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THE ART OF FASHION DESIGN FROM NATURAL DYEING

Somporn Bhurichotitham[1], Chananchida Nasom[2*], Pravit Rittibul[3]

[1]Faculty of Fine and Applied Arts, Rajamangala University of Technology Thanyaburi 12110, Thailand, Email: somporn_va@rmutt.ac.th, Orcid ID: https://orcid.org/0009-0003-3286-4620
[2]Faculty of Fine and Applied Arts, Rajamangala University of Technology Thanyaburi 12110, Thailand, Email: chananchida_n@rmutt.ac.th, Orcid ID: https://orcid.org/0009-0001-5072-9540
[3]Faculty of Fine and Applied Arts, Rajamangala University of Technology Thanyaburi 12110, Thailand, Email: pravit@rmutt.ac.th, Orcid ID: https://orcid.org/0000-0002-1998-4543

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Corresponding Author: Chananchida Nasom (chananchida_n@rmutt.ac.th)

ABSTRACT

The art of fashion design from natural dyeing to study the color fixation of cotton and silk fabrics by dyeing with natural materials and different types of fixatives by cleaning and removing natural impurities by boiling with soda ash solution. The study on dyeing with mango leaves found that cotton had the best color absorption when using alum as a dyeing agent, while salt and lime water did not perform well. For silk, alum gave the best color absorption, followed by salt and lime water. For dyeing with lemongrass leaves, cotton had the best color absorption when using salt and alum as dyeing agents, respectively, while lime water gave the least effect. For silk, alum gave the highest color absorption, followed by lime water and salt. Fabrics dyed with lemongrass and mango leaves were used to design five casual outfits, emphasizing simplicity and comfort. They used cotton and silk materials, and combined design and tailoring perfectly.

KEYWORDS: Art Design, Fashion, Natural Dyeing, Silk, Cotton.

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1. INTRODUCTION

Natural dyes are dyes extracted from natural raw materials such as plants, animals, and minerals, which are formed through natural processes. Natural dyes have played a role in human life since ancient times. Humans have learned to use natural dyes in various activities. For example, some tribes use dyes on their bodies. Many groups use dyes to glaze pottery, dye textiles, utensils, and clothing. They also use dyes to paint murals and are used as components in various ceremonies based on local beliefs (Sutthisa, Kijjareonsakkul, Nampanya, Kothawong, & Homhuk, 2015). Humans know how to adapt and create local raw materials for their own benefit. Communities in environments with available raw materials tend to adapt these materials before anything else. Therefore, local raw materials play a significant role in folk art (Kunthonsap, Khiaomang, & Sung-hee, 2017). Humans have known how to create colors from natural materials since prehistoric times. This can be seen in cave art, which is archaeological evidence that attests to ancient human civilization, demonstrating that before the advent of synthetic dyes like today, humans used to mix dyes from soil, dust, ink, or soot with water and glue to create paintings. Besides painters, another type of dye derived from nature is fabric dyes (Barber, 1991, Alegbe & Uthman, 2024).

Extraction of color from natural materials for dyeing fabrics or fibers. Dyeing from natural plants is an ecological dyeing technology on textiles or materials using dyes from natural plant resources. These dyes are extracted from various parts of natural plants, including stems, roots, flowers, leaves, fruits, and barks (Che & Yang, 2022). The earliest records of the use of natural plant dyes can be traced back to 2600 BC in China. As archaeological evidence indicates, a small number of plants and animals were used to extract natural dyes at that time (Liu et al., 2021). Since the Middle Ages, the cultivation of dye plants, their processing, and further dyeing have become important economic factors in Europe (Meyer, 1997). The user must have sufficient knowledge to know which dyes should use hot water to extract the color from the colorant, which is called "hot dyeing," or can use water at room temperature, which is called "Cold dyeing" or any type must be done in conjunction with both hot and cold dyeing (Repon et al., 2024). In addition, to ensure that the color adheres well to the fabric or fiber or to achieve vibrant colors, one must also know which plant acid or base to add to the dyeing process, or whether it is necessary to know which plant to dye with first and then repeat the dyeing with other colors so that the final color adheres better to the yarn or fabric. Finally, it is the expertise and precision in remembering the ingredients of things to be mixed with natural dyes. These processes are all knowledge gained through trial and error on the fabric (Lewis & Lewis, 2000).

