



AN EXPERIMENTAL STUDY ON THE USE OF ECO-PRINTING AND NATURAL DYES ON HOTEL LINENS FOR ENVIRONMENTAL SUSTAINABILITY

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ARTICLE INFO	ABSTRACT
<p>Article history: Received: 05-04-2025 Received in revised form: 23-05-2025 Accepted: 20-06-2025</p> <p>Keywords: <i>Eco-printing, Natural dyes, Hotel linens</i></p>	<p>Due of worries about synthetic colours' environmental effect, natural dyes in hotel linens have gained popularity. Natural colours from plants, animals, and minerals are eco-friendly alternatives to synthetic dyes. Natural dyes reduce pollution, improve air and water quality, and provide beautiful hues, which hoteliers are recognizing. Natural dyes may colour hotel bedding, towels, and tablecloths. Natural dyes may help hotels stand out in a competitive industry. This article discusses designing and eco-printing hotel linen using natural dyes. Different treatments were applied to the textiles, which were then coated with a polyester sheet and pre-mordanted natural materials. The goal was colourful eco-printed fabric textures. The findings showed that the naked eye can clearly distinguish colour hues and textures when pre-mordanting textiles with different natural materials and mordants. Colours and textures stood out.</p> <p>© 2025 The Authors. Published by IASE. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).</p>

INTRODUCTION

Eco-Printing, botanical printing, eco-dyeing, or leaf printing is a process that goes by a few different names and involves plants, leaves, flowers, and other types of floral matter, leaving their patterns, colours, and imprints on cloth. The process of making eco-dyed or printed cloth begins with the bundling of plant material with cloth, followed by the binding of the bundle, followed by the application of heat in the form of steaming, which transfers the colour from

the plants to the fabric. Dying the cloth is an enjoyable procedure that results in a wonderful look for the finished product (Rekaby et al., 2009).

Plants will impart some colour, but only specific plants or flowers, when coupled with various other components, will produce long-lasting colours. Eco-printing allows you to engage with plants in their latter stages of life, travelling around the forest or your garden while gaining a new perspective on the world. Gather a handful of the leaves lying around on the ground,

place them on some cloth, coil them into a bundle, and then steam them. The heat transfers the pigments and pictures onto the cloth, creating an ethereal design that is an explosion of colour and pattern. When used in place of traditional ink, vegetable-based ink has the benefit of not requiring any additional tools or training to be applied. This makes it a convenient alternative. It can be printed using standard offset presses and is becoming more readily available. Inks made using vegetable bases substitute a portion of the petroleum basis with oil generated from plants, which can significantly cut down on the emissions of volatile organic compounds. Canola, sunflower, linseed, tall, or soy oil are all examples of the oils used for this bio-derived product.

On the other hand, vegetable-based inks take longer to dry and may require a longer heat setting, which increases the amount of energy that a printer uses (Klaichoi et al., 2012). Additionally, ink labels are only sometimes what they appear to be. When an ink bears the name "Soy Ink," popularised in the 1990s by the American Soybean Association, it indicates that the ink includes a predetermined minimum amount of soybean oil; this number can be as little as 7%. Therefore, an ink might include more than 90 per cent petroleum oil while yet

being eligible for the title of "soy ink" (Ismal, 2016).

Terminology

The outcome is the same regardless of whether you refer to it as "contact printing," "eco-printing," or "eco-dyeing." The term "eco-printing" often refers to a way of transferring a pattern; the term "eco-dyeing" focuses on the chemical bonding that results in a dye-printed surface; and the term "contact printing" refers to a method of printing (Mongkholrattanasit, 2022).

History of Eco-Printing

Before the middle of the 1800s, the only way to impart colour to textiles was through natural dyes. The plant ingredients were traditionally used to make "tea," which was then strained into a large pot of copper or iron. This process was the norm. The material interacted with the tea, and as a result, the fibre took on the colour of the liquid. The dyers would swirl the mixture frequently to maintain its consistency. Dyers have honed their craft through the years by refining and exchanging their knowledge of natural dyeing processes, allowing them to identify which plants provide the best colours. The consequences of Eco-Print may be recognizable to readers who have consulted various sources.

