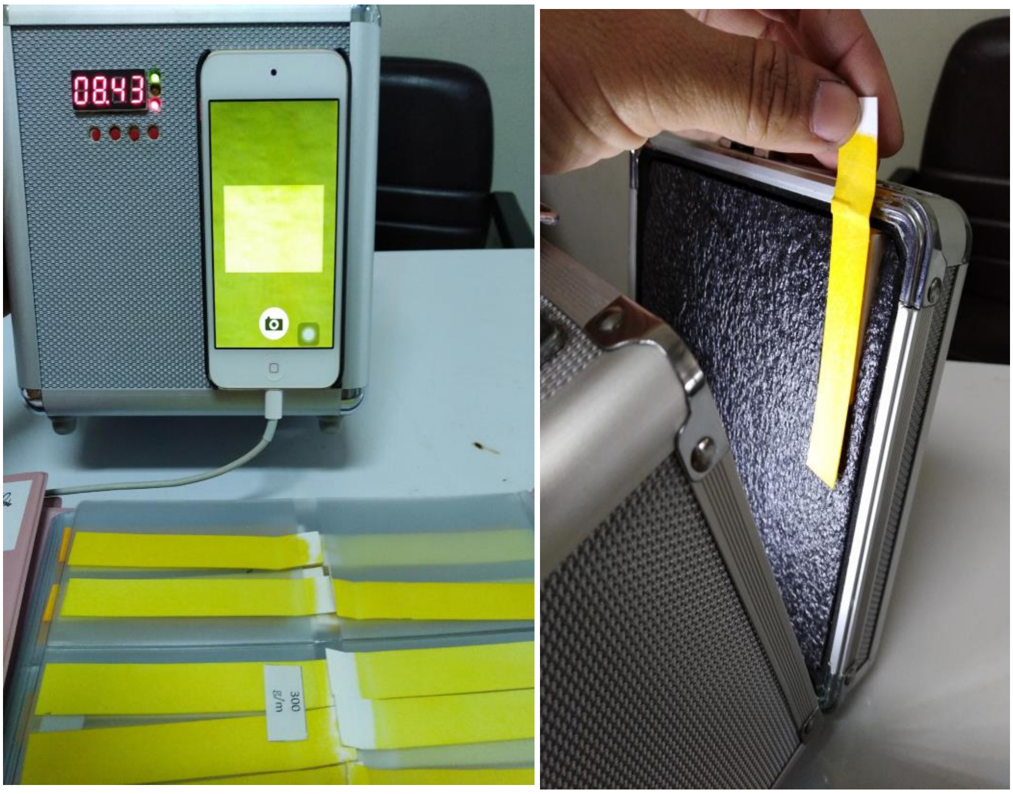


Figure 1 Process in the measurement of color value by digital image colorimeter (DIC).

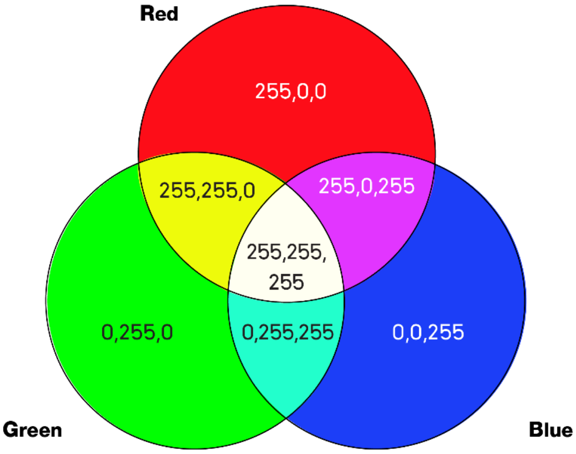
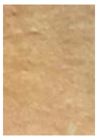
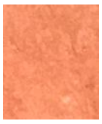


Figure 2 RGB standard values [10].

3. Results and discussion

In Table 1, 2, and 3, the result from the experiment in 3 groups of the color: red, yellow, and blue with the extraction from the plants by different solvent is shown respectively.

Table 1 The color value including hue, saturation, and brightness and RGB value in red group comparing between sappan (*Caesalpinia sappan* L.) and roselle (*Hibiscus sabdariffa* L.).