Natural dyeing in Thailand is an intangible cultural heritage, a body of knowledge passed down through the bonds of life close to nature and close family and kinship relationships. In the past, Thai families lived in extended families, living closely together as relatives. This fostered learning and passed down the wisdom of natural dyeing. Thai society, with its supportive system, allows both men and women to collaborate in dyeing. Therefore, they have the opportunity to accumulate knowledge and wisdom in sourcing materials and dyeing methods from their ancestors, most of whom were girls. This bond of knowledge in the production of Thai fabric dyed with natural dyes is a bond of care and faith from mother to child. Learning to pass on and foster deep ties, Thais have learned to select dyeing materials according to season, store materials for off-season use, use natural dyeing agents, learn to solve problems in the dyeing process, and learn to discover the right proportions of dyeing ingredients to produce beautiful dyes. There are generally three methods of natural dyeing: direct dyeing, vat dyeing, and mordant dyeing (Richards, 2012).

The principles of each dyeing method are described as follows:-

Direct dyes (or Substantive dyes) in dyeing will create a chemical bond between the color and the fiber. That is, if it is a cellulose fiber such as cotton, a hydrogen bond will occur between the hydroxyl group (OH) and the color. For protein fibers such as silk, an ionic bond will occur between the acidic or basic group of the fiber and the acidic or basic group of the color, resulting in salt (SaltFormation). Colors dyed in this way are called direct dyes. Examples of colors include colors from turmeric and safflower, but the dyed colors are not very durable. (Sathianarayanan & Narendra, 2012; Chungkrang & Bhuyan, 2020; Hamdy, Othmam, & Hassabo, 2021; Pizzicato, Pacifico, Cayuela, Mijas, & Riba-Moliner, 2023)

Vat dyes, this method of dyeing requires dilution (Reduce) of insoluble dyes to become water soluble. After the dye is applied to the fibers, the natural dyes used in this method include indigo and indigo. The indigo dye in the dye solution (indigo white) penetrates well into the structure of the cotton fibers. When the fibers are lifted and the dye solution is exposed to oxygen in the air, the indigo oxidizes and

turns into indigo blue, firmly embedded within the fibers. (Jahan, Arju, & Nahar, 2023)

Mordant dyes, this method uses mordants to improve the adhesion of dye to fibers. The resulting dyes will have different levels of fastness and acceptable shades depending on the type of mordant used. Mordants, sometimes called adhesives or dye aids, are compounds that fix natural dyes to fibers. They help combine the dye molecules with the fiber molecules to form an insoluble substance called a color lake. Many popular mordants are used in natural dyeing, such as tannin-containing plant leaf juice, acidic lemon or tamarind juice, the use of chemicals such as sodium chloride, soda ash, lactic acid, tannic acid, oxalic acid, and the use of metal salts such as potassium aluminum sulfate (alum), potassium bichromate, and copper sulfate. Since mordants are a widely used method worldwide, the author would like to explain mordant dyeing. This can be done in three ways as follows; (Mahltig & Bottcher, 2020)

- Pre-Mordanting is a system of applying a color adhesive agent before dyeing (a high-level dyeing technique of ancient Indians). Natural glue is mixed with a color adhesive agent and then written or printed on the fabric. When dyed, the fabric pattern will appear only in the areas where the color adhesive agent was written or printed. It is a complicated dyeing process. In Thailand, it is done by soaking the fibers or fabric in a color adhesive agent and then dyeing it again to get a plain color fabric. Currently, some groups use the Shibori tie-dye method to block the color to create a fabric pattern.

- Co-Mordanting/Meta-Mordanting/metchrome is a system of mixing a adhesive with a dye at the same time during dyeing. It is a technique that is practiced in many places in Thailand because it is a single dyeing method. Thai people will dye with a group of dyes that use a adhesive that is either acidic or alkaline. Dye the entire fiber or fabric with the same color by mixing the adhesive with the dye water. For example, the natural dyeing formula of National Artist, Mrs. Saengda Pansit, Ban Rai Phaingam, Chiang Mai Province, etc.