Inventor of Eco-printing

India Flint (1958) is a textile artist and colour developer who developed the method of Eco-printing. Flint was born in India. India Flint was born in Melbourne, Australia, but spent her first three birthdays in Montreal, Canada. While she was born in Australia, she grew up in Canada. Not only did this establish a restless pattern, but it also meant that when she started her official schooling once the family eventually moved back to Australia, mastering English was the first obstacle she faced. Her maternal grandmother, an incredibly patient re-threader of needles and over dyed fading clothing in various combinations of tea leaves, calendulas, and onion skins, helped her through her initial efforts at sewing. She over dyed garments in a variety of colours She discovered felt by accident when she was a little child while she was furiously cleaning wool that she had taken from barbed wire fences near Werribee. Her passion for textiles was significantly nurtured by her mother, who constantly appeared to have embroidery or knitting project in hand and brought her to an infinite number of museums throughout the family's travels worldwide (Inuin, 2023).

The unique Eco-print is now a defining characteristic of India's textile practice. It was developed while studying for a Master of Visual Arts at the University of South

Australia. Even though she has made the method's specifics accessible to dye practitioners to assist them with the colour evaluation of eucalypts, she has done so with the understanding that the procedure would not be utilized in a commercial setting such as hotel linen (Barb, 2017).

The Value Behind Sustainability

The expense caused by waste Since the severity of the environmental issue is now a well-known fact, businesses, especially print design companies, have been considering methods to include environmentally responsible practices into their work ethics to remain competitive. The procedure takes a long time, and steps only appear to be done once problems get severe enough. However, the conventional wisdom of yesteryear held that ecologically responsible business practices. The viability of a company's capacity to compete and make a profit goes hand in hand and is progressively being disproved. The disagreement between those on the "green" side and those on the "business" side has reached an impasse. It is possible that the ire of the environmentalists and the defensiveness of the corporate community served as a useful distraction for some time so that serious action could be avoided. Creativity and openness to new ideas to be successful, sustainable businesses need to find a way to separate themselves from

their conventional competitors and other green enterprises. It is no longer enough to pursue financial gain as one's only objective to appease the environmentally conscious aspirations of today's well-informed consumers (Browing, 2022). Even the entire concept of consumption and the framework of our economic system would need to be reexamined, but that is another subject. In addition to having specialist expertise in sustainability, a "green print business" has to be innovative and daring in all aspects of its operation, from the administration of the office to the communication strategies and frameworks (Pamungkas, 2020).

STEPS FOR MAKING ECO-PRINTS

Scouring:

Scouring is a preliminary treatment that may be applied to many textile fabrics. Scouring eliminates soluble and insoluble contaminants, such as oils, waxes, fats, and dirt. Scouring is used in the textile industry to describe cleaning fibres before mordanting and dyeing them. Scouring does not apply to washing garments in a washing machine. If the fibre is not clean, the mordant and dyes will not effectively cling to the fiber (Indigowares, 2023).

Mordants:

Mordants are essential for achieving the desired colour result when working with natural dyes. When combined with the same dye, several mordants will produce a

wide range of hues. A mordant is a chemical agent enabling a reaction between the dye and the cloth. This reaction is necessary for the colouring process. Mordants are used in the textile industry to fix the colour during the dyeing or printing of cloth, particularly for fibres originating from plants (Cotton). Cotton has an extremely poor ability to absorb natural colours. Tannins are an essential component of the cotton dyeing process and play a significant part in the preparation of Cotton, which is done so that it may more effectively retain colouring matter over time (Indigowares, 2023).

Dyeing:

When you have finished placing plant materials onto cloth, coil or fold it up tightly, knot it with twine, and then steam it to release the colours from the plant components into the fabric (Indigowares, 2023).

