

APPLICATION OF ECO-PRINTING ON COTTON FABRIC THROUGH VARIOUS TECHNIQUES

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Abstract

Eco Printing is a modern application of naturally dyeing fabric with plant leaves and flowers. In this study, eco-printing was applied on cotton fabric by use of *Eucalyptus camaldulensis* and *Psidium guajava* leaves. The eco-printing was applied by using four different techniques such as steaming, boiling, solar dyeing and heat press. The fabric was pre-mordant with alum, ferrous oxide and madder mordents. The result of these four techniques was evaluated by close-ended questionnaire. The result of steaming with alum mordant showed dark green with detailed printed veins of leaves with *Psidium guajava* and back of this leaf also showed dark green outline of a leaf while result of *Eucalyptus camaldulensis* showed faded colour. The steaming with Ferrous oxide mordant, showed black outlines of leaves with fading colors. The steaming with alum and Ferrous oxide showed dark green outlines of both these leaves. It was also inferred that pale colors which bled outside the outlines of leaf prints. The boiling techniques showed clear and light tones of equal red shades of leaves with detailed prints of leaves with proper outline. The solar dyeing techniques, showed light shades of faded pink with light outlines of leaves were with this technique but didn't have deeper prints of leaves. The heat press techniques, showed only veins and outlines of leaves while the color of the leaves was faded.

Key words: Eco Printing, *Eucalyptus camaldulensis*, Mordants, *Psidium guajava* .

Introduction

Eco printing is a modern application of natural dyeing. In eco printing, plants are enclosed in textiles or paper, bundled by winding over rods or stacked in layers, and then steamed or immersed in hot water to extract the pigments and produce a print made with plant dyes. There are also other ways to extract pigments from plants leaves and flowers to make beautiful prints on cellulosic fibers (Feldberg, 2014).

The importance of this research is that eco-printing can be used in a variety of art forms, such as wall hangings or tapestry, garments such as Scarves. Eco printing research assists in identifying which processes produce more attractive and long-lasting prints. Eco printing techniques can be used in the renovation of old clothes such as dupatta, old simple dupatta can be used in this process to make it more beautiful. This experimental research will also help people with health

issues, people who are dealing with skin allergies and can't wear chemically printed garments (Zhang, 2013).

A variety of different metals affect the color or intensity of the prints. When used in dyeing, these are referred to as "mordants." Mordant, which comes from the Latin phrase "to bite," opens up the fibers of the fabric or paper, allowing the dye to last longer after washing and exposure to light. When metal salts are injected, however, there is some debate about whether the process can still be called "eco." Some people choose to call the practice printing with botanicals, nature printing, or "printing with leaves" to avoid the dispute but in the end, it is the same thing. The difference between nature printing on paper and nature printing on cloth is minimal. Prints of plants can be made without any mordants, although pre-mordanting with alum or Ferrous can improve the results of prints and make them more long-lasting and doesn't wash away fast. Natural fibers should be the only fabrics that can be printed on. Most dyes available at home will not work on man-made fabric, they are manufactured from petroleum compounds. Cotton, rayon, and bamboo are all great options. Wool is a fantastic cloth for printing. When most environmental printers try it, silk quickly becomes their preferred fabric. Even bad designs with no identifiable leaf shapes seem lovely on silk, because of the natural color's subtle markings. Not all leaves leave a good print and not all the fabric has the same effect as print. This method involves a lot of trial and error, figuring out which of the local leaves work and which don't. Years of practice

and then practicing with the mordant can make a big impact. There are some effects that create lovely anti-prints with others that are leaving only the dye effect and refuse to take any color from the dye pot which is a great thing because most of the printing gets dull because of the pot colors left on fabric (Adams, 2018).

Over time, the history of how this technology was found has been lost. While it is most likely that it has been practiced as an artisan skill for thousands of years, we can trace its existence back to the Middle Ages as a more formal procedure. Herbalism, reproduction catalog, and plant classification emerged as a result of a greater interest in science and better organization at the time (Tondro, 2013).

The inked plant produces the print as opposed to an artist making strains on paper or fabric aside from the specimen, eco printing or botanical printing is every now and then additionally referred to as self-printing too. Because of its sustainability, inexperienced chemistry, environment-friendly, and ecological strategies, natural printing is becoming increasingly popular. Herbal and natural dyes are treasured for coloring textiles and have ancient, cultural, and monetary value still important today. Up till the middle of the nineteenth century, herbal dyes were the primary colors that were accessible to everybody for textile dyeing and printing operations (Jeon, 2018).

The uses of herbal and natural dyes for textile dyeing nearly absolutely disappeared with the development of artificial dyes which were cheaper and made textile operations faster but they are harmful. Waste from flora plant

along with fallen leaves of autumn on road or fallen or dried flora flowers petals and pulps of myriad end results and vegetables and fruit's outer waste, most of these plants, vegetables, and fruits consist natural pigment which can be used to extract the natural dyes and make prints on natural cellulosic fabrics or even paper (Flannery, 2017).

