Sustainable Art Practices: Harnessing Ketapang Leaves Extract for Natural Dyeing and Collage

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ABSTRACT

The health and well-being of artists can be significantly jeopardized using synthetic colourants in visual arts. Negative health and environmental consequences may result from the hazardous compounds present in certain paintings, including acrylics, oils, and watercolours. This study aimed to create artworks which included sustainable Ketapang leaf colors developed through boiling water extraction processes. The extraction occurred in distilled water at boiling temperature for 30 minutes using a solution ratio of 1:20. The fabrics consisted of cotton, linen, viscose, and satin silk experienced 30-minute immersion within the eco-colorant extract solution after receiving 5–10% (owf) alum and tunjung pre- or meta-mordanting treatment. The dyeing processes took place at liquor ratios which were 1:20 and 1:40. Subsequently, the fabrics that had been dyed were visually inspected to determine the colors they had produced and their suitability for collage-making. One intriguing finding from this study is that different mordants produced different colors when applied to the extracted eco-colorants, even though they all originate from the same source. Fabrics treated with tunjung before washing often turned-out deeper shades than those treated with alum. The final collage artwork was created after the collected information was analyzed and put into action. The effectiveness, on the other hand, may be contingent on the knowledge, skills, and capabilities required to create collage artwork products by dyeing fabric with eco- colorants extracted from Ketapang leaves. The findings of this research demonstrate that eco-colorants extracted from plant sources show promise for use in art production so more thorough investigations into this potential should be made.

Keywords: Ketapang leaves, eco-colorant, extraction, mordant, collage.

INTRODUCTION

Many countries have begun to regulate synthetic colorants in response to growing concerns about their potential toxicity and allergic reactions. As a result, natural dyes, often known as eco-colorants, have increased in popularity among eco-conscious consumers. Ljiljana Damjanović et al. (2015) identifies heavy metals in various colorants that artists used for traditional pastels and paintings. The list of heavy metals consists of antimony alongside barium and cadmium while chromium joins cobalt and copper together with lead and manganese as well as strontium and zinc. Research indicates that these metals trigger different kinds of malignancies and health disorders which target the skin as well as kidneys liver lungs and heart. During the 1970s and 1980s, artists heightened their awareness of the potential health hazards associated with the materials they utilized. The Federal Hazardous Substances Act was amended in 1988 by Congress with the passage of the Labeling of Hazardous Art Materials Act (Krieger & Higgins, 2022). Arts and crafts product labels were mandated to include a list of known chronic hazard ingredients along with the appropriate hazard warnings (Annisa, 2024). This has led to a dramatic increase in the demand for eco-colorants among textile dyers and artists.

In accordance with Toprak and Anis (2017), environmentally friendly colorants do not produce any waste. Eco-colorants can be produced using natural sources that are both sustainable and renewable. These natural sources include plants (such as indigo and woad), insects and invertebrates (such as cochineal and kermes), and microorganisms (such as bacteria, fungus, algae, and actinomycetes) (Jabbar et al., 2022).

The global environment is becoming increasingly susceptible to a wide range of ecological dangers as a result of the progression of science and technology. In accordance with the fundamental principles of the Sustainable Development Goals (SDGs), the utilization of eco-colorants for the purpose of dyeing textiles has garnered a significant amount of attention. This is since eco-colorants are biodegradable and have enhanced environmental compatibility (United Nations Development Program, 2019). Because natural colors derived from plants, insects, and minerals are both sustainable and eco-friendly, the production of eco-colorants is an important part of sustainability.

Barnes (2017) emphasizes that "textile art" covers a broad spectrum of practices, such as weaving, knitting, tufting, printing, dying, stitching, quilting, and collage (Jabbar et al., 2022). Fabrics are an integral part of textile products, which find usage in many different fields like architecture, interior design, health and wellness, the fashion industry, and the automobile industry.

LITERATURE REVIEW

Overview of Eco-colourants from Ketapang Leaves

A large, spreading tree that can be found in coastal environments all over the tropics, the Ketapang tree, also known as the tropical almond (Terminalia Catappa Linn), is also known by its other name, the tropical almond. According to Akpabio (2012), it is exploited to produce edible nuts, as well as for the purpose of providing shade. The Ketapang tree has been introduced to nearly every region of Southeast Asia, including Malaysia. During the dry season, the leaves undergo a transformation from green to crimson, yellow, gold, or copper brown, and they subsequently become detached from the tree.

