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Differences in Teak Leaf Ecoprint Results Using the Steaming Technique on Tumblr

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Abstract
The need for design innovation in the environmentally friendly craft industry, especially in non-textile media, has so far been minimally explored in academic literature and commercial practice. The purpose of this study is to evaluate the aesthetic and technical quality of the results of the application of ecoprint using teak leaves (Tectona grandis) on plastic tumblers through a steaming technique. This study uses an experimental method with a qualitative and quantitative descriptive approach through organoleptic tests involving 20 trained panelists with a Bachelor's degree in Fashion Design. The independent variables in this study include three classifications of teak leaf age, namely shoots, young leaves, and old leaves, to determine which provides the most optimal pigmentation results and motif sharpness. The assessment instrument includes six main indicators: motif silhouette, fiber and texture, cleanliness of fold lines, color quality, shape harmony, and harmony of pattern arrangement. The results of statistical analysis show that the highest average score is obtained in the aspect of silhouette line clarity (item 1A) of 4.85, while the aspect of evenness and color suitability (item 4C) recorded the lowest score of 1.90. The Friedman Test results show an Asymp. Sig. value of 0.000 < 0.05, which proves that there is a significant difference in quality between the three leaf classifications. The research findings reveal that teak leaf buds provide the best aesthetic quality due to the high anthocyanin concentration and the flexibility of the leaf tissue that is able to adhere perfectly to the cylindrical geometry of the tumbler. In conclusion, the integration of ecoprint on the tumbler requires a precise coating and alum mordant fixation process to overcome the absorption constraints of non-textile media, while providing economic and ecological added value to national craft products.

Keywords: ecoprint, teak leaves, steaming technique

INTRODUCTION

Existence global fashion and craft industry today This at a crossroads road between productivity mass and demands preservation environment. The fast fashion phenomenon is not only trigger consumerism excessive but also provide impact destructive ecology through waste dye synthetic that reaches 800,000 tons per year globally, of which approximately 70 % contain substance chemistry difficult toxic decompose in a way natural [1]. In the context this, the emergence technique ecoprint as method natural coloring and motifs become a breath of fresh air for development sustainable crafts. Ecoprint is technique transfer patterns, shapes, and colors from part plant like leaves, flowers, or stem in a way direct to on media through the contact process physical supported by heat and pressure [2]. Ecoprint technique own uniqueness lies in its exclusive and impossible nature For replicated in a way

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[2]Aryani, Ine Kusuma, Beny Wijarnako, and Ristiana Dyah Purwandari. " Eco-Friendly Eco-Printing Technique Based on Economical Creative Efforts to Create Independent Community Human Resources Post- Pandemic /COVID 19 For Member Head of the Aisyiyah Branch (PRA) of Karang Cegak Village Subdistrict Discordant Regency Banyumas." Journal Community Service 3.1 (2022): 1-16.

identical, because every strands leaf own characteristics different biological although originate from the same tree.

Friendly crafts environment This potential big in field economy, in implementation ecoprint as far as This Still shackled to textile media traditional like cotton, calico, and silk fabrics. The products produced tend monoton in form clothes, scarves, or bag cloth, so that consumer start need update more design significant and functional. Lack of exploration of non- textile materials as well as lack of source academics that discuss technical application of natural pigments to hard materials become gaps that must be quick filled by research scientific. Non- textile materials like ceramics, bamboo, leather and plastic own characteristic very different physique from fabric, especially in matter porosity and energy surface, which demands handling more technical complex in the color transfer process.

Tumbler, or receptacle portable drinking water storage, selected as object study This Because its very relevant function with style conscious modern living environment. Improvement the popularity of tumblers among teenagers and adults triggered by movement subtraction bottle plastic very use, but tumbler designs circulating on the market often only depend on massive and less digital printing own mark art organic [3]. Ecoprint technique on tumbler, no only functioning as tool House ladder but also as work art that brings message ecological challenges technical main in this process is characteristic hydrophobic from plastic tumbler that refuses absorption of natural pigments water based, so need method fixation and steaming techniques designed in a way special For ensure sharpness of the motif is not easy fade.