The nature print layout was turned into advanced by means of Benjamin Franklin, to be used on designing of Pennsylvania currency, a long time earlier than the yank revolution. Creator and print history expert Roderick Cave have explored the history of nature printing, the call for a way that makes use of the floor of a herbal item – including a leaf, bark or even insects, to provide a print. This exercise was turned into advanced within the center for a long time to help those who accumulated medicinal flowers and evolved right into a revolutionary clinical technique used to breed plant life and build collections of flora and fauna plants. At some stage in the nineteenth century, the technique of eco printing drew on a new photographic era, and these days this lengthy-status art shape continued to hobby everybody such as a botanist, printmakers, and tattoo artists (Cave, 2010).

Wool, silk and cotton fabrics are selected for eco printing because flavonoids and tannins, which are components of *Eucalyptus camaldulensis* leaves, have an excellent dyeing effect when printing on animal fibers. The leaves remaining after dyeing are dried and used as a dried flower, and the fragrance of *Eucalyptus camaldulensis* can have insecticidal and insect-preventing effects.

The stem can be boiled and reused as a dye solution, which is a raw material for dyeing. When mordant, blood red, and methyl orange used as natural dyes are mordant with iron extract, purple and red colors can be obtained depending on the amount of dye (Jeong, 2017).

The fact is that when mordant is used before water boiling” (in hot rolled eco-printing) increased the color and shape of printing effect (Oyman *et al.*, 2017). The substances which are added as dyer to the textile are called mordants (Red and Menet, 2008).

Color strength and chromaticity coordinates vary significantly depending on three different mordanting methods and mordant type. However, in ecological printing techniques, mordanting method is generally applied first. Mordanting is performed to keep the dyes on the fabric longer or to change the colors (İşmal *et al.*, 2019). Each mordant produces different dye complexes leading to completely different colors and fastness properties. Mordant can be applied in three ways: before, during and after dyeing. Bonding between the fabric and the dye is taken place with the mordant process so that the dye can be hold onto the fabric (Karadağ, 2007). Mordanting increases the affinity between the dye and the textile surface, thus wise, more vivid colors, better fastness and wider color spectra can be obtained (Kadolph *et al.*, 2013). The objective of this study is to impart eco-printing on cotton fabric by use of different leaves of *Eucalyptus camaldulensis* and *Psidium Guajava*.

Methodology

The study employed true experimental research and close ended questionnaire survey. In this study, two independent variables were studied, the one was fabric 100% cotton and the other was leaves of *Eucalyptus camaldulensis* and *Psidium Guajava*.

Research design

This study was based on quantitative research. The various techniques of eco printing was applied on cotton fabric and result was evaluated with close ended questionnaire based on observation of samples. All samples of eco printing techniques was pasted on two chart papers and students filled the questionnaire by observing the sample which were pasted on chart paper. Their preference of choosing best pint of leaves rating from excellent, good, average, below average and poor in eco-printing. The survey was filled by students of 20 to 25 age group from Home Economic Departments.

The population of this study was *Eucalyptus camaldulensis*, there are over 750 species in the genus *Eucalyptus camaldulensis* and the sample used in this study was *Eucalyptus camaldulensis* which belongs to the family of *Eucalyptus camaldulensis* found in Himalayan areas of Pakistan. *Psidium guajava* have 30 types of species such as *Psidium Cattleyanum*, *Psidium guajava*, *Feijoa sellowiana* and the sample used in this study was *Psidium guajava* (*Psidium guajava*). Cotton was split into three categories, light Weight -up to 200 GSM, medium Weight Cotton – 200-400 GSM, heavy Weight – 400+ GSM and the sample used in

this study was light weight cotton with 160 GSM.

Total 60 questionnaires were filled from Social Sciences Block of Lahore College for Women University. It was based on purposing sampling in which 30 students of semester 6 and 30 students from semester 8 were selected from department of home economics with preference of clothing and textiles discipline.

Sample

The sample used for experiment were leaves of *Eucalyptus camaldulensis* and *Psidium guajava* and 100% cotton fabric of warp 30 and weft 43 with 160 GSM purchased from Azam Market, Lahore.

Sampling Strategy

In this study, experimental research was conducted and then evaluated the result based on the purpose sampling. The data was collected through questioner from 60 students from department of Home Economics of LCWU. The instrument used was a survey questionnaire to gather needed data. Close end options were provided in questionnaire.