- Post-Mordanting/afterchrome is a system in which the dye is applied first and then a adhesive is applied later (a system that has been widely applied since 2007). This method dyes the threads/fabric with the dye solution first, which means that the color obtained in this first step has not yet adhered to the fibers. (Priya & Ea, 2022; Kamel, 2023; Bhouri, Ltaief, Bhouri, & Abdessalem, 2023)

The fibers are then divided into sections and dyed with different adhesives. For example, leaves that are dyed with only one type of dye, when treated with different adhesives, will produce different shades. This allows for a variety of naturally dyed fibers to create fabric patterns, even with only one dyeing material. This method is currently popular because it saves a lot of dyeing resources and is eco-friendly. Furthermore, the shades of fibers dyed with this natural dye are harmonious because they are dyed from the same dyeing material with different adhesives. The resulting dyed colors at the end result are different shades, but these differences are harmonious. This approach is therefore very popular among natural dyeing textile entrepreneurs in Thailand.

Natural dyeing reduces the use of chemicals that can harm the body, affecting the respiratory system, cancer, and skin diseases caused by chemical accumulation from synthetic dyes. (Tang, Lo, & Kan, 2018) Dyeing with natural materials is a safer method, another way to avoid the dangers of chemicals, which can lead to various diseases. This demonstrates the impact of chemical use on health and the environment. To promote the importance of natural dyeing in fashion design studies, the study aims to create beautiful, fashionable trends that are safe for individuals and the environment, and serve as a guideline for community development.

2. OBJECTIVES

1. To study the color fastness of cotton and silk fabrics dyed with natural materials and various adhesives.
2. To design casual wear using natural dyes from lemongrass and mango leaves.

3. LITERATURE REVIEW

1. Natural Dye Concepts

Natural dyes are fascinating and appealing. Many familiar colors spark creativity and open new perspectives on the world. Experiment! Color can be drawn from a variety of sources. Once fabric or fiber is prepared for dyeing, it absorbs color, creating a wide range of results, from deep, jewel-like tones to muted grays and pastels. Color changes can be easily achieved by altering any of the dyeing components. The acidity or alkalinity of the water used to dye natural fabrics (in both the dye bath and the dye bath) affects the color. Soft water is best for most natural dyes, except for sycamore, welsh, logwood, and brazilwood. These dyes thrive better in hard water (containing calcium and magnesium salts). Most natural dyers consider rainwater to be the best water (although in some areas it may be more contaminated than tap water). River water is the next best, and well

or tap water is the last choice, as it often contains the most contaminants. For dyes requiring hard water, Calcium carbonate can be added in the form of finely ground chalk or antacid tablets (Tum's, Rolaid) (Repon et al., 2024). Household ammonia, baking soda, or wood ash can also be added to raise the pH. If local hard water needs to be acidified, a small amount of vinegar, lemon juice, or citric acid can be added. Iron-containing water is difficult to use for natural dyes because it will obscure the color. In this case, the color will fade, or the color will appear lighter and darker. Use neutral pH water (pH 7) when washing and rinsing naturally dyed fibers and fabrics, otherwise the color may change. A pH test strip kit is a good way to test water quality. Yarn is the easiest material to dye. Woven materials must be handled with care to ensure consistent color. An adequately large dye pot is therefore important. The tightness of the fabric is also important. Clothing is the most difficult material to dye. Be careful with synthetic seams (the color will not stick) and areas of wear and tear or perspiration, as the color will not be uniform. When using wool, care must be taken not to flake. Colorfast dyeing often requires the use of a bleaching agent. Bleaching agents are metallic salts that help the dye to adhere to the fibers. Cellulosic fibers also require tannins for adherence. Tannins are not technically a bleaching agent (they are not metallic salts), but are often referred to in the bleaching process for cellulosic fibers, such as "bleach with alum at a concentration of 15% by weight of the fiber and myrobalan at a concentration of 5% by weight of the fiber." Potassium aluminum sulfate alum is the most commonly used bleaching agent by dyers for protein (animal) and cellulosic (plant) fibers and fabrics. It improves the brightness and wash fastness of all natural dyes, and it maintains the clarity of the color. It is inexpensive and safe to use. Extracted from bauxite, the raw aluminum ore, it is free from impurities (such as iron) that other alums may use, at a concentration of 15% by weight of the raw fabric (Barber, 1991, Alegbe & Uthman, 2024).