	Solvent														
		Water (H_2O)							Ethanol (C_2H_5OH)						
Coloring Plant	Paper(*Gsm*)	Color on the paper	R	G	B	Hue	Saturation	Brightness	Color on the paper	R	G	B	Hue	Saturation	Brightness
sappan (*Caesalpinia sappan* L.)	200		0.76	0.75	0.70	0.05	0.34	0.76		0.80	0.67	0.49	0.09	0.38	0.80
	300		0.85	0.60	0.48	0.04	0.56	0.92		0.87	0.59	0.48	0.05	0.43	0.85
roselle (*Hibiscus sabdariffa* L.)	200		0.63	0.51	0.62	0.63	0.10	0.70		0.70	0.68	0.68	0.60	0.02	0.66
	300		0.68	0.69	0.74	0.64	0.09	0.74		0.68	0.69	0.74	0.64	0.08	0.74

According to Table 1, it is found that sappan (*Caesalpinia sappan* L.) extracted by water (H_2O) provides the saturation (0.56) and brightness (0.92) at the highest level on 300-gsm water colored paper. Besides, this also provide the high R value (0.85) on 300-gsm water colored paper which. In contrast, sappan (*Caesalpinia sappan* L.) extracted by ethanol (C_2H_5OH) provides the highest R value (0.87) which demonstrated the highest red value. For Roselle (*Hibiscus sabdariffa* L.) extracted by water (H_2O) and ethanol (C_2H_5OH), the hue (0.64) is shown in the highest level on 300-gsm water colored paper.

Figure 3 Red extracted from sappan (*Caesalpinia sappan* L.) and roselle (*Hibiscus sabdariffa* L.).

Table 2 The color value including hue, saturation, and brightness and RGB value in yellow group comparing between *Coscinium fenestratum* (Goetgh.) Colebr and the fruit of gardenia (*Gardenia jasminoides* J. Ellis).

	Solvent														
		Water (H_2O)							Ethanol (C_2H_5OH)						
Coloring Plant	Paper(*Gsm*)	Color on the paper	R	G	B	Hue	Saturation	Brightness	Color on the paper	R	G	B	Hue	Saturation	Brightness
Coscinium fenestratum (Goetgh.) Colebr	200		0.78	0.79	0.18	0.17	0.52	0.79		0.80	0.81	0.15	0.17	0.81	0.80
	300		0.84	0.80	0.14	0.16	0.83	0.84		0.85	0.73	0.13	0.19	0.84	0.85
fruit of *Gardenia jasminoides* J.Ellis	200		0.86	0.72	0.16	0.13	0.81	0.86		0.86	0.73	0.13	0.14	0.85	0.86
	300		0.90	0.75	0.07	0.13	0.91	0.90		0.91	0.77	0.08	0.13	0.93	0.92

According to Table 2, it is found that the fruit of gardenia (*Gardenia jasminoides* J.Ellis) extracted by ethanol (C_2H_5OH) provides the saturation (0.93) and the brightness (0.92) at the highest level on 300-gsm water colored paper as well as the highest R (0.91) and G (0.77) value which demonstrated the highest yellow value. For *Coscinium fenestratum* (Goetgh.) *Colebr* extracted by ethanol (C_2H_5OH), the hue (0.19) is shown in the highest level on 300-gsm water colored paper.

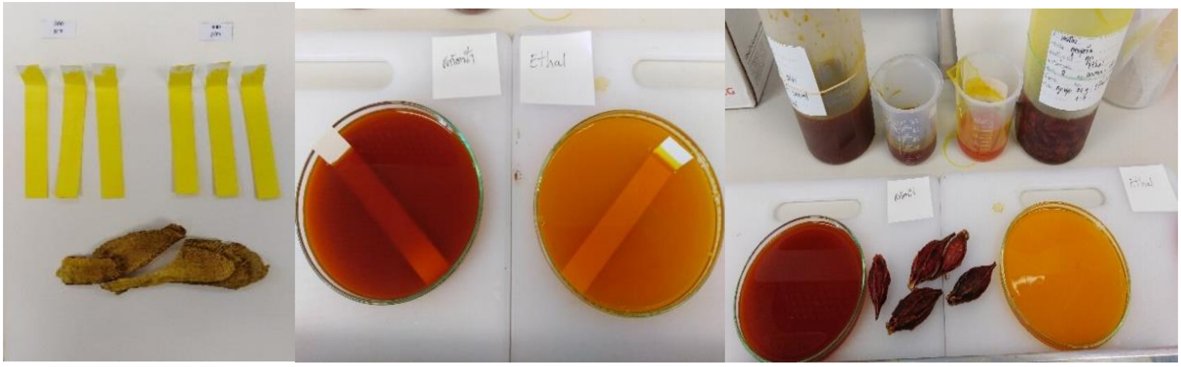
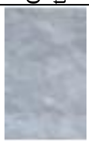
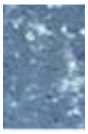


Figure 4 Yellow extracted from *Coscinium fenestratum* (Goetgh.) Colebr and the fruit of gardenia (*Gardenia jasminoides* J.Ellis).