Appendix

Questionnaire: Various Techniques of Eco Printing on Cotton Fabric
 Dear participants,
 I am student of BS Home Economics (4th-year) at LAHORE COLLEGE FOR WOMEN UNIVERSITY. I am conducting research on the topic Various Techniques of Eco Printing on Cotton Fabric. Data of this survey will be used purely for academic purpose and will be kept confidential
 Thank you for your time and decision to participate

Name: _____
 Age: _____
 Class: _____

Please rate each sample on a scale of 1-5 according to the best result. Rate the following statements as 5= Poor, 4= Below Average, 3= Average, 2= Good, 1=Excellent

	Excellent	Good	Average	Below Average	Poor
Steaming Technique:	1	2	3	4	5
Sample 1 - Alum					
Sample 2 - Iron					
Sample 3 - Alum + Iron					

	1	2	3	4	5
Boling Technique:					
Sample 1 - Roll + Boil					

Sample Size

In this study, the sample size taken for experimentation was seven pieces of 8 by 10-inch cotton fabric and 60 close ended responses from students of department of home economics of Lahore College for Women University.

Variables and Measures

In this study, two variables were used in this experiment are cotton fabric and leaves of *Eucalyptus camaldulensis*, *Psidium guajava*.

Mordants

Alum, ferrous oxide, cream of tartar & madder was used for color fixation. Iron, Alum, & cream of tartar was used as mordants for preparing the fabric before the procedure so that it can preserve the print of leaves. Madder was used in this process for preparing fabric and plants before the procedure to get even mulberry or light turkey red prints on fabric.

Data Collection Instrument

Three techniques samples of fabric were pre-mordant by soaking for 1 hours in mordant solution before rolling with plants because the fabric has no ability to observe natural pigments from plants so treatment must be needed before doing the procedure. In the last sample, only plants are being dipped in mordant for 5 minutes. After that, plant parts are decorated on the surface and rolled by fastening on a smooth roller-shaped material. But it was tightly wrapped so that the plant was in full contact with the fabric. Five fixation methods used in this process was.

Five fixation ways that will be conducted:

- **Direct boiling in water-** Fabric Roll boils in water directly.
- **Non-contact boiling in water-** Fabric Roll was steamed in a steamer
- **Heating Press-** Direct heat from the Ferrous was applied to the fabric.
- **Rolling technique-** Fabric Bundle rolled on the smooth surface back and forth.
- **Solar Dying-** Prepared fabric roll placed in a sun for 3 days.

Procedure

Steaming

Alum

Took cotton fabric of size 8 x 10 inches. Measured 600 ml of water in a beaker. Boil water until boiling stage. Took Alum 30 gm and add it in the boiling water. Let alum dissolved in water completely. Then put fabric in boiling water for 10 minutes. Turned off the burner and let the fabric rest in it for 2 hours. After 2 hours took the fabric out from Alum mordant and rinse it with water. Now laid the fabric flat and place leaves of *Psidium guajava* and *Eucalyptus camaldulensis* in arrangement. Took a metal rod and roll the fabric into bundle and place a plastic wrap while rolling and tie it tightly with thread. Now steamed it for 15 minutes. After steaming took out the bundle and let it cool. After cooling unrolled the bundle and placed it to dry in open air.

Ferrous Oxide

Took Ferrous oxide 5 gm and added it in 600ml the water. Then added *Psidium guajava* and *Eucalyptus camaldulensis* leaves in Ferrous mordant for 1 Hour. Rinsed the fabric in fresh water to remove any unwanted

finish and let it dry. Now laid the fabric flat and place leaves of *Psidium guajava* and *Eucalyptus camaldulensis* in arrangement. Took a metal rod and roll the fabric into bundle and placed a plastic wrap while rolling and tie it tightly with thread. After steaming for 1 hour took out the bundle and let it cool. After cooling unroll the bundle and placed it to dry in open air.

Alum & Ferrous Oxide

Took Alum 30 gm and added it in the 600ml boiling water. After 2 hours took the fabric out from Alum mordant and rinse it under fresh water. Then added *Psidium guajava* and *Eucalyptus camaldulensis* leaves in 5gm Ferrous mordant in 600ml water for 1 Hour. After mordanting leaves and fabric, now laid the fabric flat and place leaves of *Psidium guajava* and *Eucalyptus camaldulensis* in arrangement. Took a metal rod and roll the fabric into bundle and place a plastic wrap while rolling and tie it tightly with thread. After steaming for 1 hour took out the bundle and let it cool.

