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ANALYSIS OF INDIGENOUS MATERIALS USED IN INDIAN PAINTED AND PRINTED TEXTILES

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ABSTRACT

The term "indigenous" can refer to several diverse materials, including those that are easily obtainable in the vicinity, such as dyes obtained from different parts of plants, as well as various minerals. Traces of similar materials have also been discovered during excavations at several sites across the country. Due to the harsh environmental conditions in different regions, evidence of Indian textiles has been found in multiple literary works and at historical sites. These fabrics are being kept in museums all around the country for posterity's sake.

India's painted and printed textiles are an essential part of the nation's heritage. Because these textiles are endangered due to their organic nature, museums work to conserve and preserve them. Several museums, including the National Museum in Delhi and the Calico Museum in Ahmedabad, among others, display these beautiful textiles. This paper analyses the different sustainable raw materials that have been used for centuries in India's painted and printed textiles. This article reviews India's painted and printed textiles, their sources of materials, and their properties. Mainly, secondary resources have been used for data collection. Many heritage textiles, because of the prevailing use of synthetic dyes, are losing their authenticity. Moreover, this paper will help Conservators, curators, and researchers working in textile conservation and art & culture to use this information to help preserve these textiles.

Keywords: Indigenous Materials, Conservation, Natural Dyes, Mordants, Pigments, Painted-Printed Textiles, Museums, Sustainability, Culture

1. INTRODUCTION

Over the centuries, cultural textiles have been passed down through generations. Arts and crafts are integral parts of Indian culture. It is uncertain when dyeing and printing first became popular, although literary sources suggest that they may have emerged during excavations at the site of Mohenjo-Daro (c. 2500-1500 BCE). Textiles of various types—woven, dyed, and printed—were discovered during excavations in multiple locations around India. After such an extended period, the presence of these biodegradable fragments, which had been dyed with indigo, was speculated to be due, at least in part, to the favourable climatic conditions that prevailed at the time (Gillow & Barnard, 1991).

The country's western region is where painted and printed textiles are most well-known. Many authors have shed light on the significance of a few particularly well-known cotton painting places that are in India (Irwin & Hall, 1971; Sravani & Varma, 2020). Karolia and Buch (2008) have documented Ajrakh, one of the earliest double-sided printed textiles of Gujarat; however, due to the use of synthetic dyes, this textile is losing its authenticity. Similarly, Pandya and Vishwakarma (2010) documented the Rogan textile to preserve it and prevent it from becoming extinct.

The Kalamkari of Andhra Pradesh, a 3000-year-old religious craft patronised by the Mughals, is a hand-painted and printed textile made organically by using indigenous colours and sustainable practices. The quality that gained attention

was its mesmerising, vibrant, and brilliant colour, which is unaffected by repeated washing as described by many authors (Divakala & Muthian, 2017; Divakala & Vasantha, n.d.; Sravani & Varma, 2020). Other similar types of crafts include Mata ni Pachedi of Gujarat, Pabu Ji ki Phad of Rajasthan, Nathdwara Pichhawai, Pattachitra of Orissa, Madhubani paintings of Bihar, Thangka, a Tibetan Buddhist painting, and Kalighat paintings of West Bengal. These crafts also use vegetable dyes, with slight differences in their production processes. Ramani (2007) stated, "It was fascinating to see very old textile pieces dating back to the 17th and 18th centuries, tattered and brittle with age but still retaining their original colours, produced with vegetable dyes. It was obvious that age-old practices and traditional techniques, even though unscientific, had stood the test of time"(p.5).

1.1. PAINTED AND PRINTED TEXTILES IN INDIA

India has a rich cultural legacy. The beauty of its legacy is found in its arts and culture. Painted and printed textiles have been a part of and used for centuries. Crafts are showcased in museums to inspire others and preserve our heritage. Painted textiles are those made with a pencil/pen, or brush, using different colours to create designs.

In contrast, printed textiles have pigments and dyes bonded to the fabric with the help of blocks, creating designs or patterns. India's diverse civilisations have given rise to a wide range of traditional crafts based on those cultures, such as Pabu Ji ki Phad, Mata Ni Pachedi, Kalamkari, Pattachitra, Thangkas and so forth, produced with indigenous colours.