Several studies have been done to determine the possibility of Ketapang leaves as an eco-colourant source for textile dyeing. According to the researchers, Park et al., (2008), they investigated the effects of using tannin as a mordant on the silk fabric, which had been dyed and then treated with extracts from tropical almond leaves after which a cotton cloth was used. The Cu2SO4, K2Cr2O7, potassium aluminium sulphate, cassava leaves were the four types of tannin (mordants) used in this experiment. Each mordant was determined to be 5% by concentration. The results show that the mordants of the type had a significant impact on color value with p<_0.05), and they also resulted in a rise of lightness (L*) of material. The total colour difference was investigated to determine whether the dyed fabrics were able to maintain their colour after being washed again. It was determined that the types of mordants had a significant impact on the color change, but not on the color staining since the level of significance was 0.05. The findings led to this conclusion. Thus, when combined with eco-colorants, tannin can be used as a mordant to enhance the quality of silk dyeing. This is because tannin is a pigment that occurs naturally.

In a yet another study Yogesh Vadwala and Kola (2017) dye nylon fabric successfully with an eco-colourant prepared from unused Ketapang leaves. This environmentally friendly dye colored the fabric. For that, they were able to achieve the intended results. Nylon fabrics were pre-mordanted for half an hour at room temperature using ten percent natural mordants such as tannic acid, acetic acid and chemical mordants such as iron and copper sulfate. This was done initially for the purpose of being able to get the fabrics ready for the dying process. Nylon fabrics were dyed at temperatures from 85 to 90° C for 25 to 30 min after pre- mordanting. The dyed nylon fabrics were then examined in the subsequent step to know the fastness of the dyed nylon fabrics and the color that was produced. Results showed application of eco colorants from Ketapang leaves in combination with the choice of mordants were able to produce range of dyed nylon fabrics with very good fastness qualities.

Chafidz and Faisal (2019) took natural dye from Ketapang leaves, which colored the textile materials. And so that they could color the materials. To complete the extraction processes, the leaves of the Ketapang plant were macerated with distilled water for four, six, or eight days. The extract tannin was used to dye fabric made of cotton tannin solution for one hours and dyed with the extract tannin. Addition of a post mordanting procedure of 60 minutes for pre dyed cotton fabrics at a concentration of 50g L alum (alum), kapur tohor, and tunjung. Some evaluations of the washing and rubbing fastness characteristics were made on the specimens. Alum treated fabric showed better performance in the fastness evaluations.

In 2020, the solvent extraction techniques employed by Sintha Soraya Santi et al. allow to successfully extract the tannin from the leaves of the Ketapang plant. Extract process was conducted by maintaining the temperature at 850 degrees Celsius and stirring at a speed of 200 revolutions per minute for the mixture for 30, 60, 90, 120 and 150 minutes, respectively. Ethanol concentrations used were sixty, seventy, eighty, eighty-five and ninety percent. Results from the study indicated that the yields of tannin were significantly increased (98.97%) when 85% ethanol was used for 120 minutes.

Collages

Collage, derived from the French verb 'coller' (to stick), is a method of presenting objects that are affixed Butler-Kisber and Poldma (2010) describe these techniques as being a small fragment of discovered images or materials used onto a flat surface. The Cambridge Advanced Learner's Dictionary & Thesaurus (2020) defines collage as the artistic practice of assembling diverse materials or objects, including paper, fabric, or photographs, and affixing them to a larger substrate. Textile artists can express their creativity while learning modern stitching techniques through fabric collage, a groundbreaking method of quilting (Eichorn, 2003). One possibility for the backing materials is to use freshly dyed, cut, and glued fabric instead of the fabric already used for the collage.

The use of collage goes back many years. Japanese artists and calligraphers used collages to enhance their poems over a thousand years ago (Francks,2008). The "fathers" of collage, Picasso and Braque, used collage in the early 20th century to challenge the realistic demands of formalist painting, say Butler-Kisber & Poldma (2010). "Collage exemplifies our perception of the world, where objects derive meaning not from their inherent qualities, but from their relational context" (Robertson, 2002). Moreover, the essential skills of cutting and adhering are developed early in life and constitute a crucial component of an individual's skill set, allowing novices to engage in collage while progressively mastering sophisticated aesthetic and compositional techniques (Butler-Kisber & Poldma, 2010).

METHODOLOGY

Materials

The eco-colorants utilised in this research came from Ketapang leaves that were discovered in the Rawang district of Selangor. Alum ($Al2(SO4)3$) and tunjung ($FeSO4$) were the mordants that were utilised. Fabrics utilised included plain cotton, linen, and viscose rayon woven fabrics in addition to silk woven with a satin weave structure.