Boiling

Roll and Boil & Rolling & Boil

Took cotton fabric of size 8 x 10 inches. Measured 250 ml of water in a beaker. Added 3 tbsp of madder & 1gm of ferrous oxide in water. Dipped leaves in madder and Ferrous mordant for 2 hours. In another beaker measured 700 ml of water. Boiled water until boiling stage. Took Alum 30 gm and added it in the boiling water. Let alum dissolved in water completely. Then added fabric in boiling water for 10 minutes. Turned off the burner and let the fabric rest in it for 2 hours. After 2 hours took

the fabric out from Alum mordant and rinsed it under fresh water. Took out leaves from mordant and removed excess water from leaves with a tissue paper. After mordanting leaves and fabric, now laid the fabric flat and place leaves of *Psidium guajava* and *Eucalyptus camaldulensis* in arrangement. Took a metal rod and roll the fabric into bundle and placed a plastic wrap while rolling and tied it tightly with thread. Now rolled the bundle on a plain surface back and forth thoroughly for 10 – 15 minutes. Now boiled it for 1 hour in water. After boiling took out the bundle and let it cooled. After cooling unrolled the bundle and placed it to dry in open air. For boiling and rolling technique, rolled the bundle on a plain surface back and forth thoroughly for 10 – 15 minutes after taking boiling. Unrolled the bundle and placed it to dry in open air.

Solar dying

Cream of tartar & Alum

Took Alum 30 gm and added it in the 700 ml boiling water. Let alum dissolved in water completely. Then added fabric in boiling water for 10 minutes. Turned off the burner and add 1 table spoon cream of tartar in water and then let the fabric rest in it for 1 hour. After 1 hours took fabric out from Alum and cream of tartar mordant and rinsed it under fresh water. Took a metal rod and rolled the fabric into bundle and placed a plastic wrap while rolling and tie it tightly with thread. After steaming for 15 took out the bundle and let it cooled and placed the bundle in direct sunlight for 3 days.

Heat Pressing

Rinsed fabric in fresh water to remove any unwanted finish and let it dried. Now laid

the fabric flat and place leaves of *Psidium guajava* and *Eucalyptus camaldulensis* in arrangement. Now sprayed fabric with water on both sides iron again. Kept on ironing again until leaves start to show shape stains. After ironing sprayed the fabric until fabric becomes wet and let it rest overnight. Next morning sprayed fabric again with water and ironed the fabric thoroughly for 15 minutes on both sides. After leaves left a print on fabric open the fabric and removed the leaves.

Data Analysis

After applying eco printing techniques, the questionnaire was developed based on close ended questions and made four parts, steaming, boiling, solar dying and heat press. The questionnaires were based on rating the best print from seven technique that was applied and students rated by choosing excellent, good, average, below average and poor. Then the results filled by student in questionnaire was added in SPSS and the result was interpreted in pie graph.

Results and Discussion

This chapter deals with the experimental research on eco printing by using the leaves of *Eucalyptus camaldulensis* and *Psidium guajava* and evaluating the results of prints of leaves by giving a questionnaires and rating prints of leaves from excellent, average, below average and poor, and evaluating the result through pie chart after collecting data from students of LCWU.

In **figure 1** showed the result *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with steaming technique with alum mordant. The results of

Psidium guajava were dark green print with detailed printed veins of leaves and back of *Psidium guajava* leaf also gave result of dark green outline of leaf while result of *Eucalyptus camaldulensis* leaves from front and back very faded.

a *Psidium guajava* leaf

b *Eucalyptus camaldulensis* leaf

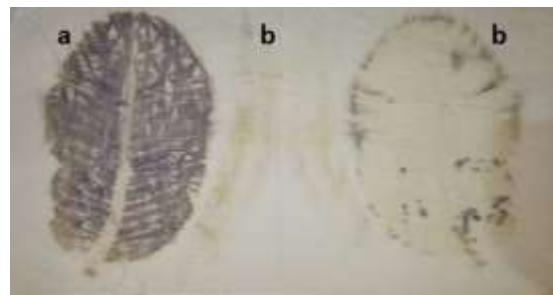


Figure 1: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Alum Mordant

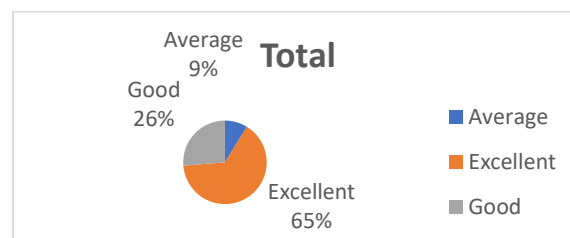


Figure 2: Result of Alum Mordant with Steaming Technique

Figure 2 showed that, students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaf as 65% Excellent result, 26% good and 9% average of Alum mordant sample through steaming process. It was concluded that there was significant effect of applying and evaluating eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using steaming technique with alum mordant.