2. Design Concept

Design is a creative problem-solving approach created by humans, using the knowledge and principles of art to create beauty and utility. Beauty is primarily derived from psychological perception, as the mind expresses feelings of like, dislike, satisfaction, or dissatisfaction, or the expression of needs (Rittibul, Boontonglek, Ngerndang & Nasom, 2025). Therefore, it can be stimulated by various things. Generally, people perceive beauty and satisfaction in various things, and thus there are no clear criteria for determining these values. Therefore, design results must be based on the visual perception of the form of the object. Form is what creates happiness and satisfaction for those who encounter it. Design or creative works include the design of everyday objects, beautifying spaces, and creating works of art. Utility is often prioritized to meet physical and mental needs. Therefore, utility design is primarily concerned with consumer goods essential to the daily lives of people in various occupational groups, such as housing, clothing, vehicles, tools, agricultural equipment, and office equipment. These benefits are directly focused on physical benefits. Therefore, product design Designers, therefore, need to possess excellent knowledge and skills in translating their imagination into product design. This aims to create aesthetically pleasing works, particularly those that emphasize function, combining aesthetics and utility. This ensures that they can effectively meet the needs of a diverse group of people. The importance of design is that it can solve various product problems. Therefore, design is crucial and valuable to human life, with its endless physical, emotional, and attitude needs. Furthermore, design can contribute to the successful completion of various operations (Inkong, 2020).

3. Product Prototype Creation Concept

A product prototype is a final design model for a product designed for testing. Prototypes are created to assist entrepreneurs and those involved in product development in analyzing and testing the product before proceeding to production. Final production, or prototyping, requires gathering customer feedback for product evaluation. Following this process, the actual prototype is produced. During the collaborative design and development (R&D) phase, once the product's conceptual details are crystallized, the prototype is created, a tool for research and development. Prototypes enable designers to explore designs, test theories, and verify product performance before actual production begins. Prototypes are useful for validating design concepts, identifying product design patterns, including appearance, materials used, manufacturing processes, and technologies. Prototypes serve as a tool for studying consumer user experiences, allowing designers and those involved in product development to experience the actual product before proceeding to production. Furthermore, prototypes facilitate clearer communication when presenting new products to executives or customers, as three-dimensional visualizations facilitate understanding

more easily than verbal explanations. Even sketching a product on paper isn't as comprehensive as creating a prototype. Since a prototype is tactile, it truly creates a direct, shared experience between designers and consumers. Therefore, the concept of product prototyping is crucial for product design research, as it reflects the benefits consumers will receive from using the product, such as its functionality and value in various aspects. Researchers have therefore incorporated this into consumer market trials to select products for further production and distribution, allowing for appropriate adjustments. This reduces production costs, as consumers can evaluate and refine their purchasing decisions by experiencing the product's shape and form, identifying design flaws and addressing them before actual production begins, significantly saving time and cost (Keawpan, Itsaranuwat, & Plangnok, 2020).

4. METHODS

The research design is a mixed methods research design between experimental research and creative research with the following research processes:-

1. Research preparation stage

The researcher studied and researched information from books, academic documents, textbooks and related research to analyze the data.

2. Research Process

The researchers used the ADDIE Model to define the steps in the process as follows:-

1. Analysis: Review relevant theories, concepts, and research documents, such as fabric patterns, design techniques, current market demands, and other relevant product data. This information serves as a guideline for study, research, and data collection.
2. Design: Analyze data to develop a casual wear design concept, creating unique community-specific designs with aesthetic appeal that will appeal to consumers.
3. Development: Design fabric patterns and draft prototypes using five naturally dyed fabrics to create unique designs that align with current consumer preferences. This approach aims to capture consumers' attention in an era where cultural capital is being leveraged to create social value and economic value. This participatory process stimulates and supports creativity, or soft power, to enhance and develop knowledge, skills, and creativity.
4. Implementation: Cotton and silk fabrics were dyed with natural dyes, including mango and lemongrass leaves, and then processed with binding agents such as salt, alum, and limewater. These were then used to produce prototypes of casual fashion wear.
5. Evaluation: Product-to-object fit indexes were calculated using the IOC formula and a ready-made statistical program for data analysis. The following were used:

5.1. Design: Satisfaction was assessed by the sample group, with data expressed as means and standard deviations.

5.2. Product Suitability: Satisfaction was assessed by the sample group, with data expressed as means and standard deviations.

