TRADITIONAL TECHNIQUES OF DYEING TEXTILES WITH NATURAL DYES: A CASE STUDY OF SOUTHERN PROVINCE IN SRI LANKA.

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Abstract- Dyeing with plant-based extracts has a long tradition in the world. The desire for more bright and stable colours can be seen as one of the strong driving forces in the historical development of natural dyes. Today synthetic dyes and heavy metal mordants have been identified as serious threat to human and environmental health. Therefore, a new era has come to lookback ancient values and customs. The objective of this study is to find reclaimed system of dyeing according ancient natural dyeing of Sri Lanka.Survey was based on the employees of the Sothern Province hand loom industry. Mode of collecting the data was carried out through personal interviews and telephone survey. Data were tabled according to colour, dye substances, mordant. It helps to compare data and make link in-between. Analysis of data was developed by writing summaries of what have found that leads towards discussion and conclusion. The survey explores thirteen hues of colours including blue, green and turquois shades. Seventeen kinds of plant-based extracts have been explored for different usage. Mordants and colour fastness which are based on extraction of plants have been successfully practiced through ages. This survey shows positive attitudinal practices as beginning a groundwork of good practices, move away of from a dependency on a few dye substances and developing a list of dye techniques with rich cultural traditions and all show the range of skills and resources that are available to us.

Keywords- Natural dyeing, traditional practice, Southern province of Sri Lanka

I. INTRODUCTION

Textiles could be dyed as fibres, yarn or in fabric form. Since ancient time, colouring of textiles was conducted mainly by using the colours extracted from natural sources such as plants and animals, until the synthetic dyes were developed and commercialized in 1856 (Verenker and Krishnan, 2017). Synthetic dyes captured the market almost entirely due to their superior fastening properties, availability of a wide range of colours and cost advantages (Indrianingsih and Darsih, 2013). However, synthetic dyes are petrochemical based, and their toxic nature as well as the resource intensive dyeing process has created adverse environmental impacts (Kant, 2012). Dyeing process uses substantial amount of water, chemicals, and energy. While energy creates carbon footprint and chemical are harmful in nature, removal of wastewater to natural water streams after the dyeing process causes water and environmental pollution (Chequer et al., 2013). The presence of dye particles and also heavy metals in the wastewater such as copper, lead, nickel makes the effluent highly toxic (Kant, 2012). Conventional wastewater treatment technologies could only partially remove those harmful substances

from the dye effluent to date, and therefore the resultant wastewater carries harmful substances to the environment. It is estimated that around 10-50% of the used dyes could be ended up in effluent without fixing to the fabric. Due to these facts, textile dyeing process is categorized as one of the most environmentally unfriendly industrial processes in the world (Chequer et al., 2013).

Due to the toxic nature and the adverse environmental impacts of synthetic dyes, potential use of natural dyes has gained a significant attention in recent years. Even though synthetic dyes captured the market due to various reasons such as wide colour range, brightness and cost advantages, the use of natural dyes has never gone completely out of the textile industry (Samantha and Konar, 2011). It has now been recognized that natural dyes could provide both social and environmental benefits over synthetic dyes, as natural dyes are environmentally friendly and the extraction and preparation process provides employment opportunities for rural communities (Fletcher, 2008). However, there are some drawbacks of natural dyes that hinder them being commercialized and widely used. Usually natural dyes provide a limited and dull range of colours (Kant, 2012). Moreover, long extraction process, moderate colour fastness to wash and light, non-availability in bulk quantities and less reparability made the limited use of natural dyes in the textile industry (Samanta and Agarwal, 2009; Indrianingsih and Darsih, 2013). Nevertheless, the use of eco friendly natural dyes has become significantly important today due to rising environmental awareness around the world, and specially in the textile industry, in order to minimize the adverse environmental impact created in the textile dyeing process.

For successful commercialization and use of natural dyes, it is vital to develop standardized dyeing techniques, improve colour fastness properties, obtain new shades of colours and investigate an economical process for extraction and application of natural dyes (Samanta and Agarwal, 2009). Therefore, a need has arisen to look back and examine the traditional natural dyeing and mordanting techniques to learn from ancient practices and redevelop them to suit for modern world, while maintaining the eco aspects of the product and process. Therefore, this study focused on investigating traditional dyeing techniques in Sri Lankan textile handloom industry with the view of minimizing the unsustainability of the textile dyeing process.

