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A REVIEW ON THE EXTRACTION OF NATURAL DYE FROM THE TREE

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Abstract : Dyeing of textiles impart aesthetic appearance to the apparels. Around 90% of textiles were dyed for various reasons. Out of 90%, majority of textiles are dyed with synthetic dyes due to its good all round fastness properties. Due to the global warming, the people try to go back to the natural dyeing methods. But, the natural dyes are poor in fastness properties and the colours available in natural dyeing is also limited. The synthetic dyes used in industry create lots of issues like, environmental issues and colour removal in effluent. Nowadays, the development of natural dyes are enormous, every day, the new natural dyes are invented. In this paper, various natural dyes extracted from the bark of the trees, Pinus Brutia Ten, Mangrove tree, Eucalyptus camaldulensis tree, Walnut tree, Albizia Lebbeck (Siris tree), Terminalia arjuna (Marutha Maram) are described.

Index Terms: **Natural dyes, Bark, Ebony tree, Turkish red pine tree, Mangrove tree, Eucalyptus tree, Walnut tree, Sirisis tree, Mordants.**

INTRODUCTION

Natural dyes replaced the synthetic dyes in the past year due to its eco-friendly in nature. Now it is currently being favoured by consumers because of its benefits (Sutrlović, 2011). Like eco-friendly, less toxic, usage in children's wear, favour to wearer skin etc., Natural dyes which are used in colouring of clothes, food substrate, leather, etc., Natural dyes can be obtained from various parts of plants including leaf, barks, roots, flowers. The natural dyes were extracted from natural plants for alternate to synthetic dyes (Deo and Desai, 1999; Vankar, 2000; Belemkar and Ramachandran M, 2015; Nadiger and Shukla, 2015). The parts of some trees like, ebony tree, turkish red pine tree, mangrove tree, eucalyptus tree, walnut tree, sirisis tree and etc., have the ability to dye the textile materials. Mostly, the bark of the tree able to produce dye. The synthetic dyes creates bad impact on water resources. For processing of a one ton of textile material, might have to use as much as 230-270 tons of water (Ali, Nisar and Hussain, 2007). The natural dyes are great alternators of synthetic dyes. Natural dyes are not commercially used one which is fully consumer favour. The natural dyes obtained from fruits, vegetable, leaves, bark, flowers, roots etc., are less toxic and allergenic than synthetic dyes (Rungruangkitkrai and Rattanaphol, 2014). Using natural dyes to products becoming important for avoiding the skin related issue. Textile chemical processing industry is one of the major environmental polluters. There are two ways to control the environmental pollution of the textile processing industry. The first one is to use eco-friendly products like natural dyes, mordants etc., and another one is to build a proper and effective effluent treatment plants (Ali, Nisar and Hussain, 2007; Sivakumar, Vijaeeswarri and Anna, 2011). Natural dyes produces the different and unique shades that can be obtained from roots, insects, minerals, flowers (Cushnie and Lamb, 2005), fruits (Barhanpurkar, Kumar and Purwar, 2015), bark (Ahuja, Ahuja and Ahuja, 2015), leaf (Punrattanasin *et al.*, 2013). In spite of various advantages of natural dyes, it also has some disadvantages like, Availability of dye source (Tree, Vegetables) might be found for some particular season and poor fastness properties. The natural dyes are unable to form the strong bonds with textile materials, it needs a crosslinking agent (Orhan, Kut and Gunesoglu, 2009) or intermediate materials like mordant to improve the substantivity of the dyeing. Various mordants are used to improve the fastness properties of the natural dyes. Natural and synthetic mordants are available in the market. It is better to use natural mordant for eco-friendly. The banana sap is a natural mordant used to improve the fastness properties of the dyeing process and it is a cost effective mordants (Barhanpurkar *et al.*, 2015).

The natural dyes were extracted from the varieties of tree. Each tree has its own colour. The colours produced from these trees are unique and can't be matched with other dyes and dyeing methods. With this, here we are describing the extraction of dye from the bark of some commercially available tree like, Pinus brutia ten, Mangrove tree, Eucalyptus camaldulensis tree, Walnut tree, Albizia Lebbeck (Siris tree), Terminalia arjuna (Marutha maram).