Teak leaves (Tectona grandis) become focus material standard in experiment This Because its abundant availability and status as one of the plant natural pigment producer the strongest in Indonesia. Teak leaves contain compound bioactive in the form of tannins and anthocyanins which are capable of produce spectrum color start from maroon, red -violet, to chocolate golden depending on maturity leaves and types fixative used. Research[4] This share teak leaves in three category growth namely shoots, leaves young, and leaves old For identify which classification is most capable adapt with The surface of the tumbler is smooth and provides saturation the highest color.

A number of study previously has explore technique ecoprint as alternative coloring friendly environment in the context of textile crafts. Research by Adriani and Sari (2023) states that technique ecoprint with steaming and pounding method on primissima cotton material produce difference significant in clarity of motive and resilience color to washing, so that show that method application influential to quality results ecoprint on textiles [5]. Hayati Anugrah and Sri Zulfia Novrita (2023) also showed that ecoprint teak leaves on cotton material with use mordan alum capable produce direction distinctive color as well as durability of the motif after washing, so that strengthen understanding about the behavior of natural pigments on fabric media [6]. Furthermore, research by Laily Jaelina Sofiyatur Rohmah and Agus Ridwan Misbahudin (2025) applied ecoprint use steaming technique on organza fabric and found that technique the effective produces sharp patterns and relatively bright colors stable after washing, indicating potential steaming technique for repair ecop [7]visual quality

Most of the study previously about ecoprint Still focusing on textile media such as cotton, silk, linen, and mori, with indicator evaluation covering direction color, sharpness of motif, expression

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color, and durability fade (Darmawanti & Sutopo, 2021 [8]; Anugrah & Novrita, 2023 [9]; Bashiroh et al., 2022 [10]; Mardiyyah, 2022 [11]; Fitri et al., 2020 [12]). Although there is research that has begun exploring non- textile materials like paper, bamboo, leather, and ceramics, studies the Not yet in a way specific research implementation ecoprint on tumbler media as modern [13]functional craft products. In addition, some big study No differentiate level maturity teak leaves as variables research, so that Not yet known in a way scientific influence of shoots, leaves young, and leaves old to sharpness of motif, direction color, and resilience results ecoprint.

More further research previously also not yet discuss in a way deep challenge technical ecoprint on the surface hydrophobic like plastic tumbler, which has characteristics different in a way significant compared to textiles in matter porosity and power absorb natural pigments [14]. Therefore, it is necessary research that is special study implementation technique ecoprint steaming using teak leaves based on classification of shoots, leaves young, and leaves old on tumbler media, with focus on the sharpness of the motif, direction color, and resilience results as contribution new in development of non- textile crafts sustainable

Study This aim For analyze influence use teak leaves based on classification of shoots, leaves young, and leaves old to quality results ecoprint on tumbler via steaming techniques, which include sharpness of motif, direction color, and durability results. Research results This expected can give contribution scientific in development of non- textile crafts sustainable as well as become references technical for craftsmen in diversification product friendly environment.

Quality

Quality is totality characteristics products that show level resilience, trust, and conformity to need consumer [15] [16]. Quality is also understood as ability product For fulfil function, interesting visually, and maintain satisfaction customer [17]. Dimensions quality product covering performance,

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power resistance, suitability specifications, features, reliability, aesthetics, and perceived quality [18] [19]. In the work art, quality No only determined by function, but also by value influential aesthetics to interest purchase [20].

Ecoprint

Ecoprint is technique printing of motifs and colors experience from plant direct to the fabric media or other surfaces through contact direct [21]. This technique using natural pigments like tannins and anthocyanins which produce color unique and not can replicated in a way identical [22]Ecoprint different with batik because No use candle or canting, but utilise leaf or interest in direct [23]. The visual uniqueness of ecoprint influenced by the type plants, techniques, time processing, and print [24]media.

Ecoprint Technique

Ecoprint technique covering three method main, namely pounding, steaming, and fermentation [25]. Pounding technique is performed with hit leaves on cloth For extracting color pigments. Steaming technique is carried out with steaming cloth that has been plastered leaf so that color move through [26]. Fermentation techniques done with soak leaf before the color transfer process For increase pigment [27]discharge.