II. METHODOLOGY

The key objective of this study was to investigate the traditional eco dyeing processes and techniques that are still being practiced by the handloom industry in Sri Lanka. There are five handloom weaving centres in Southern Province that currently use natural dyeing for their products. Semi-structured interviews were conducted with five respective employees based on those centres. Semi –structured interviews were selected as the method for data collection because that helps to investigate the situation in detail and obtain rich descriptions from the participants regarding the dyeing process and techniques (Yin, 2003). Interviews were conducted to obtain information regarding the source and type of natural dyes being used, dye process (recipe), mordant (fixing agent), colour fastness and durability of the final product. Follow up telephone interviews were conducted to clarify the process and techniques. Moreover, field observations were carried out to understand the dyeing process. Samples of the coloured yarns using natural dyes were also obtained.

Interview data were summarised and categorised based on the colour range, raw material that are being used to obtain each colour, respective mordant being used and the dye process. Furthermore, colour and wash fastness properties were also investigated in detail for each of the colour.

III. RESULTS AND DISCUSSION

According to the interview results and field observations, a range of natural dyes and natural mordant (fixing agents) were discovered. According to the respondents, the final colour of the material is depending on the dye recipe as well as the mordant. Usually plants extracts are used in raw form, or dried form, or powder form. From all three forms, colour intensity was found to be high. To obtain a powder, plant extracts are chopped into small pieces, dried them in sunlight and grind them to obtain a dye power. Plant extracts are not only used as dyes, but also as a mordant (fixing agent) in the dyeing process. Either plant extracts or non-toxic mordants such as Alum are always being used in the dyeing process as shown in Table 1. Clay pots are used as the dye bath in which dyes and mordant are mixed with required amount of water and boiled with the yarns using fire wood. The colour fastness to the fabric is checked time to time by visual observation and the fabric is kept in the dye bath

until the yarns absorb the expected colour evenly. Once taken out of the dye bath, the yarns are washed few times with cold water until the colour is not washed off with the fabric. Moreover, to achieve better colour fastness, bombu leaves (*Symplocoscochinchinensis synonym: Symplocosstawellii*) are put into the cold water. Finally the yarns are dried in air.

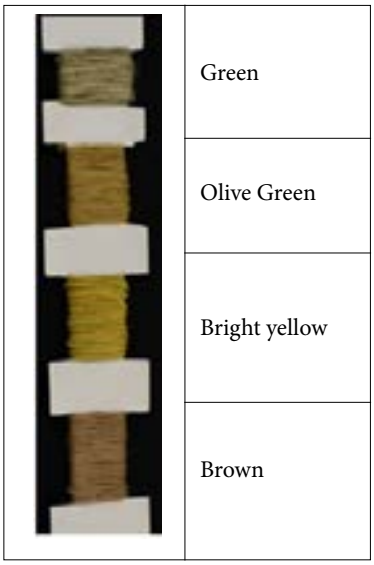
The general understanding of using natural dyes is that there are difficulties in obtaining a colour range as well as bright and dark colours. However, according to the Table 1, the respondents were able to obtain a colour range and also bright colours and dark colours, only by using natural dyes and natural or environmentally safe mordants. For example, three shades of green colour were obtained using different natural dyes, but using same mordant. A range of bright colours such as Bright yellow, turquoise blue, reddish pink could be obtained as shown in the Table 1, and according to the respondents, the resultant fabrics made out of those dyed yarns were shown good colour fastness properties even after 5-6 years even after undergoing more than 20 washes.