Extraction of Eco-colourants from Ketapang Leaves

Using a blender, the dried ketapang leaves were pulverised into a fine powder by dicing them into small fragments. A beaker of distilled water was filled with the powdered dried ketapang leaves, and the mixture was boiled for 30 minutes. The extraction was conducted at a liquor ratio of 1:20. Subsequently, the solid ketapang leaf powder was removed by sieving the mixture.

Mordanting

Two different mordanting techniques were used for the purposes of this investigation: pre-mordanting and meta-mordanting which is known as simultaneous mordanting. Both solved the problems and were used. The mordants, as indicated by the fabrics used, were set to 5 and 10% (owf) concentration, the liquor ratio was 1:20, and was carried out in accordance with the weight of the fabrics used. Moreover, afterwards, they were also boiled in a mordant solution for a period of thirty minutes to be prepared for the pre-mordanting process. They were then dry to the sun to dry out. For meta-mordanting the parameters used for the pre-mordanting were kept and dyeing and mordanting were done simultaneously

Dyeing

The dyeing process was carried out at the same time on pre and meta mordanted fabrics. The dyeing was done at a boil for 30 minutes at a ratio of 1:20 liquor to water. Despite this, a liquor ratio of 1:40 was utilised to accomplish the goal of achieving lighter hues. When the dyeing process was complete, the fabrics that had been dyed were

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exposed to direct sunlight to allow them to dry.

Collage Making

Figure 3.1 illustrates the steps involved in the collage-making process. An illustration was generated from a self-portrait captured with a smartphone and subsequently transformed into an illustration using Adobe Illustrator. The illustration was subsequently traced onto the canvas. The selected fabric was utilised to construct a collage on canvas, which was subsequently divided into fragments. Subsequently, a collage was created by affixing the dyed fabric to patterned canvas fabric.

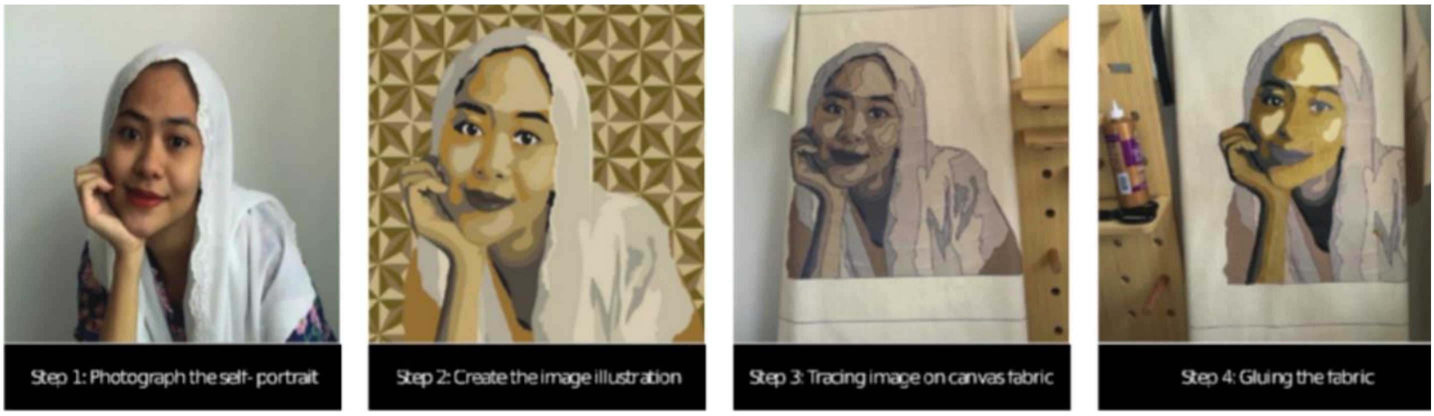

Figure 3.1: The steps of making collage artwork using Ketapang dyed fabrics

FINDINGS

Shades of dyes fabric

The presence of tannins as the primary pigment compound was indicated by the brownish hue that was exhibited by the eco-colorants that were derived from the leaves of the ketapang plant. On the other hand, fabrics that were mordanted with tunjung produced a dark, black colour. Because alum is classified as a brightening mordant, it produced lighter hues. On the other hand, tunjung produced darker hues because it is recognised as a dulling mordant (Samanta and Konar, 2011). As can be seen in Tables 4.1 and 4.2 (for pre-mordanting) and Tables 4.3 and 4.4 (for meta-mordanting), the polygenetic properties that are present in eco-colorants derived from ketapang leaves cause the colour that is produced to change depending on the mordant that is applied