Table 3 The color value including hue, saturation, and brightness and RGB value in blue group comparing between butterfly pea (*Clitoria ternatea* L.) and hom (*Strobilanthes cusia* (Nees) Kuntze).

Coloring Plant	Solvent														
		Water (H_2O)							Ethanol (C_2H_5OH)						
	Paper *(Gsm)*	Color on the paper	R	G	B	Hue	Saturation	Brightness	Color on the paper	R	G	B	Hue	Saturation	Brightness
butterfly pea (*Clitoria ternatea L.*)	200		0.68	0.72	0.74	0.61	0.18	0.77		0.63	0.64	0.75	0.58	0.07	0.75
	300		0.69	0.72	0.77	0.60	0.08	0.75		0.70	0.72	0.79	0.64	0.24	0.80
hom (*Strobilanthes cusia (Nees) Kuntze*)	200		0.45	0.56	0.67	0.57	0.17	0.67		0.60	0.64	0.68	0.58	0.14	0.67
	300		0.60	0.66	0.70	0.58	0.19	0.71		0.61	0.66	0.72	0.57	0.20	0.71

According to Table 2, it is found that butterfly pea (*Clitoria ternatea* L.) extracted by ethanol (C_2H_5OH) provides the hue (0.64), the saturation (0.24) and the brightness (0.80) at the highest level on 300-gsm water colored paper as well as the highest B value (0.79) which demonstrated the highest blue value. For hom (*Strobilanthes cusia* (Nees) *Kuntze)* extracted by ethanol (C_2H_5OH), the hue (0.72) is shown in the highest level on 300-gsm water colored paper.

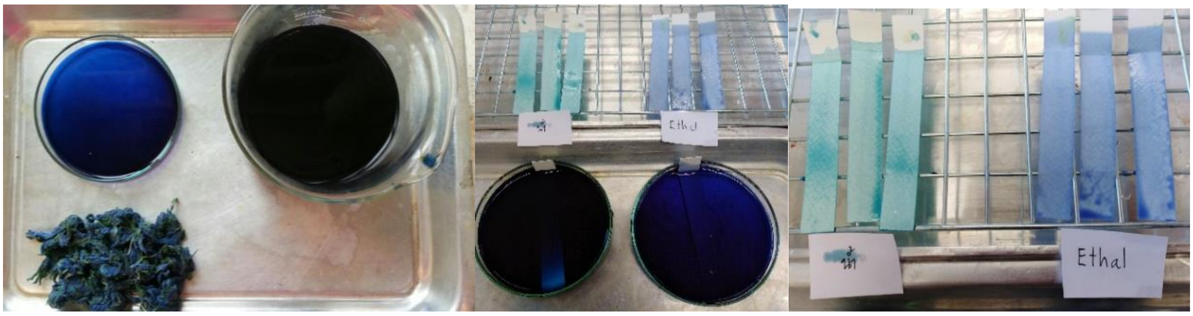


Figure 5 Blue extracted from butterfly pea (*Clitoria ternatea* L.) and hom (*Strobilanthes cusia* (Nees) *Kuntze*).

According to the results of experiment, sappan (*Caesalpinia sappan* L.) extracted by water (H_2O) provides the saturation (0.56) and brightness (0.92) at the highest level on 300-gsm water colored paper, but sappan (*Caesalpinia sappan* L.) extracted by ethanol (C_2H_5OH) provides the highest R value (0.87) which demonstrated the highest red value for the red group. For the yellow group, the fruit of gardenia (*Gardenia jasminoides* J.Ellis) extracted by ethanol (C_2H_5OH) provides the saturation (0.93) and the brightness (0.92) at the highest level on 300-gsm water colored paper as well as the highest R (0.91) and G (0.77) value which demonstrated the highest yellow value. Lastly, butterfly pea (*Clitoria ternatea* L.) extracted by ethanol (C_2H_5OH) provides the hue (0.64), the saturation (0.24) and the brightness (0.80) at the highest level on 300-gsm paper as well as the highest B value (0.79) which demonstrated the highest blue value. As aforementioned results, this reveals that the natural color from plants especially extracted by ethanol (C_2H_5OH) on 300-gsm water colored paper is able to use in artworks. Thus, the researcher uses the experimented color in creating the artworks with these 3-color group: red, yellow, and blue tone respectively.