The museums of India account for several beautiful and aesthetically painted, printed, and dyed textiles. Different private and government museums in India have such a set of textiles. The National Crafts Museum of Delhi houses an extensive collection of textiles, including kalamkaris, bandhani (tie and dye), Pichwais, ikat fabrics from Orissa and Gujarat, and block-printed and resist-dyed fabrics from Rajasthan and Gujarat (Figure 1).

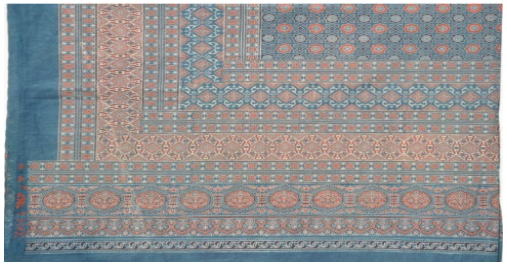

Figure 1 Bichhna (bedspread) with small eight-pointed star motifs. Hand block printed cotton cloth of Barmer, Rajasthan, in the National Crafts Museum, New Delhi

Source- https://artsandculture.google.com/asset/bichhna-bedspread-unknown/oAHa8AQL4bGkIg

The Calico Museum of Ahmedabad comprises two wings: the 'haveli', where a block-making and printing technique gallery, miniature paintings, and silk bandhani pichwai—a hanging for a Krishna temple are present (Murphy & Crill, 1991). The second wing ‘chauk’ has a tie and dyed textiles as shown in Figure 2. Irwin & Hall (1971) also mentioned the collection of pichhwais of Rajasthan and pachedis of Ahmedabad in the museum.

Figure 2 Tie-dyed textiles in the Calico Museum, Ahmedabad

Source https://www.calicomuseum.org/visiting-the-museum-galleries/

The National Museum in Delhi has a collection of paintings made with natural pigments on cloth (Figure 3). It also has a conservation department that oversees the preventive conservation of objects, assists with exhibitions, manages storage facilities, and coordinates the transportation of objects.

Figure 3 Krishna as Shrinathji, celebrating the festival of Sarad-Purima (Early 19th Century CE), Nathdwara, Rajasthan, in the National Museum, New Delhi

Source-https://artsandculture.google.com/asset/krishna-as-shrinathji-celebrating-the-festival-of-sarad-purima/fAGowbZdEH_wmA

In addition, the Salarjung Museum in Hyderabad, the Anokhi Museum of Hand Printing in Jaipur, the Sanskriti Museum in New Delhi, and the Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS) Museum in Mumbai are other museums that store such textiles in their collections.

Mohanty et al. (1987) in their book "Natural Dyeing Processes of India" reported that 168 samples of dyed fabrics, which had been dyed with indigenous colours, are kept in the Bengal Economic Museum, Calcutta.

The alluring textiles of India have left a mark on other countries as well. The V&A Museum in London has a vast collection of resist-dyed and block-printed fabrics, including fragments of mordant-dyed, resist-dyed, and block-printed fabrics from Gujarat (15th century). The Metropolitan Museum of Art, New York, has Pichhwais, cotton-painted and dyed pieces, patola cloth, dyed patterned silk, and other items in its collections.

All these textiles are made using pigments and dyes obtained from nature, utilising different parts of plants or coloured stones. These colours are generally fugitive but can be applied with the aid of mordants to improve their fastness (Mohanty et al., 1987).

1.2. SOURCES OF MATERIALS USED

Indigenous colours were naturally created by grinding stones and blending them with water or a binder, as claimed by Pandya and Vishwakarma (2010). Nature greatly influences the sourcing of materials. For centuries, plants, animals, minerals, and insects have been used to develop natural colours. Different plant parts, such as roots, leaves, stems, flowers, and fruits, were used as primary colouring agents prior to the development of synthetic dyes in 1856. Their longevity depends on their sustainability and biodegradability. In ancient times, natural elements were the only source of such colours. In addition to their accessibility and availability, natural colours are environmentally friendly. In various religious paintings, even textile artisans use natural colours. Indigenous materials have been employed on textiles extracted from natural sources (Pandya & Vishwakarma, 2010). Natural colours are often used for various purposes in numerous religious and cultural contexts, depending on their specific hues.