Table 4.1: Swatches of Pre-mordanted Dyed Fabrics with Alum

Fabric	Water (ml)	Mordant (ml)	Dye (ml)	Fabric Weight(g)	Result
Satin Silk (30 mins boiled)	1956	9.78 (10% owf)	1956	97.9	
Linen (30 mins boiled)	2958	14.79 (10% owf)	2958	14.79	
Cotton (30 mins boiled)	2938	14.69 (10% owf)	2938	146.9	
Viscose (30 mins boiled)	3470	17.35 (10% owf)	3470	173.5	
Viscose (60 mins boiled)	2838	28.38 (20% owf)	2838	141.9	

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Table 4.2: Swatches of Pre-mordanted Dyed Fabrics with Tunjung

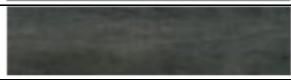
Fabric	Water (ml)	Mordant (ml)	Dye (ml)	Fabric Weight(g)	Result
Satin Silk (30 mins boiled)	920	4.6 (10% owf)	920	46	
Linen (30 mins boiled)	3022	15.01 (10% owf)	3022	150.1	
Cotton (30 mins boiled)	2822	14.11 (10% owf)	2822	141.1	
Cotton (30 mins boiled)	1940	3.88 (4% owf)	1940	97.0	
Cotton (60 mins boiled)	2000	20.00 (20% owf)	4000	100.0	
Viscose (30 mins boiled)	3848	19.24 (10% owf)	3848	192.4	
Viscose (30 mins boiled)	3048	30.48 (20% owf)	6096	152.4	

Table 4.3: Swatches of Meta-mordanted Dyed Fabrics with Alum

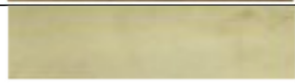
Fabric	Water (ml)	Mordant (ml)	Dye (ml)	Fabric Weight(g)	Result
Cotton (30 mins boiled)	-	14.49 (10% owf)	2898	144.9	
Cotton (30 mins boiled)	-	6.17 (5% owf)	2470	123.5	
Viscose (30 mins boiled)	-	7.58 (10% owf)	2958	78.5	
Viscose (40 mins boiled)	-	18.14 (20% owf)	2938	90.7	
Viscose (60 mins boiled)	-	16.64 (20% owf)	5676	141.9	
Linen (30 mins boiled)	-	22.0 (20% owf)	2220	111.0	
Linen (60 mins boiled)	-	19.6 (20% owf)	3920	98.0	

Table 4.4: Swatches of Meta-mordanted Dyed Fabrics with Tunjung

Fabric	Water (ml)	Mordant (ml)	Dye (ml)	Fabric Weight(g)	Result
Cotton (30 mins boiled)	-	7.74 (5% owf)	3098	154.9	
Cotton (30 mins boiled)	-	6.67 (5% owf)	2670	133.5	
Cotton (30 mins boiled)	-	4.86 (4% owf)	2432	121.6	
Viscose (30 mins boiled)	-	3.9 (4% owf)	1986	99.3	
Viscose (30 mins boiled)	-	7.45 (10% owf)	1490	74.5	
Viscose (30 mins boiled)	-	15.25 (15% owf)	1670	87.1	
Viscose (60 mins boiled)	-	17.42 (20% owf)	3848	87.1	

Application of Dyed Fabrics in Collage

Figures 4.1, 4.2, 4.3, and 4.4 illustrate the collage created by cutting, arranging, and adhering dyed fabrics using eco-colourants derived from ketapang leaves. Various fabrics were utilised in conjunction to achieve distinct effects and hues. These various series of portraits utilised silk, cotton, viscose, and linen fabrics, respectively. The collages illustrated the diverse shades that emerged because of the fabric's colour absorption property. The dyeing and mordant concentrations used in each frame were also evident in the colour of the fabrics. Variable shades of colour were observed.

Figure 4.1: Collage from Dyed Fabrics with Eco- Colourants Extracted from Ketapang Leaves

Figure 4.2: Collage from Dyed Fabrics with Eco-colourants Extracted from Ketapang Leaves.

Figure 4.3: Collage from Dyed Fabrics with Eco-colourants Extracted from Ketapang Leaves.

Figure 4.4: Collage from Dyed fabrics with Eco-colourants Extracted from Ketapang Leaves.

CONCLUSION

A combination of pre- and meta-mordanting procedures with the boiling water extraction method allowed for the successful extraction of tannin-containing eco-colorants from ketapang plant leaves. After experimenting with different mordant and liquor ratios on dyed silk (satin), cotton, linen, and viscose rayon, it was decided that the resulting tones would provide an adequate medium for a collage.