Figure 3 showed the result *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with steaming technique with Ferrous mordant. Black outlines of leaves of *Eucalyptus camaldulensis* and

Psidium guajava with fading colors of *Eucalyptus camaldulensis* and *Psidium guajava* on cotton fabric were observed.

a *Psidium guajava* leaf

b *Eucalyptus camaldulensis* leaf

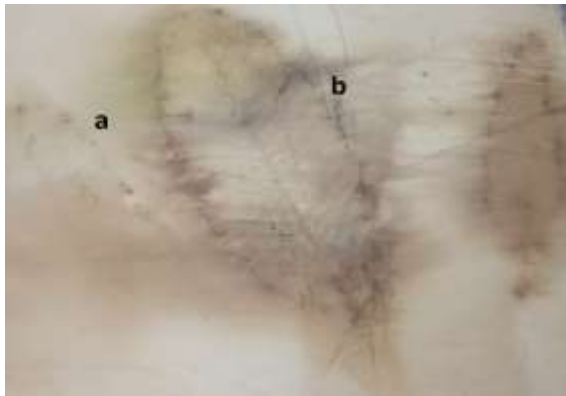


Figure 2: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Ferrous Oxide Mordant

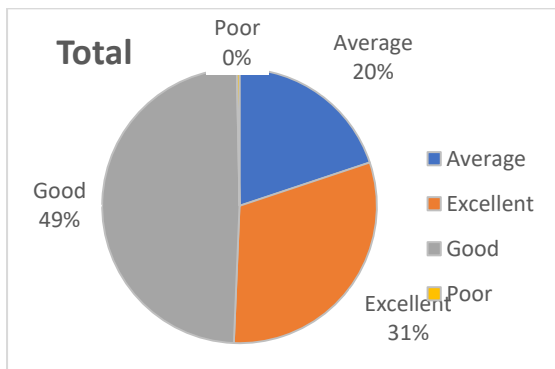


Figure 3: Result of Ferrous Mordant with Steaming Technique

Figure 4 illustrated that, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaves as 49% Good result, 31% Excellent, 20% Average and 1% Poor of Ferrous oxide mordant sample through steaming process. It was inferred that significant effect of applying and evaluating eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using steaming technique with Ferrous mordant.

Figure 5 showed the result *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with steaming technique with alum and ferrous oxide mordant. It was concluded that dark green outlines of *Eucalyptus camaldulensis* and *Psidium guajava* leaves. *Eucalyptus camaldulensis* and *Psidium guajava* have pale while colors were bleeding outside the outlines of leaf prints onto cotton fabric.

a *Eucalyptus camaldulensis* leaf

b *Psidium guajava* leaf

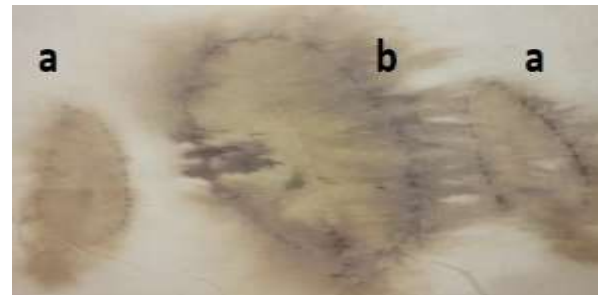


Figure 4: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Alum & Ferrous Oxide Mordant

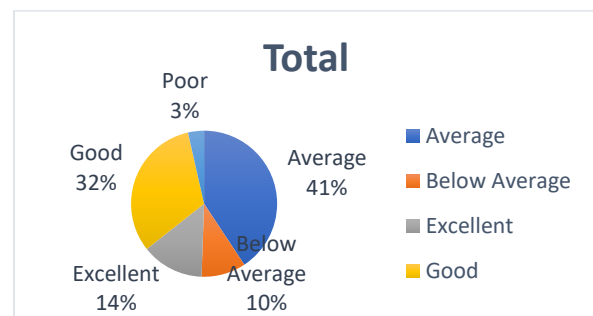


Figure 5: Result of Alum & Ferrous oxide Mordant with Steaming Technique

According to **Figure 6**, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leave as 41% Average, 32% Good result, 14% Excellent, 10% Below Average and 4% Poor of Alum & Ferrous Oxide mordant sample through steaming process. It was concluded that there was significant effect of applying and

evaluating eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using steaming technique with alum and Ferrous oxide mordant.

In **figure 7** showed the effect of *Eucalyptus camaldulensis* and *Psidium guajava* leaves used with rolling technique & then was boiled by using Madder Mordant. It was observed that clear and light tones of equal red shades of leaves with detailed prints of leaves of *Psidium guajava* and proper outline and colors of *Eucalyptus camaldulensis* leaves.

a *Eucalyptus camaldulensis* leaf

b *Psidium guajava* leaf

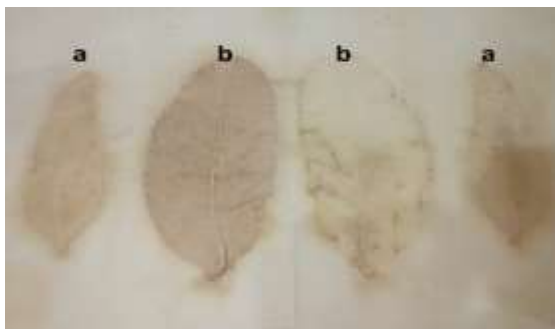


Figure 6: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Rolling & Boiling Mordant