Rajvanshi & Srivastava (2013), asserted that "The colour orange is used for limbs and torso, yellow for ornaments, clothing and designs, gray for structure, blue for water and curtains, green for trees and vegetation and red is used for clothes". The painted and printed textiles of India exhibit the usage of various dyes and pigments. In general, painted textiles are categorised into pigment-painted and dye-painted textiles. Crafts like Pichhwais, Phad painting of Rajasthan, and Pattachitra of Orissa fall under pigment-based textiles, whereas Kalamkari and Mata ni pachedi fall under dye-based textiles. Such crafts, along with other Indian crafts like Ajrakh, Dabu prints with indigo dyeing, and Rogan, utilise indigenous dyes and pigments. Chishti et al. (2000) state that in ancient times, pigments such as crimson, ultramarine, gold, and silver were popular in pigment-painted textiles. Sometimes mordants are also used to fix the colours, which can be procured from natural settings and applied to the cloth using conventional methods.

Vegetable dyes are fugitive, so they use mordants, which act as a binder for the dye to attach to the surface of the fibre. In the past, iron, copper, and tin ions were used as mordants along with alum, which is a source of aluminium ions. Our ancestors' inventiveness and perseverance led to the discovery of natural dyes. Organic matter that is soluble in a solvent is called a dye. Pigments are inorganic molecules or minerals that are insoluble in the medium, so they use a synthetic binder to adhere to the fibre surface (Bechtold & Mussak, 2009; Chakraborty, 2015). Most pigments are inorganic (e.g., ochre and lead white), but all dyestuffs are organic. Some dyes can also act as pigments (such as alizarin, carmin, and indigo) (Tímár-Balázsy & Eastop, 2012).

These materials can be further classified in several ways according to their origin, their application, and their chemical structure. In this review, these sources are classified into dyes, pigments, mordants, and binders.

2. CLASSIFICATION OF MATERIALS BASED ON SOURCE OF ORIGIN

2.1. DYES

The solvent-soluble nature of dyes allows them to bond with the surface to which they are applied. According to their source, dyes are primarily subdivided into natural and synthetic dyes. The dyes are further categorised based on their origin-

2.1.1. NATURAL DYES

These dyes can be further divided into four categories: plant, animal, mineral, and microbial (Saxena & Raja, 2014; Yusuf et al., 2017).

2.1.2. PLANT BASED

Plant parts such as roots, leaves, branches, twigs, stems, heartwood, bark, wood shavings, flowers, fruits, rinds, hulls, and the like are used to produce natural dyes. Historically, several natural dyes were extracted from plants (Hamdy & Hassabo, 2021; Saxena & Raja, 2014; Yusuf et al., 2017). In 1985, Sethna conducted a study examining various vegetable colouring materials. Ramani (2007) claims that 300 colouring herbs were present in prehistoric times, but have since disappeared. To date, various natural dyes have been developed, as explained below.

Blue dyes

Indigo, a vegetable dye, is derived from the leaves of Indigofera tinctoria (Figure 4). It is also known as the "king of dyes" and has been in use since ancient times. Indikon, Indicum, and Indian blue were some of the names used by the Greeks and Romans for indigo, according to Legrand (2013). While in Hinduism and Sanskrit, it is known as 'nil', in Europe, it is commonly referred to as 'indigo'. Since ancient times, its use has been seen and described in many painted and printed textile-like Ajrakh, Dabu, Mata Ni Pachedi paintings, Roghan, Pattachitra, Kalamkari, etc. (Divakala & Vasantha, n.d.; Durga Kulkarni, 2021; Karolia & Buch, 2008; Pareek & Pant, 2015; Purohit & Arora, 2017; Tripathy, 1998; Wheeler et al., 2011; Sravani & Varma, 2020). In addition to Indian textiles, its use was confirmed in excavated textiles of the Joseon dynasty through dye analysis (Baek et al., 2012). The colouring ingredient present is a light, yellow colourant known as "Indican" (Hamdy & Hassabo, 2021; Saxena & Raja, 2014) or "Indicum" (Varadarajan, 1982). It is believed that indigo blues are insoluble in water and, after deoxidising, become soluble in water and become an indigo white, which is a colourless, slightly yellowish substance. The content of colouring matter varies according to the season and age of the plant, which increases with the age of the plant, as stated by Mohanty et al. (1987). It requires an alkali