5.3. Material Suitability: Percentages were expressed.

5.4. Overall satisfaction was assessed by the sample group, with data expressed as percentages.

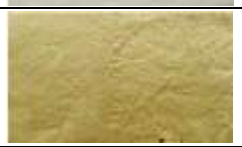
5. RESULTS

1. Study The Color Adhesion of Cotton and Silk Fabrics Dyed with Natural Materials and Different Types of Adhesives.

1.1 The researcher studied the color adhesion of cotton and silk fabrics dyed with natural materials and various adhesives and found that each natural dye gave different colors. In addition, mordants are the main ingredients that make the color adhesion durable and long-lasting. Lime water, salt, and alum water are the main ingredients that make the fabric brightly colored, as shown in Table 1.1.

Table 1.1: The Color Adhesion of Cotton and Silk Fabrics Dyed with Natural Materials and Different Types of Adhesives.

Fabric type	Material	Quantity	Adhesive agents		
			Salt Weight: 5 grams	Lime water 50 cc	Alum Weight: 5 grams
Cotton Weight: 3 grams	Mango leaves Weight: 10 grams	500 cc. water			

	Lemongrass leaves Weight: 10 grams				
Silk weight: 3 grams	Mango leaves Weight: 10 grams	500 cc. water			
	Lemongrass leaves Weight: 10 grams				

From Table 1.1, it was found that the natural dyeing from mango leaves using cotton fabric as the dyeing material in this dyeing experiment found that the natural dye from mango leaves using alum dyeing agent had the highest color absorption, yielding a light-yellow color. However, the color absorption using salt and lime water dyeing agents was poor. The natural dyeing from lemongrass leaves using cotton fabric as the dyeing experiment found that the natural dye from lemongrass leaves using salt dyeing agent performed well, followed by alum dyeing agent. However, the adsorption from lime water dyeing agent was low. The natural dyeing from mango leaves using silk fabric as the dyeing experiment found that the natural dye from mango leaves using alum dyeing agent had the highest color absorption, followed by salt dyeing agent and lime water dyeing agent. The natural dyeing from lemongrass leaves using silk fabric as the dyeing experiment found that the natural dye from lemongrass leaves using alum dyeing agent had the highest color absorption, followed by lime water dyeing agent and salt dyeing agent.

In conclusion, the results of this experiment on natural dyeing for fashion found that silk was the most suitable material for dyeing with lemongrass leaves, followed by mango leaves and three types of dyeing agents: salt, lime water, and alum. With a color fastness value of level 5, the highest, and durability for actual use according to textile testing standards.

2. To Design Casual Wear by Dyeing with Natural Colors from Lemongrass and Mango Leaves.

The researcher applied knowledge in design to design 5 models of casual wear prototypes before making them into prototype products dyed with natural colors from mango leaves, lemongrass leaves. The research results are as shown in Table 1.2.

Table 1.2: Design Of 5 Prototype Casual Wear Models.

number	Sketch	Prototype image	Casual Prototype
1			

2			
3			
4			

5			

Figure 1: Colors For Sewing Fashion Products.

Table 1.3: Assessment of Consumer Satisfaction with Fashion Products from Natural Dyes (N=30).

Evaluation list	$\bar{x}$	S.D.	Satisfaction level
In term of design			
The prototype design has interesting patterns, colors and decorations.	4.62	0.62	Most
The prototype design features a unique expression of creativity in design, form and functionality.	4.67	0.54	Most
The prototype design has the characteristics of appropriate form, color, material harmony, perfect shape and complete elements.	4.67	0.60	Most
In terms of the suitability of the prototype of the product from natural colors			
The prototype product is suitable for composition with the pattern.	4.80	0.40	Most
The prototype product is suitable for usage	4.77	0.43	Most
The prototype product is interesting and attractive to users.	4.73	0.45	Most
In terms of suitability of using natural materials			
Materials that are easily available locally.	4.87	0.34	Most
The materials used are beautiful.	4.73	0.45	Most
The materials used have a clear design.	4.87	0.34	Most
In term of satisfaction with implementation			