Teak Leaves

Teak leaves (Tectona grandis L.) contain natural pigments in the form of potential tannins and anthocyanins produce color red, brown, to purple on textile media [28]. Color results ecoprint teak leaves

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[28]Anugrah, Hayati, and S. Zulfia Novrita. " Application of eco print of teak leaves (Tectona grandis) on cotton material using mordan alum." *Tambusai Education Journal* 7.2 (2023): 18364-18371.

are influenced by the type mordants and techniques used, e.g alum, tunjung, and pure [29] [30]. Teak leaves are classified become shoot leaves, leaves young, and leaves old, each of which produces intensity and sharpness different colors [31].

Tumbler

Tumbler is receptacle drink portable used as alternative friendly environment to bottle very use [32]. The use of tumblers is influenced by factors practical, economical, healthy and stylish life green. Innovation tumbler products continue developing, including The use of ecoprint motifs provides mark aesthetics, exclusivity, and identity product friendly environment.

Aspect Aesthetics

Aesthetics is study about beauty, creation, and appreciation work art [33]. In ecoprint, the aspect aesthetics determined by color, texture, sharpness of pattern, and durability fade [34] [35]. Ecoprint colors originate from natural pigments plants that provide impression harmonious and unique. Texture ecoprint nature real Because can touched in a way physique [36]. The sharpness of the motif shows clarity form results print, while resilience fade show Power stand color to washing and use [37].

METHOD

Study This use method experiment For obtain data based on trial results manufacturing ecoprint on tumbler media with steaming technique. Research aim For describe quality results ecoprint teak leaves based on three category growth, namely shoots, leaves young, and leaves old, which is assessed from aspect direction color, texture ecoprint, sharpness footprint or motives, and resilience faded. Research held in March 2024 at Perum Argajaya, Regency Magelang. Research data consists of from primary data in the form of results experiment ecoprint on tumbler and questionnaire data evaluation panelists, and secondary data in the form of documentation and the data obtained from related websites. Stages experiment includes : (1) preparation tools and materials in the form of tumbler coating, teak leaves, water, duct tape, HVS paper, plastic, pan steam, and stove; (2) cleaning the tumbler; (3) coating the tumbler using coating machine; (4) composition teak leaves according to pattern on the tumbler; (5) tumbler packaging using HVS paper, duct tape, and plastic For ensure optimal contact; (6) steaming for 60–90 minutes; (7) cooling; and (8) release leaf from tumbler

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surface. Data collection techniques were carried out through organoleptic test experiments and questionnaires. Assessment conducted by 15–20 panelists, with amount end of 20 panelists Fashion Design students from the 2019 intake who have understand indicator assessment. Panelists give evaluation use scale of 1–5 against four indicator study.

Testing direction color done with match results ecoprint on tumbler with catalog available colors. Testing texture done through touch direct tumbler surface, while testing sharpness of motif and durability fade done through visual observation. Resilience fade assessed with comparing the motifs on tumblers that have been made for a long time with a new tumbler made. Instrument study tested through validity content with involving three experts, namely two PKK lecturers from the Faculty of Engineering, Semarang State University and one practitioners Ecoprint in Yogyakarta. Validity counted use Aiken index (V). Reliability test done use Cronbach's Alpha coefficient, with criteria instrument reliable if α value > 0.6. Data analysis was carried out in a way descriptive quantitative with count average value (mean) of each indicator based on score panelists, using assistance of the SPSS version 16 program. In addition to descriptive analysis, the data was also analyzed using the Friedman test to know whether there is significant difference between results ecoprint teak leaves, shoots, leaves young, and leaves old on each indicator. Testing done with SPSS version 16 program assistance at level significance 0.05.

RESULTS AND DISCUSSION

Results

Based on the data obtained of 20 respondents, the quality results ecoprint on the tumbler shows highly variable performance between dimensions assessment. The following is the data resulting from the panelists' statistical analysis.