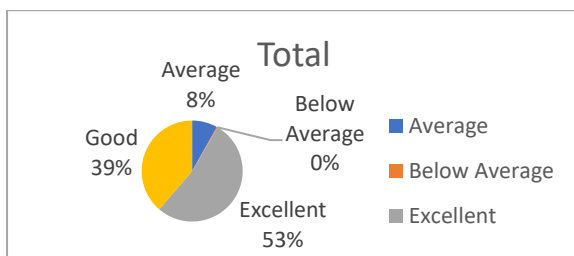


Figure 7: Result of Rolling & Boiling with Boiling technique

Figure 8 showed that, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaf as 53% Excellent, 39% Good, 8% Average and 1% Below Average of Rolling and then Boiling technique. The result showed that there is significance effect of applying and evaluating

eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using rolling and boiling technique with madder mordant.

In **figure 9** showed the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with boiling technique & then rolling by using Madder Mordant. The result showed clear and light tones of equal light red shades of leaves with detailed prints of leaves of *Psidium guajava* and proper outline and colors of *Eucalyptus camaldulensis* leaves.

a *Eucalyptus camaldulensis* leaf

b *Psidium guajava* leaf

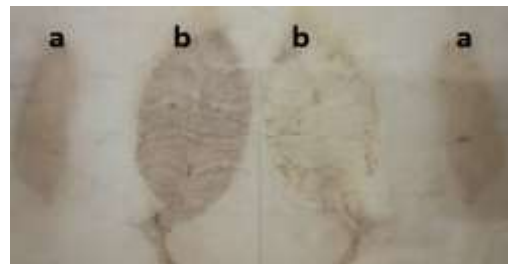


Figure 8: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Boiling & Rolling Mordant

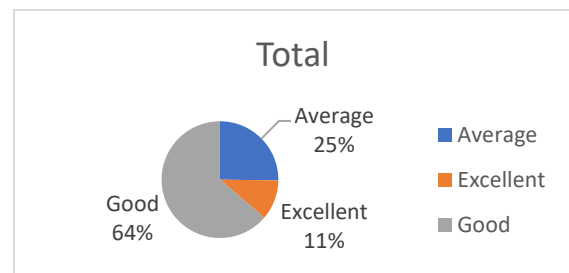


Figure 9: Result of Boiling & Rolling with Boiling technique

Figure 10 showed that, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaf as 64% Good, 11% Excellent, 25% Average of Boiling and then Rolling technique. The result showed that there is significance effect of applying and evaluating eco printing of leaves

of *Eucalyptus camaldulensis* and *Psidium guajava* by using boiling and rolling technique with madder mordant.

In **figure 11** showed the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with solar dying techniques with Alum and cream of tartar mordants. The result showed clear and light tones of equal light red shades of leaves with detailed prints of leaves of *Psidium guajava* and proper outline and colors of *Eucalyptus camaldulensis* leaves. The result showed light shades of faded pink with light outlines of *Eucalyptus camaldulensis* and *Psidium guajava* leaves were achieved with this technique but didn't have deeper prints of leaves with alum and cream of tartar as a mordant.

a *Eucalyptus camaldulensis* leaf

b *Psidium guajava* leaf

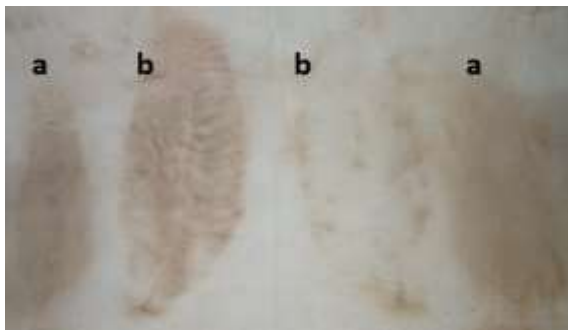


Figure 10: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Solar Dying Technique

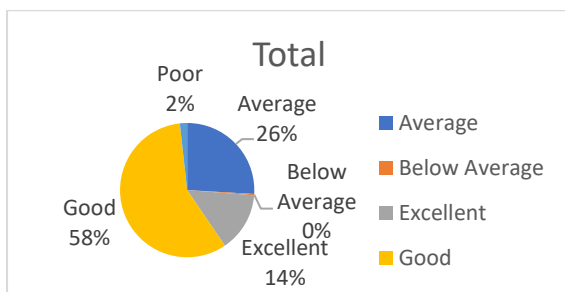


Figure 11: Result of Solar Dying technique

Figure 12 showed that, majority of students considered the result of *Eucalyptus*

camaldulensis and *Psidium guajava* leave as 58% Good, 14% Excellent, 26% Average, 1% Below Average and 2% Poor of Solar Dying technique. The result showed that there is significance effect of applying and evaluating eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using solar dying technique with alum and cream of tartar mordant.