The products are exquisitely beautiful.	4.73	0.45	Most
The product is convenient to use.	4.77	0.43	Most
The product is environmentally friendly.	4.83	0.37	Most
The product is valuable and has a price.	4.80	0.40	Most
Overall satisfaction	**4.75**	**0.45**	**Most**

The analysis results in Table 1.3 revealed that the prototype design exhibited creativity in designing unique shapes and functions. The design also had appropriate forms and colors, blended materials, and a complete, complete form, with an average of 4.67 percent, the highest level of satisfaction. The prototype product had interesting patterns, colors, and decorations, with an average of 4.62 percent, the highest level of satisfaction. In terms of the suitability of the prototype of the natural dye product, the prototype product had the most appropriate composition and pattern, with an average of 4.80 percent. Next, the prototype product size was appropriate for use, with an average of 4.77 percent, the highest level of satisfaction. The prototype product was interesting and appealing to users, with an average of 4.73 percent, the highest level of satisfaction. In terms of the suitability of using natural materials, materials that are easily available locally, and materials with clear designs, the average of 4.87 percent, the highest level of satisfaction. The materials used were beautiful, with an average of 4.73 percent, the highest level of satisfaction. In terms of satisfaction with use, the product was environmentally friendly, with an average of 4.83 percent, the highest level of satisfaction. Next, the product was valuable and expensive, with an average of 4.80 percent, the highest level of satisfaction. The product was convenient and comfortable to use. The average of 4.77 percent is the highest and least satisfied level. The product is exquisite and beautiful. The average of 4.73 percent is the highest satisfied level. The overall satisfaction level is the highest satisfied level.

6. DISCUSSION

From the art of fashion design to natural dyeing, we studied the color adhesive of cotton and silk dyed with natural materials and various dyeing agents, to design casual wear using natural dyes from lemongrass and mango leaves.

From the experiment of dyeing natural colors from mango leaves using cotton fabric, it was found that natural colors from mango leaves using alum dyeing agent had the highest color absorption, yielding a light-yellow color. As for salt and lime water dyeing agents, the color absorption using cotton fabric was poor. The experiment of dyeing natural colors from lemongrass leaves using cotton fabric using cotton fabric showed that natural colors from lemongrass leaves using salt dyeing agent performed well, followed by alum dyeing agent. However, lime water dyeing agents had low adsorption. The experiment of dyeing natural colors from lemongrass leaves using silk fabric showed that natural colors from lemongrass leaves using alum dyeing agent had the highest color absorption, followed by lime water dyeing agent and salt dyeing agent. The experiment of dyeing natural colors from mango leaves using silk fabric using silk fabric showed that natural colors from mango leaves using alum dyeing agent had the highest color absorption, followed by salt dyeing agent and lime water dyeing agent. In line with Bishal et al. (2023), natural dyes and their applications play an important role in various purposes, such as in textiles, cosmetics, and food products. They can be extracted from natural sources such as roots, leaves, and barks. Natural dyes are more environmentally friendly and effective, and have attracted the attention of the industry due to their better environmental compatibility and better biodegradability. The textile industry has begun to use natural dyes to dye various fabrics, and people have begun to utilize natural dyes in various applications of natural dyes on textiles. In line with Jordeva, Kertakova, Zhezhova, Longurova, & Mojsov (2020), the use of natural dyes in textile dyeing has great potential. By using appropriate dye extraction processes and dyeing techniques for natural textiles (cotton, wool, and silk), beautiful and durable dyes can be obtained. Natural dyes are environmentally friendly, renewable, biodegradable, and do not harm human health. However, most of them require bleaching agents for textile dyeing. Some synthetic bleaching agents are not environmentally friendly. The color of the dye on the fabric depends not only on the bleaching agents used, but also on the dyeing technique. Although natural dyes have many advantages, they also have some limitations, such as difficulty in changing color. Color changes are susceptible to sunlight, perspiration and air, and in line with Mabuza, Sonnenberg & Mark-Pienaar (2023), the commercialization of natural dyes relies on a consumer-centric approach to identify the characteristics that are crucial to consumers' apparel