Table 1. Summary of colours obtained using plant extracts

Colour	Dye Substance	Mordant (Fixing Agents)
Green	Asparagus *Racemosus* (Hathavariya raw leaves)	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
Olive Green	*Terminalia Chebula* (Aralu) and Corcuma longa (kaha /turmeric)	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
yellowish green	*cococ nucifera* (Kaha-kada) (thinner inner layer of the king coconut shell) and *Corcuma longa* (kaha /turmeric).	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
Light yellow	*Zingiberofficinale* (Val-inguru root in raw)/ (local ginger)	KM_nO_4 (Potassium manganate)
Bright yellow	*Zingiberofficinale* (Val-inguru root in raw)/ (local ginger) or *Nyctanthesarbor –tristis* (dried sepalika flowers)	KM_nO_4 (Potassium manganate)
Blue	*Corcuma longa* (kaha /turmeric)/ *Cosciniumfenestratum* (veniwel-geta) / *Artocarpusheterophyllus* (jack roots)/ *Corcuma longa* (raw kaha roots/ Turmeric)	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
Turquoise Blue	*Indigoferatinctoria* (Chopped Nil-avariya)	$CuSO_4$ (Copper(II) sulphate) or $KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
Navy blue	*Indigoferatinctoria* (Chopped Nil-avariya) leaves are leave in cool water for a day- the powder is leave at the bottom. Strain and dry in sun light until it become powder.	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum) or Calcium oxide (CaO),(*aluhunu*)
Reddish pink	*Corcuma longa* (kaha /turmeric)/ *andIndigoferatinctoria* (Nil-avariya)	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)
Purple	Terminalia Chebula (Aralu)	ferrous (Fe^{2+}) (an Iron nail is to dissolve in water) or Alternanthera sessilis (mukunuvenna)

Colour	Dye Substance	Mordant (Fixing Agents)
Reddish brown	Allium cepa var. aggregatum (Dried rathulunu peals) / *Caesalpiniasappan* (pathagi)/raw hibiscus flowers (Hibiscus rosa-sinensis) /RubiaCordifolia (vel Madata creepers)	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum) orMemecylonedule, Memecylonumbellatum (Blue mist) Korakaha-leaves
Brown	Garcinia Mangostana (Husks of purple mangosteen)or *Caesalpiniasappan* (pathagi)	*Caesalpiniasappan* (pathagi)was boiled withMemecylonedule, Memecylonumbellatum (Blue mist) Korakaha-leaves
Black	Swietenia macrophylla (Raw roots of mahogany tree)or Terminalia Chebula (Aralu) retting in black clay	$KAl(SO_4)_2 \cdot 12H_2O$ (Alum)

Table 2. Spectrum of Colours



As shown in Table 1, some plant extracts were used as mordants that showed good colour fastness properties. For example, Alternanthera sessilis (mukunuvenna) was used as a mordant instead of Ferrous to obtain purple colour that showed similar colour fastness properties. Moreover, Kora-kaha(Memecylonedule, Memecylonumbellatum

(Blue mist)was used as mordant in obtaining reddish brown, and the yarn dyed with kora-kaha showed similar colour fastness properties to those dyed with alum. Additionally, the mixes of few natural plant extracts were used to obtain better colour fastness properties in some of the colours.

These results demonstrate that there is a significant potential of replacing toxic-dyes and mordant with natural dyes and natural mordents'. The plants and extraction processes used by ancients seem to be environmentally friendly and sustainable, yet remain hidden at the moment. There are sufficient evidences that the fabric coloured with those natural dyes and mordants were well performed over the years. Moreover, this study shows that a range of colours as well as bright and dark shades could be obtained with natural dyes without any issue. This is only a preliminary study conducted to discover the range of possibilities of natural dyes, mordants and their ability to replace toxic dyes. While there is a deep investigation needed to understand the dye recipe and different types and combinations of mordant, it is also vital to standardize the recipes and processes to facilitate repeatability. A shift from trial and error methods to a standardized process would support to increase the usability of natural dyes and mordants. Further studies and investigations that make use of modern technologies would be required to bring this natural dyeing industry into an economically viable level.

IV. CONCLUSION

Nature is the genius in producing wide range of colours in a sustainable manner. Nature extracts would be the most environmentally friendly way to produce any colour. Textile dyeing process had followed the same rule in ancient times, where nature based dye recipes were used in textile colouration. This study attempted to uncover some of the ancient practices, with the view of bringing sustainability back into the textile colouration process. Even though the synthetic dyes captured the market mainly due to attractive range of colours, this study showed the natural dyes also carry the potential to produce an attractive range of colours. Moreover, given the fact that the synthetic dyes are harmful to the environment, plant extracts could replace synthetic dyes and toxic mordants, in order to lessen the environmental impact of textile colouration process.

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