LITERATURE REVIEW

The eco-printing technique appears to be more complex than it would first appear. Kavyashree (2023) emphasized the need for talent in this endeavour. She explains the method: "This process is a one-of-a-kind art where no two pieces can be similar." Certain vegetation types leave a lasting impact when the seasons change, while others do not. The outcome is highly dependent, to a large extent, on the

circumstances in which the materials are dried. While the designer discusses the procedure with the customer, they note that several elements significantly influence what ultimately occurs with the cloth. "To begin, the cloth is cleaned with soap in a very cautious manner and thorough manner. The cloth is then mordanted, which simply means that it is coloured in various hues after that. During this step, the item is submerged in various solutions, including tea, indigo, etc. After that, it is stretched out, and exposure to the sun is permitted to cause it to dry. Radiation from the sun is another factor that significantly impacts the final result. A cloudy day may impair the impression. After it has been washed and dried, the cloth is next prepared for dyeing and eco-printing. The designer does not dye the materials used for distinct leaves. She instead rolls them very firmly to guarantee that the leaves come into contact with the fibre and that it is imprinted correctly. This is done to ensure that the leaves are properly stamped. It depends on the leaf type, but she steams or boils them for three to four hours. "Boiling will result in prints that are dispersed." "The prints are darker," is all she has to say about it. However, eco-printing can only be done on specific materials compared to other printing methods.

Haar (2011) conducted a study on eco-printing with plants. Khadi fabric is a type of textile that is traditionally hand-spun and hand-woven out of Cotton, although you can also get khadi wool and khadi silk these days. Because of its widespread appeal among young people, adults, and designers, khadi cloth has become a new fashion statement. Because of rising awareness regarding environmental pollution and the potentially hazardous effects of synthetic dyes, the use of natural dyes that are non-toxic and friendly to the environment has emerged as a topic of great importance in the textile industry. In this work, the author addressed the standardization process of dyeing and printing using three selected natural dyes and five natural mordants to generate eco-friendly designs on cotton khadi fabric. These dyes and mordants were obtained from natural sources. Subjective assessment was used to analyze the effect of dyes and mordants on the preliminary qualities of the khadi fabric, as well as the various colours achieved on the printed cloth.

Tiwari and Srivastava (2020) performed a study on the development of eco-friendly print on cotton khadi fabric with selected natural dyes and natural mordants. Yogyakarta is one of the centres of batik that has already established a strong reputation worldwide. The Bering harjo

Market on Malioboro Street and the centre of batik, located in the Imogiri sub district of the Bantul Regency, are two of the many locations in Yogyakarta where tourists can purchase batik. Irwan Tirta describes batik as "a technique for decorating fabrics or textiles by using wax in a colour dyeing process," adding that the entire process is carried out by hand. Batik is a kind of Indonesian folk art. Either by printing the resist using a copper stamp known as a cap or by painting dots and lines of the resist using a spouted instrument known as a tjanting, batik may be created in either of these two ways. In most cases, individuals are only familiar with the following three varieties of batik: hand-made batik, copper-stamped batik, and printed batik. However, with the expansion of the textile industry came a new type of batik method known as eco-print batik. Because it uses materials already available in the community, batik eco-print is a textile activity that is kind to the environment. This batik eco-print generates motives from nature, such as leaves with their arrangement of motives, which are free and do not hold any symbolic significance so that they may be incorporated into current motifs. In general, this batik eco-print differs somewhat from traditional handcrafted batik since the motives produced by this batik eco-print are from nature. The

objective of this study is to create an entrepreneurial venture to enhance and expand existing local batik companies in the Puri Mojo Asri neighbourhood of Sleman, Yogyakarta. As a current development, artisans working with batik and eco-print are returning to improve their manufacturing capacity. To produce further goods made from eco-print cloth for the fashion industry and use in home design, such as pillows, bolsters, curtains, and other items. A qualitative approach was taken for this study's research methodology. Noto Pamungkas and Colleagues (2020).

OBJECTIVES

- Printing methods by using towards eco-printing by making use of natural dyes on hotel linens.
- To produce something novel in the hotel industry, offering a wide range of creative possibilities and serving the needs of the general public.
- Prepare different eco-ricing and use different natural kinds of stuff by changing different mordants by Pre-Mordanting on different fabrics.

RESEARCH METHODOLOGY

This section of the article has provided a conceptual overview of the print design field's current inability to print design. The

objective was to demonstrate how the notion of sustainability emerged and the conceptual, technological, and financial advancements it provides to the printing business. Based on the findings of this preliminary research, the concept that all of these shifts might play an important role in the need to reinvent print design in the future was brought to light.

Aim

To prepare different eco-print samples using different natural kinds of stuff by changing different mordants by Pre-Mordanting on different fabrics.