and a reducing agent. Earlier, urine was used as an alkali, and fruits were used as a reducing agent. Nowadays, sodium hydroxide (NaOH) and sodium dithionite are used for their alkaline reduction (Tímár-Balázsy & Eastop, 2012). Indigo does not react in the presence of air, so any trapped air in the fabric during the process will result in a patterning appearance. Indigo is then oxidised by oxygen in the air, leading to its oxidised form (Purohit & Arora, 2017), which is why it is not used in block-printed textiles (Varadarajan, 1982).

Figure 4 Indigo leaves
Photography by Nitika Joshi

Yellow dyes

The various natural yellow colours used in printed and painted textiles include turmeric, myrobalan, kesula/Palash, pomegranate, mango, and marigold, among others.

Turmeric is a perennial herb, obtained from the rhizomes of Curcuma longa, which contains curcumin, a colouring agent/pigment used for brilliant shades, but it is fugitive. The chemical structure of curcumin, with its extended conjugated double bonds (carotenoid), absorbs light in the 400-500 nm range, giving it a yellow hue (Yusuf et al., 2017). It is one of the basic materials in Ajrakh printing (Karolia and Buch, 2008). Myrobalan, which is a tannin source, is used as a mordant to enhance its fastness. (Hamdy & Hassabo, 2021; Ramani, 2007; Saxena & Raja, 2014)

Myrobalan, also known as kadukka, is obtained from dried myrobalan fruit (Terminalia chebula), as shown in Figure 5. This fruit produces valuable Indian tanning materials, such as chebulic and black myrobalan, which are high in tannin and provide a bright yellow dye for all textiles (Gillow & Barnard, 1991). It can be identified as a raw material in the printing of textiles (Karolia & Buch, 2008; Sravani & Varma, 2020), which gives a yellow tint on the surface of the fabric. In various preparatory and dyeing processes, it has been used to remove starch from cloths and acts as a mordanting material (Durga Kulkarni, 2021; Purohit & Arora, 2017; Ramani, 2007).

Figure 5 Myrobalan fruits
Photography by Nitika Joshi

Pomegranate Rinds of pomegranate (Punica granatum) fruits, as shown in Figure 6, contain tannins that are employed as mordants. It contains the colouring agent granatonine, which comes in the alkaloid form N-methyl granatonine and creates a yellow colour. (Sravani & Varma, 2020; Karolia and Buch, 2008) reported it as a raw element in the textile printing process. According to a study by Ramani (2007) and Satyanarayana & Chandra (2013), its wash fastness is moderate on cotton cloth, and its light fastness is good.

Figure 6 Dried Pomegranate peels
Photography by Nitika Joshi

Flame of the forest (Butea monosperma), also known as Palash and tesu/kesula locally. Purohit and Arora (2017) reported that it is used as a raw material in the Akola printing process to produce a yellow colour. These are the flowers of the Butea monosperma palm tree, which contain the colouring pigment butein as well as an orangish-red chalcone. It produces different colours with different mordants, such as pale yellow with Al, yellow-brown with Cu and Cr, greenish grey with Fe, and bright yellow with Sn. (Chakraborty, 2015; Purohit & Arora, 2017)

Peori is an ancient colour described by Ramani (2007), which is manufactured spontaneously from the urine of cows fed on mango leaves. As per some literary sources, its use has been restricted now.

Red dyes

Many authors have stated the use of red dyes in the painted and printed textiles of India (Durga Kulkarni, 2021; Karolia & Buch, 2008; Sravani & Varma, 2020). They all have the quinonoid chemical structure (Yusuf et al., 2017). Some of the majorly used red dyes are described below.