In **figure 13** showed the result of *Eucalyptus camaldulensis* and *Psidium guajava* leaves used in the experimenting with heat press techniques. The result showed only veins and outlines of leaves of *Psidium guajava* and *Eucalyptus camaldulensis* while the color of the leaves was faded and in this experimental technique no mordant was used.

a *Psidium guajava* leaf

b *Eucalyptus camaldulensis* leaf

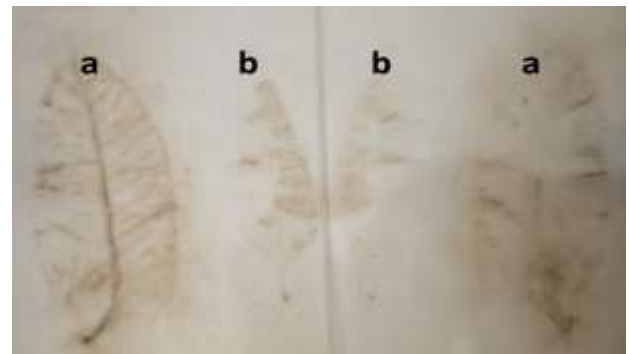


Figure 12: Leaves of *Eucalyptus camaldulensis* and *Psidium guajava* with Heat Press Technique

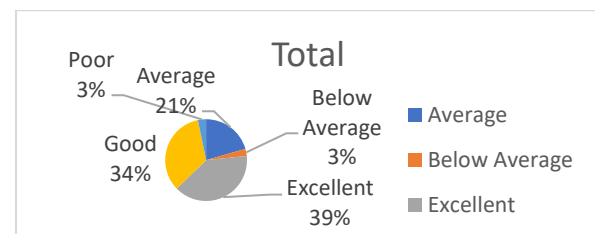


Figure 13: Result of Heat Press technique

Figure 14 showed that, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leave as

39% Excellent, 34% Good, 21% Average, 3% Below Average and 3% Poor of Solar Dying technique. The result showed that there is significance effect of applying and evaluating eco printing of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using heat press technique.

Comparison

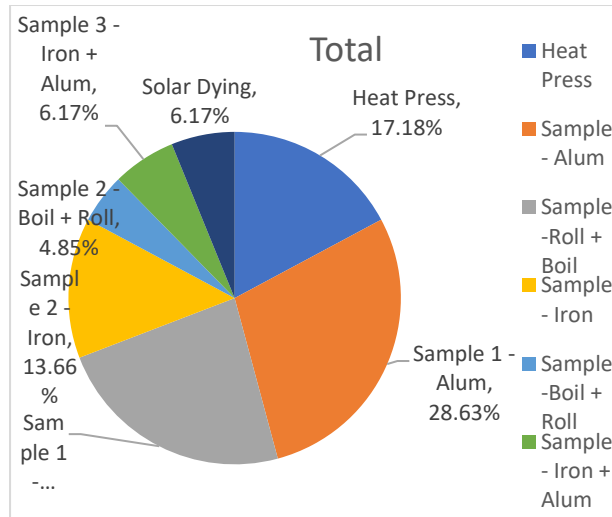


Figure 14: Comparison of all eco printing techniques

Figure 15 showed that, majority of students considered the result of *Eucalyptus camaldulensis* and *Psidium guajava* leave as an excellent with 29% of alum mordant steaming technique. Then rolling and boiling technique as good with 23%. Result of heat press technique was considered as an average with 17% and steaming technique with Ferrous mordant was considered as an average with 14%. Solar dying and steaming technique with Ferrous & alum mordant was considered below average with 6%. And the results of boiling and rolling technique was considered as poor with 5%. All result showed that there is significance effect of applying and evaluating eco printing

of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* by using various techniques.

Discussion

This chapter deals with the discussion and conclusion. Discussion was written by comparison of the previous researches' pictures in contrast to current study results picture. Eco printing with leaves of *Eucalyptus camaldulensis* and *Psidium guajava* was applied on cotton fabric by steaming, boiling, solar dying and by heat press techniques. The result was evaluated by filling the questionnaire based on two chart paper which have the pictures of all seven techniques



Figure 16: Eco printing with alum mordant

Figure 16.a showed the results of leaves of *Psidium Guajava*. This study showed that the process undergoes with scouring, then the fabric soaked in TRO and rinsed in clean water, lastly fabric is mordant with alum and soda ash. **Figure 16.a** showed darker and detailed results of leaves veins. The method used in this research is similar to this experiment research of **figure 16.b**. Steaming technique with alum mordant, but eliminating soda ash and TRO, the fabric was inserted into boiling water of Alum mordant but was soaked for 1 hour rather than 8-12 hours (Mardiana, 2020). **Figure 16.b** shows that result of current study was similar to previous study. Both

results showed darker and detailed results of *Psidium guajava* leaves veins and support the study of Mardiana.