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REFERENCES

1. Abbas, J., & Sagsan, M. (2019). Identification of key employability attributes and evaluation of university graduates' performance: Instrument development and validation. Higher Education, Skills and Work-based Learning, 10(3), 449-466.
2. Akpabio, U. D. (2012). Evaluation of proximate composition, mineral element and anti- nutrient inalmond (Terminalia catappa) seeds. Advances in Applied Science Research, 3(4).
3. Annisa, S. (2024). The Creative Economy: Arts, Cultural Value and Society in PracticeThe Creative Economy: Arts, Cultural Value and Society in Practice, by Amanda J. Ashley, Carolyn G. Loh, Matilda Rose Bubb, and Shoshanah B. D. Goldberg-Miller, London, UK, Routledge, 2024, 330 pp., £39.99 (paperback), £135.00 (hardback), ISBN: 9780367707231. The Journal of Arts Management, Law, and Society, 54(3), 188–189. https://doi.org/10.1080/10632921.2024.2357097
4. Butler-Kisber, L., & Poldma, T (2010). The Power Of Visual Approches In Qualitative Inquiry. The Use Of Collage Making And Concept Mapping In Experiental Research. Journal of Research Practices 6(2): 1-16.
5. Cambridge Advanced Learner's Dictionary, & Thesaurus. (2020). COLLAGE | meaning in the Cambridge English Dictionary. Dictionary.cambridge.org. https://dictionary.cambridge.org/dictionary/english/collage
6. Eichorn, R. (2003). The art of fabric collage: an easy introduction to creative sewing. Taunton Press; [Berkeley, Ca.
7. Faisal, R., & Chafidz, A. (2019). Extraction of Natural Dye from Ketapang Leaf (Terminalia catappa) for Coloring Textile Materials. IOP Conference Series: Materials Science and Engineering, 543, 012074. https://doi.org/10.1088/1757-899x/543/1/012074
8. Francks, P. (2008). Agriculture in the Modernization of Japan (1850-2000). Social Science Japan Journal, 11(2), 309–312. https://doi.org/10.1093/ssjj/jyn044
9. Jabbar, H. A., Shafai, S. N. D., & Kadir, M. I. A. (2022). Eco – colourants and Collage: Exploring natural colours extracted from ketapang leaves. Environment-Behaviour Proceedings Journal, 7(SI9), 389–394.

https://doi.org/10.21834/ebpj.v7iSI9.3947

10. Krieger, J., & Higgins, D. L. (2022). Housing and health: time again for public health action. American Journal of Public Health, 92(5), 758–768. https://doi.org/10.2105/ajph.92.5.758
11. Ljiljana Damjanović, Maja Gajić-Kvaščev, J. Đurđević, Velibor Andrić, Milica Marić-Stojanović, Lazic, T., & Sanela Nikolić. (2015). The characterization of canvas painting by the Serbian artist Milo Milunović using X-ray fluorescence, micro-Raman and FTIR spectroscopy. Radiation Physics and Chemistry, 115, 135–142. https://doi.org/10.1016/j.radphyschem.2015.06.017
12. Park, A.-Y., Song, W.-S., & Kim, I.-Y. (2008). Effect of Tannin Mordanting on Gromwell-dyed Silk Fabric. Textile Coloration and Finishing, 20(6), 51–62. https://doi.org/10.5764/tcf.2008.20.6.051
13. Robertson, B. (2002). Why collage? Unpublished manuscript.
14. Samanta, A.K., and Konar, A. (2011). Dyeing of Textiles with Natural Dyes. In Kumbasar, E.P.A. (Ed.), Natural Dyes (29 - 56). Croatia, InTech.
15. Sintha Soraya Santi, Irawati Febriana, & Nita, P. (2020). Extraction of Tannin From Ketapang Leaves (Terminalia catappa Linn). 1st International Conference Eco-Innovation in Science, Engineering, and Technology. 196 – 199. DOI: 10.11594/ Nstp.2020.0530. https://doi.org/10.11594/nstp.2020.0530
16. United Nations Development Programme (UNDP) | Department of Economic and Social Affairs. (2019). Sdgs.un.org. https://sdgs.un.org/un-system-sdg-implementation/united-nations-development-programme-undp-24528
17. Yogesh Vadwala, & Kola, N. (2017). Dyeing of nylon fabric with natural dye extracted from waste leaves of Terminalia catappa locally known as tropical almond tree. International Journal of Home Science, 3(2), 175–181.