Indian Madder, also known as Manjeet/Rubia cordifolia, the queen of natural dyes, is a red vegetable material widely known under various names: manjit, manjhista, shevali kodi, manchetti, etc. It is an ancient dye that dates back 3000 years. The principal dyeing components typically found in the roots (figure 7) of madder plants are alizarin, purpurin, and pseudopurpurin, which produce a red colour and serve as the source of anthraquinone pigments (Rosenfield & Shibayama, 2020; Tímár-Balázsy & Eastop, 2012). This is a mordant dye that produces lakes of metal ions that are vividly coloured (Hamdy & Hassabo, 2021). Red is made using aluminium and tin; orange with tin; and violet with iron (Chakraborty, 2015; Gillow & Barnard, 1991). In Mata Ni Pachadi, it is used as a dominant colour, which is extracted from the madder plant, which works as a hue-inducing agent (Durga Kulkarni, 2021). Ramani (2007) has reported that fabric dyed with madder has been discovered in the excavations, demonstrating its vibrant colour and confirming its durability against light and washing. (Karolia & Buch, 2008; Clifford, 2012) While documenting the materials and process of ajarkh craft, they have elaborated on the use of madder in the dyeing stage. According to Rosenfield & Shibayama (2020), five varieties of madder red dyes were identified on the painted and block-printed textiles from India. The names, along with their botanical names, are listed in Table 1, which includes primarily those found in Indian textiles.

Table 1 Red dyes used in Indian Painted and Block-Printed Textiles (Rosenfield & Shibayama, 2020)

S.No.	Red dyes	Botanical Name	Other Names
1	Chay Root	Oldenlandia umbellata L.	Chayaver, Chavalkodi
2	Indian mulberry	Morinda citrifolia L.	Al
3	Dyer's madder	Rubia tinctorum L.	English madder

4	Indian madder	Rubia cordifolia L.	Munjeet
5	Alizarin (synthetic dye, after 1869)	Oldenlandia umbellata L.	Chay root

Figure 7 Roots of the Madder plant

Source https://www.farmandfolk.com/blog/2024/1/5/natural-dye-cultivation-series-madder-root

Brown and Black dye

The numerous materials used to generate brown and black colours have been addressed by Mohanty et al. (1987).

Tamarix fruit contains a high tannin content (Kalam Urfi et al., 2016), which is used to produce a dark brown colour along with iron sulphate (Mohanty et al., 1987).

Oak galls with a high tannin content are used for mordanting and can also be utilised to achieve a brown colour.

Acacia catechu The heartwood of Acacia catechu is used to make catechu. It has a high tannin content and can be used to achieve a black colour with an iron mordant.

Logwood For creating logwood black with iron mordant, an extract of logwood obtained from the heartwood of Haematoxylon campechianum is utilised; it also exhibits excellent fastness property (Hamdy & Hassabo, 2021).

Black dye Shakuntala Ramani asserts that in the process of kalamkari, the black colour known as kaseem is employed to outline the images. This colour is made by mixing scrap iron with water and palm jaggery solution. When applied directly without any mordant, the colour appears brown, but when combined with myrobalan, it turns entirely black (Ramani, 2007; Durga Kulkarni, 2021). Black is also obtained after burning coconut or indigo to produce syahi, which is then used for outlining images (Rajvanshi & Srivastava, 2013).

2.2. PIGMENTS

Minerals are the primary source of pigments. Various studies have shown that a range of mineral pigments, including cinnabar, chrome yellow, malachite, ultramarine blue, azurite, yellow ochre, and red ochre, are used as raw materials in Indian painted and printed textiles (Das, 2013; Pandya & Vishwakarma, 2010; Pareek & Pant, 2015; Tripathy, 1998; Wheeler et al., 2011). These inorganic pigments have been discussed below-

2.2.1. INORGANIC PIGMENTS

Inorganic pigments refer to colours that come from naturally occurring sources, such as minerals.