choices. The insights gained from this study can guide future interdisciplinary expertise, focusing on multiple areas including raw material sourcing, dye extraction, analysis, properties and applications, to align with consumer needs. Furthermore, unbiased consumer knowledge and the extent to which consumers perceive limitations as barriers to consumers' choice of naturally dyed apparel as a more sustainable option are critical. And, at Fabric Sight, we are committed to offering fabrics that reflect this commitment to the environment. Choosing naturally dyed fabrics not only supports environmentally friendly practices, but also allows us to enjoy the unique and vibrant colors of these dyes. Explore our organic and sustainable fabrics today and join us in making a positive impact on our world.

The results of natural dyeing using lemongrass and mango leaves, along with three dyeing agents salt, limewater, and alum on silk and cotton fabrics led researchers to design casual wear using naturally dyed fabrics to achieve beauty and modernity. This aligns with the concept of Pizzicato, Pacifico, Cayuela, Mijas, & Riba-Moliner (2023). Natural dyes, emphasizing sustainable innovation in various aspects, including extraction techniques, precursor preparation, mordant processes, and dyeing processes, demonstrate the successful adoption of new technologies and techniques to improve the efficiency and sustainability of the natural dyeing process. This aligns with Park (2013)'s widespread use of natural dyes and the need for further research to expand their use beyond niche applications. Furthermore, in line with Wongmuek (2025), the way of life of people in communities is related to important social and cultural capital areas that reflect the feelings, thoughts, and ways of life of the community, resulting in four themes: 1) culture and traditions, 2) important places of spiritual value, 3) social capital, and 4) natural resources. This reflects the Roi Rak community enterprise in various dimensions as well. It said that the utility of product design must meet the intended use, not just be beautifully designed. Currently, utility can create a good selling point for the product and aligns with the concept of Komonsirichok, Sutakcom, & Mitpaeng (2024), who stated that all products must have a functional purpose that meets the user's needs efficiently and conveniently. It is also consistent with Kaewthong (2017), who found that consumer attitudes towards sustainable fashion products and sustainable fashion approaches positively influence the intention to purchase sustainable fashion products. It is also consistent with the concept of Ngamnisai (2018), who stated that the perspective of creating or improving from the traditional to the contemporary should be consistent with trends, and newly created products must be usable in everyday life. It is also consistent with the research results of Inkong (2020), who found that souvenir products must be usable so that consumers are aware of their utility. It is also consistent with Dechsri & Wisetprapha (2022), who found that consumers in Bangkok decide to purchase eco-friendly products.

7. SUGGESTION

1. Expanding the Scope of Raw Materials and Sustainability
- Exploring New Natural Plants: Research and experiment with potential but untapped natural plants for creating natural patterns and dyes to create a variety of patterns and colors.
- Developing Eco-Friendly Techniques: Focus on in-depth research on natural dyeing techniques.
- Zero-waste or minimal energy/water consumption, such as direct contact dyeing and the use of natural dyes, to enhance sustainability selling points.

2. Technology and Design Applications
- Digital Research and Simulation: Study the use of Computer Aided Design (CAD) or Artificial Intelligence (AI) to reproduce or simulate the colors of natural plant patterns in fashion to ensure accurate and rapid production.
- Durability Assessment: Conduct experimental research to compare the color fastness of natural plant patterns with natural dyes, particularly for heavy-duty products.
- Functional Design: Study the application of natural plant patterns to functional fashions, such as breathable and antibacterial fabrics, to increase product value.

3. Economic and Marketing Value Creation
- Market Demand Analysis: Conduct market research to assess the willingness of target consumers, such as environmentally conscious and premium consumers. to pay more for products using natural patterns and dyes.
- Storytelling and Branding: Study communication and marketing strategies that emphasize plant sources, environmentally friendly processes, and local wisdom to create emotional attachment and increase brand value.
- Knowledge Transfer and Networking: Study technological models and share knowledge with the general public interested in natural

dyes to strengthen production capabilities and connect natural plant producers with fashion entrepreneurs.

- Cost-Benefit Analysis: Study and analyze actual production costs, from harvesting to finished products, to create a sustainable business model.

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