Materials Used

1. Degummed silk fabric
2. Scoured cotton fabric (Markin)
3. Scoured cotton fabric (Poplin)
4. Rubber bands
5. Cotton crochet thread
6. Polyester sheet
7. pH paper
8. Potassium alum (Hydrated potassium aluminium sulfate - $KAl(SO_4)_2 \cdot 12H_2O$)
9. Iron rust (Hydrated ferric oxide - $Fe_2O_3 \cdot H_2O$)
10. Vinegar (CH_3COOH)
11. Stainless-steel vessels
12. Perforated stainless steel plate
13. Burner (household LPG gas flame)
14. Aegle marmelos leaves
15. Red sanders leaf
16. Marigold leaves

17. Onion peels
18. Guava leaves
19. Jackfruit leaves
20. Mango leaves

Calculations

The weight of all materials may vary slightly from previous experiments as the main objective is to produce interesting-coloured eco-printed textures on the fabric.

Procedure

- All the natural materials were placed in a solution of Potassium Alum (Hydrated Potassium Aluminum Sulfate - $KAl(SO_4)_2 \cdot 12H_2O$) and Vinegar (CH_3COOH) for samples 1-7. For the remaining samples (8-17), the natural materials were dipped in a solution of Iron Rust (Hydrated Ferric Oxide - $Fe_2O_3 \cdot H_2O$) and Vinegar (CH_3COOH) and kept overnight for pre-mordanting.
- The next morning, a specific fabric was soaked in fresh tap water, and Sodium Chloride was added to improve the dye's penetration into the fabric. It was kept submerged for 30 minutes.
- The pre-mordanted natural materials were placed onto the fabric and covered with a polyester sheet. The fabric was then rolled

and tied using rubber bands or cotton crochet thread to produce a well-composed, naturally coloured texture.

- A vessel was set up with half-filled water, and a perforated stainless steel plate was placed on top. The bound fabric was placed onto the plate and covered with another vessel.
- The set-up was steamed for 30 minutes. Every 15 minutes, the sides of the fabric were alternated by rotating it. This process was repeated for another 30 minutes.
- The set-up was allowed to cool down to room temperature.
- The pre-mordanted and dyed fabric was then removed from the set-up.

- The fabric was left to dry.
- After drying, the rubber bands or cotton crochet thread and the natural materials were removed from the fabric to reveal a well-composed, naturally coloured texture.
- The fabric was washed in a non-ionic detergent solution (Ezee) and allowed to dry again.
- Finally, the fabric was pressed and ready as an eco-printed sample.

RESULTS

The naked eye can easily recognize the colour shades and textures when using different natural materials with different mordants during the pre-mordanting process on various fabrics.

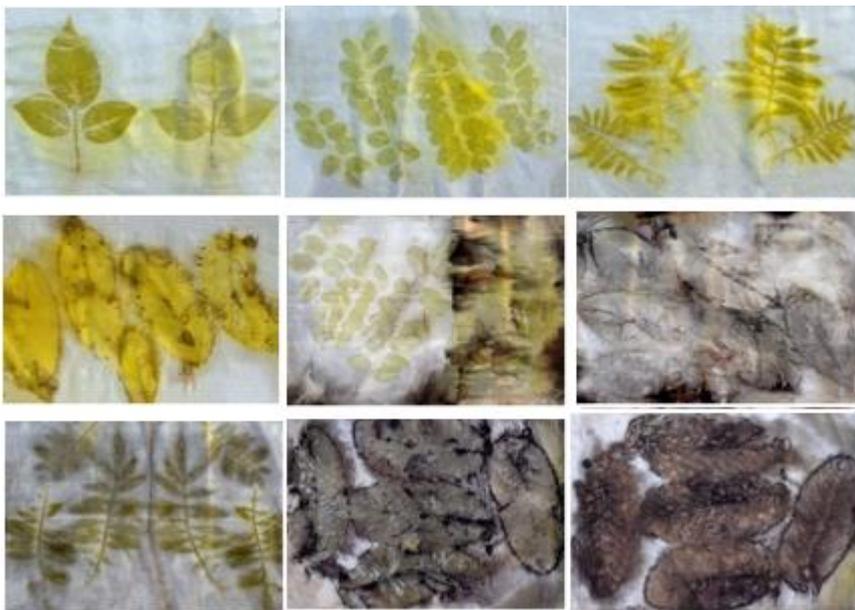


Figure 1: Eco-prints on different hotel linens

Exploration of Natural dyes on different Product ranges

Product Categories:

- Cushion cover design
- Scarf design

Layout of Cushions

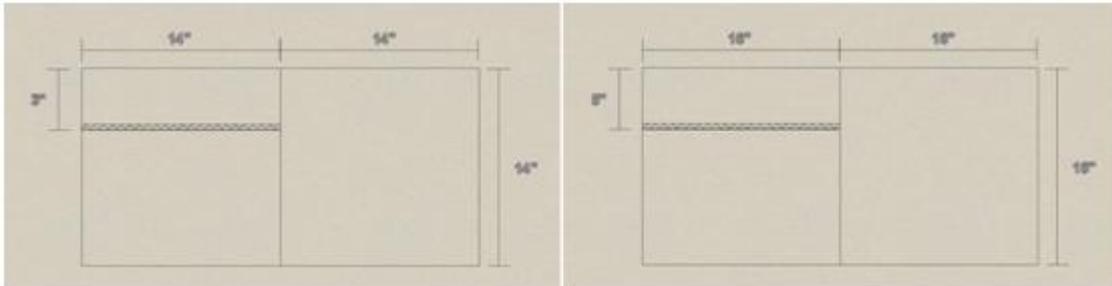


Figure 2: Layout of cushions

Cushions



Figure 3: Eco-prints on cushions

Scarf

- 1) 36"x44"



Figure 4: Eco-prints on scarf (36"x44")

2) 22"x46"



Figure 5: Eco-prints on scarf (22"x44")

3) 36"x44"



Figure 6: Eco-prints on scarf (36"x44")

Observations

- The colour shades and textures are particularly good and noticeable.
- When Potassium alum + Vinegar was used, the colour of the fabrics became brighter and more yellowish, but only slightly more noticeable.
- When Iron rust + Vinegar was used, the colour of the fabrics became darker, brownish-black and slightly less vibrant, but still very noticeable.

CONCLUSION

The field of eco-print design is undeniably going through a transitional phase right now. In this time of environmental strain,

the printing sector, which depends on natural resources, must confront difficult challenges to produce more environmentally friendly manufacturing techniques. Additionally, the proliferation of digital technology has posed a threat to the status of print as a current and relevant medium for communication. The dominance of digital media as the major medium of communication is stronger than it has ever been. Although it is true that the use of print is seeing a gradual but steady decrease, the notion that print is becoming extinct is in no way being conveyed. It is a significant component of our way of life, as well as our culture and our communication patterns, and it will continue to be so. Print is regaining some of its popularity due to the information flows that are becoming increasingly crowded in the digital age. This is because print may help anything stand out from the crowd. Print design has successfully expressed several qualities, including credibility, trustworthiness, authenticity, and materiality, all of which are difficult for digital support to compete with. This is where print excels and should concentrate on maintaining relevance among the various virtual communication channels.

White linen is a common choice for hotel bedding and tablecloths, but it comes at a significant cost to the environment and the bottom line. The production of linen

requires extensive resources, including water, energy, and land, which can lead to environmental degradation and higher consumer prices. Additionally, using harmful chemicals, such as bleach and detergents, during manufacturing and washing can further contribute to environmental harm and negative health effects for workers and guests alike. As consumers become increasingly aware of the impacts of their purchasing decisions, the hospitality industry may need to reconsider using traditional white linen in favour of more sustainable and eco-friendly alternatives.

Through experimentation, a newfound appreciation for the natural colours and beauty of the plants surrounding us was developed. Natural dyeing allowed for extracting and applying these often-overlooked natural hues, resulting in a sense of satisfaction and pleasure. Ultimately, using natural dyes presents a promising solution for promoting sustainability and eco-friendliness in the hospitality industry while offering a unique and personalized experience for guests. Moreover, it is also essential that the move towards environmentally friendly practices stems from a personal determination to challenge the established order and construct an alternative, cleaner and more effective system. It should come as no surprise that the issues that have

arisen directly from worries about the environment are both extremely complicated and comprehensive in scope. It questions our beliefs and ways of life, notably our unrestrained consumption patterns. Instead of concentrating on the issues, which might make one feel like there is no way out, we should look at the opportunities presented by developing alternative solutions.

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