Cinnabar (Red) is also known as hengula (Tripathy, 1998). Since ancient times, mercury sulfide, a naturally occurring red pigment, has been used to make colourants and pigments (Tripathy, 1998; Wheeler et al., 2011). Due to its low hardness and high density, it is suitable for dyeing textiles. Additionally, it is less vulnerable to oxidation and acid rain. Most studies indicate that it turns grey or black, which is a rare event. Factors contributing to this blackening include environmental stress, photosensitivity, cinnabar composition, and structural changes (Nöller, 2015). Red Lead (lead tetroxide), also known as sindur, which is orange-red, was historically derived from cinnabar and has been detected in Indian paintings in abundance (Yusuf et al., 2017). Hematite (iron oxide) is another red pigment used in these artworks (Wheeler et al., 2011). According to Tripathy (1998) and Pareek & Pant (2015), hengula is mainly used as a background colour in Pattachitra paintings.

Vermillion (Lal/Red) is the oldest pigment obtained from the mineral Cinnabar and is designated as HgS. It does not fade but darkens in sunlight and when applied to plaster. It is toxic and tends to be used to emphasise a small key figure in a picture due to its high price. Das (2013) states that its use has been seen in the preparation of Pattachitra paintings. Rajvanshi & Srivastava (2013) have asserted that vermilion is produced through the pulverisation of cinnabar (mercury sulfide).

Orpiment (also known as Hartali) is a pigment derived from arsenic that is yellow to lemon-coloured and has been used since ancient times. Its golden colour made it a popular pigment in the past. It is naturally found in small quantities (Yusuf et al., 2017). Chemically, it is yellow arsenic sulfide (As_2S_3). Besides being used as a pigment, it has also been used to tint paper, giving it a yellow hue. This process also imparts insecticidal properties to the paper. Light yellow (pilla, hartal) is made from yellow orpiment, which fades over time. It is used to sketch or colour figures and structures (Rajvanshi & Srivastava, 2013) and serves as the raw ingredient in the preparation process of Pattachitra paintings. Goddesses are often depicted as being painted yellow using this colour (Pareek & Pant, 2015).

Red Ochre, also known as Geru in Hindi, is a natural earth pigment made up of anhydrous and hydrated iron oxide ($Fe_2O_3 \cdot nH_2O$). It is a very stable compound and is not affected by light, acids or alkalies (Yusuf et al., 2017). It is one of the pigments used in Pattachitra paintings (Pareek & Pant, 2015).

Yellow ochre Since ancient times, this mineral pigment has been used for colouring and blending. Limonite is the colouring material present in it. It is readily mixed with other mineral pigments to produce a range of different shades. In the literature (Singh et al., 2020; Tripathy, 1998), Raman microscopy has confirmed that it is a natural pigment present in paintings.

Ultramarine blue, an ancient blue pigment also known as Neeli mandu (Divakala & Vasantha, n.d.), is obtained from lapis lazuli (lazurite) (Wheeler et al., 2011).

Malachite is a bright green, naturally occurring pigment. It is a mineral pigment (Saxena & Raja, 2014; Singh et al., 2020). The pigment contains 57.48% copper. The use of this pigment dates to time immemorial (Haldar, 2017).

Azurite is a mineral made up of copper carbonate. As a pigment, it produces a pale blue colour (Haldar, 2017). Therefore, it is likely to be a suitable source of mineral dye (Singh et al., 2020).

Conch shell powder (Safeda) According to the literature, this pigment was used as a basic material in painted textiles from India. After being ground into a fine powder, it is combined with water and heated to produce a white colour (Das, 2013; Pandya & Vishwakarma, 2010; Pareek & Pant, 2015; Tripathy, 1998). According to Tripathy (1998), the colour of God is white, hence they are painted in this safeda.

Lampblack (soot) It has been in use since ancient times and is prepared by burning oil in a lamp. Different scholars have elaborated on its usage in the raw materials of textiles that are painted with pigments (Das, 2013; Pareek & Pant, 2015; Tripathy, 1998; Wheeler et al., 2011)