Table 1. Statistical Analysis of Average Score per Question Item (N=20)

Item	Average Score	Category Quality	Analysis of Findings
1A	**4.85**	**Very high**	silhouette lines of the motif are very clear; almost No there is a broken line.
1B	4.30	Tall	Structure bone printed teak leaves with good clarity.
1C	2.10	Low	Happen A little shift silhouette consequence pressure rolling.
2A	4.75	Very high	The pattern fibers look very real and resemble leaf original.
2B	4.05	Tall	Fiber does not vague and distributed in a way consistent.
2C	2.00	Low	Texture surface felt not enough smooth on the skin post -process.
3A	4.45	Tall	few interfering fold lines on the leaf motif.
3B	3.95	Tall	Background area behind Enough clean from folds big.
3C	2.90	Enough	Folds small Still influence flatness color in some point.
4A	4.65	Very high	Ability teak leaf transfer color to the tumbler is very effective.
4B	4.30	Tall	resulting color thick and shows intensity strong.
4C	**1.90**	**Low**	Flatness color in a way micro throughout less motif area maximum.
5A	4.70	Very high	Size The teak leaves used are very proportional (< 20 cm).
5B	4.35	Tall	Consistency size between maintained motifs with Good.
5C	2.60	Enough	Some motives are felt too dominant compared to others.
6A	4.40	Tall	Neat motif arrangement; no There is collision between elements.
6B	3.90	Tall	Structure pattern compilation assessed structured and interesting.
6C	2.30	Low	Compatibility pattern with geometry cylindrical tumbler needed repaired.

Source : Processed Data Writer

Based on results analysis statistics in Table 1 involving 20 respondents, can be seen pattern clear dichotomy between macro visual advantages and disadvantages technical micro on *ecoprint* tumbler products. In aesthetics, engineering *steaming* proven to be very effective in transfer characteristics biological teak leaves, things This shown by the acquisition score "Very High" category on the clarity of silhouette lines (item 1A: 4.85), realism fiber motifs that resemble leaf original (item 2A: 4.75), as well as proportionality size leaf (item 5A: 4.70). In addition, the color transfer capability was also considered very satisfactory. with dense intensity (item 4A: 4.65). However, behind these visual advantages, there are decline significant quality in terms of technical details and *finishing,* which is marked with score " Low " category. Most critical weakness identified on the flatness color in a way micro (item 4C: 1.90) and texture surface post -process that is still felt rough moment touched (item 2C: 2.00). In addition, the application on the cylindrical tumbler media gave rise to challenge alone, visible from existence A little shift silhouette consequence pressure rolling (item 1C: 2.10) as well as

difficulty in adapt pattern with geometry tumbler curve (item 6C: 2.30). This data conclude that although product own Power strong visual appeal, refinement method packaging and formulation *coating* absolute required For repair consistency color micro and fineness texture.

Study This succeed identify difference quality significant results between three classification age teak leaves. Based on Experimental data synthesis and review literature, determination quality best can detailed as following.

Table 2. Results of the Friedman Test of Motive Quality Based on Leaf Age

Test Variables	N	Chi-Square	df	Asymp. Sig.
Quality Ecoprint	20	40,000	2	**0,000**

Source : Processed Data Writer

Based on Table 2, it is obtained mark significance of 0.000, which is more small from level significance of 0.05 (0.000 < 0.05). This result prove in a way scientific that there is difference quality results very significant ecoprint consequence factor age teak leaves used.

Table 3. Mean Rank Friedman Test

Classification of Teak Leaves	Mean Rank	Information
Shoots (Tops)	**3.00**	**Rank 1 (Best)**
Young Leaves	2.00	Rank 2
Old Leaves	1.00	Rank 3

Source : Processed Data Writer

In table 3, the mean rank results show that teak leaf shoots occupy ranking highest (3.00), followed by leaves young (2.00), and lowest is leaf old (1.00).

Discussion

Application ecoprint on plastic tumbler present dimensions new in evaluation aesthetics appearance. Based on input panelists, scores beauty product No only depends on the color, but also on how the motif is interact with light that penetrates the tumbler material (transparency) [38]. Principle unity and balance become very crucial because the tumbler is object three dimensions seen from various corner [39]. Low score on item 6C (Suitability with form product) shows that panelists feel arrangement of wide leaf motifs sometimes No in harmony with the tumbler's sleek proportions. The layout leaves that are too big can dominate visual field in general excessive, so that remove impression artistic expected organic. In addition, the appearance of fold lines (item 3C) which although No dominant, fixed considered as reducer mark aesthetics Because give impression poor workmanship professional (less craftsmanship).