Figure 17: *Eucalyptus camaldulensis* with Ferrous oxide mordant

Figure 17.a showed that in this study *Eucalyptus camaldulensis* leaves were used with similar method of steaming with Ferrous mordant and gave results by producing black outlines of leaves (Feldberg, 2013). **Figure 17.b** shows similar results given in **figure 17.a** and support the study of Feldberg, in this research by producing black outlines of leaves of *Eucalyptus camaldulensis* and *Psidium guajava* but in **figure 17.b** there is also fading of colors of *Eucalyptus camaldulensis* and *Psidium guajava* on the cotton fabric.



Figure 18: *Eucalyptus camaldulensis* with alum and Ferrous oxide mordant

Figure 18.a showed that, alum and Ferrous mordant is being used in this experimental research with the steaming technique, the results shows that alum has brought out oranges and yellows from the

Eucalyptus camaldulensis leaves, while the Ferrous has gave more depth and detail on cotton pieces (Upshall, 2017) **figure 18.b.** showed the results of this experiment, *Eucalyptus camaldulensis* and *Psidium guajava* have pale, and faded prints of leaves of *Eucalyptus camaldulensis*.



Figure 19: Eco printing with *Eucalyptus camaldulensis* madder mordant

Figure 19.a showed the eco printing with madder, in this technique madder is used on fabric before applying leaves and using Ferrous with leaves as a mordant to darken the results of prints. The result showed reds which were quite ‘saddened’ in this result where the Ferrous solution was a bit too strong. There are still red undertones and a gold resist that are captured in such shapes (Barb, 2019). In **figure 19.b** showed the result of this experiment, the result was clear and had light tones of equal red shades of leaves with detailed prints of leaves of *Psidium guajava* and outline of *Eucalyptus camaldulensis* leaves in both samples of boiling techniques and support the study of Barb.



Figure 20: Eco printing with heat press technique

In **figure 20.a** it was shown that eco printing with the heat press technique. The preparation for heat press technique requires layering the fabric with more wet fabric such as Teflon. Heat press had its own station, protected by plastic and rolled towels to keep the excess moisture at bay. Vodka was used as a mordant and the result in figure 20.a also showed that leaves were printed well but most areas were left with only dull smudges (Suyatno, 2021). **Figure 20.b** showed the result of this experiment, the results showed only veins and outlines of leaves of *Psidium guajava* and *Eucalyptus camaldulensis* while the color of the leaves were faded and in this experimental technique no mordant was used and support the study of Suyatno.

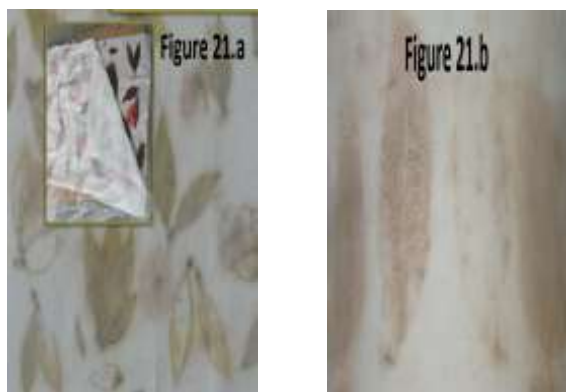


Figure 21: *Eucalyptus camaldulensis* with solar dyeing technique

Figure 21.a showed the result of *Eucalyptus camaldulensis* on mercerized cotton cloth. Folded damp fabric over impatiens, covered with plastic and solar dye for a few days. The result showed light prints of leaves and leaves print with light brown outlines from the back of leaves as it was folded in half and no mordant was used in this research (Sherry, 2011). In **figure 21.b** showed the result of this experiment, light shades of pink with same outline were achieved with this technique but didn't show deeper prints of leaves and alum and cream of tartar was used in this experiment as a mordant and support the study of Sherry.

Conclusion

To conclude this topic 'Eco-Printing', is the study of nature and its properties and how to make a good use of them in a piece of art. After experimenting different plants leaves and flowers, good results of guava leaves were achieved. The best prints of leaves were achieved in Alum mordant steaming techniques, it was inferred that guava had dark green print with detailed printed veins of leaves and back of guava leaf. The best result of leaves was also achieved in boiling techniques the result showed clear and light tones of equal red shades of leaves with detailed prints of leaves of guava and proper outline and colors of eucalyptus leaves. While other results were not vigorous and up to satisfaction. Practicing and doing research on mordants and types of plants can give the best results and prints of plants.

Conflict of interest

Authors declare no conflict of interest.

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