2.3. MORDANTS

Metal oxides have been used as an interface to bond the dye with the fibres known as mordants, which in Latin means 'mordere', meaning to bite. Fibres, especially cellulosic ones, have little affinity for natural dyes; as a result, they must undergo an additional mordanting process, which increases the dye's ability to adhere. Additionally, the type of dyes used often indicates the use of mordants. For instance, adjective dyes require a mordant to bind themselves with the fibre, as opined by Gillow & Barnard (1991). Different hues can be achieved on the same fibre by using different mordants. Dyeing with traditional methods usually employs large pots made of iron, copper, stainless steel, and aluminium, which themselves act as mordants (Pandya & Vishwakarma, 2010; Saxena & Raja, 2014; Sethna, 1985). Using metal salts, colour was produced by the formation of insoluble dye complexes (Hamdy & Hassabo, 2021). Mordants can be grouped into three subcategories: metallic, oil, and tannin. Aluminium, copper, iron, tin, and chromium make up metallic mordants. Most often, they are used with natural colours. Alum is the primary mordant used in oil mordants, which are primarily employed to dye madder and generate turkey red oil. Sesame and castor oils were traditionally utilised (Divakala & Vasantha, n.d.; Pandya & Vishwakarma, 2010; Ramani, 2007). Due to a lack of affinity for metallic mordants, tannins are mainly used with cellulosic materials. For mordanting, tannic acid can be found in its pure form or obtained from plants that contain tannins, such as myrobalan (Terminalia chebula), oak galls, sumac, or pomegranate peel (Saxena & Raja, 2014). Classification and the various types of mordants have been the subject of several studies

(İşmal & Yıldırım, 2019; Sethna, 1985). Other factors influencing the shade of colour include mordant concentration, the pH and temperature of the dyebath, and, of course, the type and quality of the dye itself (Rosenfield & Shibayama, 2020).

Aluminium

Aluminium potassium sulphate (APS), aluminium acetate (AA), and aluminium hydroxide have been employed since antiquity as mordants. APS (AlK(SO4)2), also known as alum, potassium alum, potash alum, or potassium aluminium sulfate, has been utilised in textile dyeing to enhance the fastness and brightness of colours, producing red and yellow hues (Baek et al., 2012). This compound serves as the foundational mordant in the preparation of kalamkari textiles (Ramani, 2007; Sethna, 1985). Furthermore, Durga Kulkarni (2021) has identified alum as the raw material (figure 8) for generating red colours on fabric surfaces during the creation of Mata Ni Pachedi. To secure dye fixation on the fabric, alum serves as a fixative agent during the final washing process after printing (Gillow & Barnard, 1991).

Figure 8 Alum Mordant

Source https://www.suzannedekel.com/post/all-about-alum-based-mordants?srsltid=AfmBOoonIq5wY-g7m7EN-Ej3tqd6wSs3wPDVGQZYcVNI_9Hmc6c0Uqzk

Iron

It belongs to the category of dulling mordants. It is mainly used in the dyeing and printing of textiles. It produces a black-grey colour on the fabric (Baek et al., 2012; İşmal & Yıldırım, 2019; Saxena & Raja, 2014; Sethna, 1985). In the kalamkari process, the iron mordants are referred to as 'kasam' (Varadarajan, 1982).

Copper

Copper sulphate is mainly used for copper mordanting. It improves the light fastness and produces brown and black colours (Saxena & Raja, 2014; Sethna, 1985). Sometimes, the red dyeing process appears to benefit from the use of copper (Rosenfield & Shibayama, 2020).

Tin

It comes under the category of brightening mordants. Stannous and stannic chloride are the two forms that are mainly used (İşmal & Yıldırım, 2019; Saxena & Raja, 2014; Sethna, 1985).

2.4. BINDER/THICKENERS

Also known as a thickening agent. Natural thickeners, which are both non-allergenic and non-toxic, come in a wide range of forms derived from various roots and seeds, seaweeds, and plant extracts (Hassabo et al., 2021).

2.4.1. PLANT BASED

Natural Gums

Natural gums are not soluble in water due to their hydrophobic nature. Its biological origin causes a variety of characteristics to change, such as molecular weight, branching properties, and linear chain length. Plant exudate gum (e.g., gum karaya, salai gum, and Arabic gum), seed gum (e.g., guar gum, locust bean gum, and tamarind gum), microbial

gum (e.g., xanthan gum, gallant gum, and dextran gum), and marine gums (e.g., alginic acids) are the four types of natural gums (Hassabo et al., 2021). According to Varadarajan (1982), gums expedite the printing process.