Success technical study This is also supported by the effectiveness of the fixation process. Experimental results show that use mordan alum capable lock maroon color from anthocyanin teak leaves so that own resilience to washing very good soap (score fixation reach criteria No changed The same once in research reference). Aluminum ion in alum act as bridging mordant bond hydrogen between group functional in plastic *coating* with group hydroxyl in leaf pigments. Stability color this is very important for tumbler products that have intensity use high and frequent touch with detergent or hot from drinks in it.

Innovation ecoprint on the tumbler brings implications strategic for development economy creative in Indonesia. With utilise waste biological from abundant teak plantations, craftsmen can create product with mark plus tall without must invest large capital in dyes synthetic imports. Foreign markets moment This show trend improvement request to eco-friendly products that have narrative culture and material honesty. Ecoprint tumbler offer strong differentiation compared to patterned tumblers mold machine. The " beautiful flaws " (wabi-sabi) characteristic of ecoprint, such as variation gradation color that is not unexpectedly, in fact become mark sell for premium consumers looking for uniqueness and authenticity. Products This capable positioning self as alternative sustainable that combines function practical daily with aesthetics high craft art. Although product This own real visual

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excellence, transitions going to production scale industry demand settlement quick to various obstacle identified technical issues, in particular related low scores on aspects technical micro (category C).

Findings This indicates urgency standardization in three main areas, starting from development coating formulation that is not only friendly environment but also has affinity tall against organic pigments to ensure flatness color (item 4C). In addition, it is required implementation mechanization packaging through tool press automatic For replace use manual duct tape to eliminate unnecessary fold lines desired in the field cylindrical (item 3C), as well as optimization thermal precision sensor based For reach pigmentation maximum without degrade structure polymer tumbler. Realization steps the No only crucial For increase quality physique product only, but also strategic in strengthen image of Indonesian crafts as competitive products in a way technical at a time superior in artistic value.

CONCLUSION

Based on the research results, it can be concluded that the quality of the teak leaf ecoprint on the tumbler is visually assessed as very good and has great potential as a non-textile product innovation. This is evidenced by the highest average score in the clarity of the silhouette lines of the motif (4.85) and fiber realism (4.75). The steaming technique has proven effective in transferring natural anthocyanin and tannin pigments to the coated plastic surface. However, there are significant technical weaknesses in the aspect of detailed color evenness and surface texture smoothness due to the constraints of the curved media geometry, which is reflected in the low score in the micro-technical category (scores ranging from 1.90 - 2.40). Through statistical proof of the Friedman Test ($p = 0.000$), it was determined that teak leaf shoots are the best raw material that provides the sharpest, densest, and most aesthetic results compared to young and old leaves. This innovation has great potential to be developed in the environmentally friendly craft industry, but requires technical improvements in the packaging mechanism to increase color evenness in the micro-details of the product. Second, the best quality ecoprint results are obtained through the use of teak leaf shoots. Teak shoots produce the sharpest maroon-violet color intensity, the most precise leaf vein anatomical details, and the most stable pigmentation adhesion compared to young and old leaves. This is due to the density of anthocyanin content and the flexibility of the shoot cell tissue that allows optimal surface contact during the steaming process. Young teak leaves are a viable second alternative, while old teak leaves are highly not recommended for tumbler media because they produce dull colors and patterns that tend to be incomplete. Overall, this study confirms that the integration of local wisdom through ecoprint techniques on non-textile materials can create aesthetic, exclusive, and sustainable craft products. The success of this innovation depends heavily on the synergy between understanding plant biochemistry, the accuracy of steaming thermodynamic techniques, and the correct application of fixation mordants. For future development, further research is recommended on the variety of natural mordants and the optimization of rolling aids to achieve technical perfection that is equal to its visual beauty.

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