The use of plant colors to create painting works can be done by painting with a brush on the 300 gsm of colored paper. The natural color can give a good result. With dry, fast, overlapping properties for a more intense color, translucent and watery colors can be used to mix colors extracted from ethanol.

Figure 6 The painting on 300-gsm water colored paper by highlighting on the group of red and comprising of yellow and blue group created by Woraunyu Narongdecha.

Figure 7 The painting on 300-gsm water colored paper by highlighting on the group of yellow and comprising of red and blue group created by Woraunyu Narongdecha.

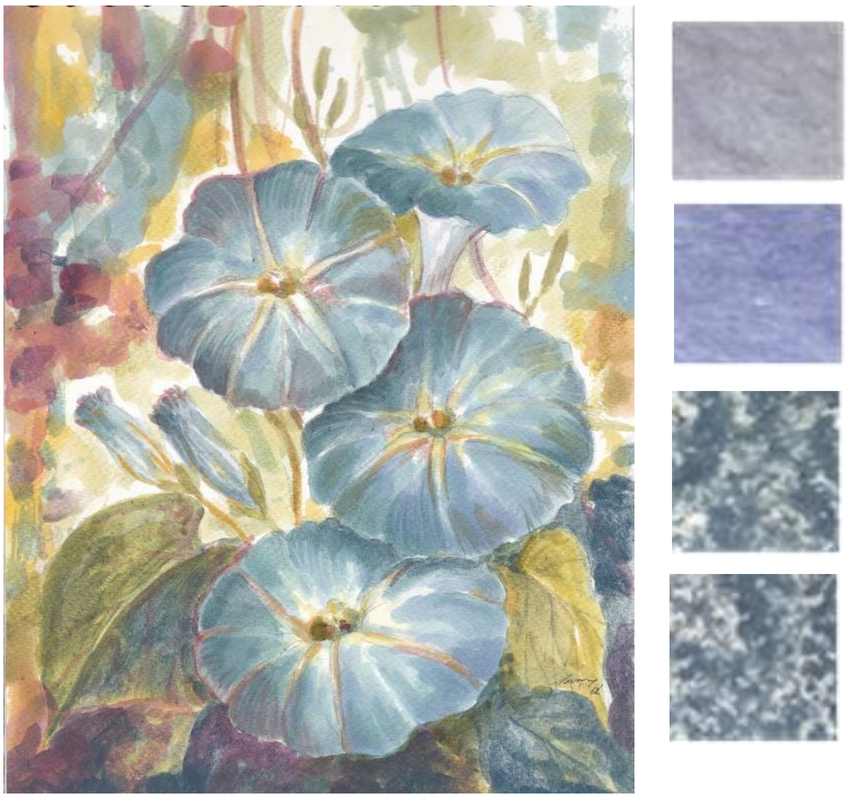


Figure 8 The painting on 300-gsm water colored paper by highlighting on the group of blue and comprising of red and yellow group created by Woraunyu Narongdecha.

Figure 9 Painting equipment consists of round brushes, ceramic palettes, ceramic cups, and plant color storage bottles (opaque bottles) are all used to create painting works.

4. Conclusions

In the creation of an artworks, it is found that the color extracted by ethanol (C_2H_5OH) can be used in painting as well as mixing with water (H_2O) to make the percolation technique effective. The mentioned color can be used in layer to increase the intensity by repainting on the same spot.

Todays, the study of natural color is popular, through the study of the practice of traditional color extraction and the development of color quality in various methods by both Thai and foreign scholars [11]. However, the recently usage of plant color remains limited in term of durability. For printmaking, Mr. Yanawit Kungchaethong creates natural color printing works from tea leaves: *Indigofera tinctoria*, and the natural mordant: honey. The process of this work the reflects, emphasizes and exhorts the human awareness for the current crises, and focuses on the use from the natural products and materials [12]. Besides, this notion is also supported by the work of Yin Y. et al. [13] which mainly concentrate on the extraction of natural colorant anthocyanin from purple sweet potato powder via ultrasound-assisted ammonium sulfate/ethanol aqueous two-phase system. An anti-pollution process can avoid serious conditions in the preparations, which also corresponds with the aim of this study.

The researcher believes that natural plant colors are going to be a suitable alternative; this claim is supported by Avinc O. et al. [14]. In term of eco-friendly approach and the creation of artworks with different patterns, this aforementioned color is easy and safe to use, as well as convenient to experiment with for research purposes. Additionally, the results also confirm the artist's interest regarding the value of art made with various plants because they stimulate the economy of natural resources in local areas. Moreover, exploring new kinds of hues leads to the discovery of color making from the best plants for using in future art painting.

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