Kaitha gum

Kaithatta or Kainth (locally available fruit gum) is the raw ingredient in the preparation of Pattachitra painting, which is mixed with the paste prepared by grinding the stone. (Pareek & Pant, 2015)

Tamarind powder

Tentuli gunda (tamarind powder) and Tentuli Manji (tamarind seed) are the raw ingredients used in Pattachitra painting. For preparing the canvas, tamarind gum and white chalk powder are applied to the surface of the canvas. White chalk is mixed with gum to give the glazed effect on the fabric. (Tripathy, 1998; Pareek & Pant, 2015). It is used as a thickening agent in Mata Ni Pachedi to prepare the red and black dye (Gillow & Barnard, 1991; Durga Kulkarni, 2021).

Jaggery

Jaggery is used in the preparation of black dye and aids in its fermentation process (Durga Kulkarni, 2021; Gillow & Barnard, 1991; Varadarajan, 1982).

Castor oil

It is a key component in the making of Kutch, Gujarat's Rogan/Roghan paintings. According to Pandya & Vishwakarma (2010), castor oil is boiled for 5-6 hours to eliminate impurities and achieve a gelatinous appearance. When it cools, it solidifies into a thick paste that is mixed with the dyes, which is then applied to the fabric. During the procedure, the colour also changes to yellow. (Erikson, 1968; Gillow & Barnard, 1991) has also described the use of castor oil in the preparation of fabric for the Mata Ni Pachadi painting process.

2.4.2. ANIMAL BASED

Buffalo milk (casein)

(Sravani & Varma, 2020; Gillow & Barnard, 1991; Varadarajan, 1982) has highlighted the use of buffalo milk in the preparation of kalamkari fabric, as it prevents the smudging of colour on the fabric and provides stiffness when mixed with starch.

2.5. OTHER MISCELLANEOUS RAW MATERIALS

Various materials, along with binders and mordants, are used as resist or scouring agents during the dyeing and printing processes. Different types of resist materials are suggested in multiple sources. Varadarajan (1982) has identified wax, mud, and gum as resist materials for kalamkari textiles, which are not used nowadays. Some of the other materials used have also been described below:

Rice starch

It is used for preparing the fabric in Phad Painting (Gillow & Barnard, 1991) and Kalamkari (Varadarajan, 1982), which provide strength to the fabric. It sometimes acts as a resist in the printing of cloth, which is then further removed with hot water, as in Ajrakh printing (Gillow & Barnard, 1991).

Lime

It is combined with gum and then printed on the regions that need to be colour-resistant. (Gillow & Barnard, 1991)

Cow Dung

It has been used since ancient times to remove impurities from cloth, as evident in the preparatory steps of painting and printing fabrics such as Ajrakh, Kalamkari, and Mata Ni Pachedi (Gillow & Barnard, 1991). Cow dung contains ammonia, which acts as a bleaching agent (Wisniak, 2004). Today, its use has become limited due to its labour-intensive application process and the availability of a wide range of chemical bleaching treatments.

Tamarisk Flowers

To prevent smudging and the spread of red dye to the white areas of the textile during dyeing, tamarisk flowers or Woodfordia floribunda L. are added to the dyebath (Rosenfield & Shibayama, 2020).

3. CONCLUSION

It is common to find literary sources that describe the materials and methods used in the crafts. However, there is limited literature on the indigenous materials, particularly used in Indian painted and printed textiles. This review has thoroughly described the indigenous raw materials based on their source of origin as dyes, pigments and binders. As painted and printed textiles are organic, they are susceptible to deterioration over time. Upon analysing the literature, it was found that over time, changes occurred in the raw materials used in these historic textiles. This is because the exploitation and availability of novel synthetic materials have become more prevalent. That is why it is utmost to preserve the materials and processes of this craft. The paper reviews the different natural dyes, pigments, mordants and binding materials used in painting and printing practices. Furthermore, gathering information will provide conservators and restorers with the added knowledge when conserving such textiles. To maintain the original beauty of cultural heritage textiles and provide income for artisans, these textiles and their ingredients must be maintained.

CONFLICT OF INTERESTS

None.

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