Extraction of Natural Dyes from the Bark of the Pinus Brutia Ten Tree

Pinus brutia (or Turkish pine) is a pine native to the eastern Mediterranean region. The bulk of its range is in Turkey, but it also extends to southeastern-most Bulgaria, Iran, western Syria, Georgia, Lebanon, Israel, north-west Jordan, and Cyprus. Turkish pine is also known by several other common names: Calabrian pine. Pinus brutia ten is botanical name of Turkish red pine tree that belonging to Pinaceae family (Avinc *et al.*, 2013). Natural dyes are extracted from waste barks of red pine tree. The outer bark of pine tree contains the dihydroquercetin and quercetin in addition to phenols and tannins (C. Alya and N. Parameswaran, 1980; Mongkholrattanasit *et al.*, 2011). The tannin is largely present in the bark of the red pine tree. That gives reddish brown colour, the colour the bark of red pine tree (S. M. Robertson, 1973). The dye powder was extracted from red pine bark by using the dye extraction machine. The machine operation consist of milling, spiral conveyor, extraction unit, solvent tank, solvent removing, and recycling & spray drying (Avinc *et al.*, 2013). This extraction method was carried out one by one. The barks are vacuum dried before launching the extractor and vacuum plant fluid was used instead of a fresh water for further processing. In this extraction unit the 2% of bark particles were treated with 78% ethanol and 20% stock fluid for recovered the vacuuming process. The solvents present in the dye extracts are removed by the solvent removing process and the solvents which is removed is recycled and used for next process. The purified dye powder which is free from solvents are used to dye textile materials. Normally, 10% dye concentrations used to dye the textiles with 1:40 at 100oC for one hour. The alum and oak ash are used as the mordant for this dyeing. Normally 20% mordant concentrations are used. The natural dye extracted from the bark of the Pinus brutia ten produces good light and wash fastness properties. The fabric dyed with Pinus brutia ten natural dye in the presence of oak ash as mordant exhibits good rub fastness. When oak ash used in dyeing operation, then it is considered fully eco-friendly method (Avinc *et al.*, 2013).

Extraction of Natural Dyes from the Bark of the Mangrove Tree

Natural dyes are extracted from barks of Mangrove tree (Rhizophora apiculate Blume) (Bandaranayake, 1998). Mangrove barks are removed from the timber because to reduction of ash content in charcoal products and the barks are highly rich in tannin content (Nichol *et al.*, 2006; Punrattanasin *et al.*, 2013). Tannin gives the natural colour, the rich reddish brown to the tree and the same colour is extracted as dye (Chapman V. J, 1970; Norman C Duke and James A. Allen, 2005). The bark was dried in sunlight and then milled to the small pieces for dye extraction process (J M CHEESEMAN and C E LOVELOCK, 2004). The dried bark was crushed in to powder for extraction of dye (Mongkholrattanasit *et al.*, 2016). For extraction, Soxhlet apparatus is used (Gobalakrishnan and Saravanan, 2017). Water is used as solvent for extraction purpose. The extracted dye was applied on textile materials using an exhaustion dyeing process (Nichol *et al.*, 2006). Mordants are used to improve the dyeing process. Several mordants are used for this purpose like Aluminium potassium sulphate, Ferrous sulphate, Copper sulphate and Stannous chloride (Bhattacharya and Shah, 2000). The dyed texile material has naturally reddish brown in shade without mordant because (Norman C Duke and James A. Allen, 2005; Punrattanasin *et al.*, 2016) barks are rich in tannin. Mordants change the shade of the colour. Different mordants produces different shades from pale to dark reddish brown. The mordants, aluminium potassium sulphate and copper sulphate are used to dye the silk fabrics (Punrattanasin *et al.*, 2016). The material to liquor ratio 1:10 was adopted to dye the silk fabrics. The dyeing was carried out for one hour at boiling temperature. Nattaya Punrattanasin et al., used to dye the silk with four different concentration of Mangrove tree extracts at four different dyeing time, temperature and pH level. From his experiment, it is determined that there is increase in temperature the colour strength is also increasing, that is the temperature is directly proportional to the colour. Maximum colour strength was yielded at 90oC. Colour fastness is good when using this mordants aluminium potassium sulphate, copper sulphate and ferrous sulphate except stannous chloride mordant. Similarly, the wash fastness and perspiration fastness was good in aluminium potassium sulphate, copper sulphate, stannous chloride except ferrous sulphate mordant (Punrattanasin *et al.*, 2013).

Extraction of Natural Dyes from the Bark of the Eucalyptus Camaldulensis Tree

The bark of the Eucalyptus camaldulensis tree is rich in tannins and polyphenols. The bark is one of the sources of yellowish-brown colour. Apart from the tannins the new components like quercetin, naringenin, rhamnetin are also present in this bark (Chakrabarti *et al.*, 1997; Vankar P. S, 2002; Naz, Bhattia and Adeel, 2011). The natural dyes extracted from the bark is yellowish-brown in colour(Chakrabarti *et al.*, 1997). The dye extracted from this tree is used to dye the cotton fabrics (Verma, 1998). This dye has very good affinity towards cellulosic fibres like cotton. But, the dye has poor colour fastness properties (Ali, Nisar and Hussain, 2007). Mordant was used to improve the fastness properties of this natural dye. The dye is extracted by making the bark in to small pieces. The bark is dried in shade. The shade dried barks are crushed in to small pieces. The barks are grinded for making the bark into powder (Naz, Bhattia and Adeel, 2011). The bark dye powder is extracted using the aqueous solution. The Soxhlet apparatus or beaker is used to extract the natural dye powder. Approximately, 20 grams and mixed with 200 ml of distilled water. Ali et al (2007)., used 25 samples to optimise the process parameters (Ali, Nisar and Hussain, 2007). The dyeing was carried out at 60oC with 1:15 m:l ratio for 60 minutes in exhaustion dyeing machines. The sodium sulphate, the exhausting agent is used for better exhaustion. Approximately, 15 gpl of sodium sulphate or sodium chloride is used. Soaping treatment is given to remove the unfixed natural dyes. The dried fabrics are tested for colour fastness to wash, light and rubbing. The temperature of the dyeing process has the influence on the colour yield. When increase the temperature, the colour strength increases gradually and it is observed that the pre-soaking with natural colour solution yield better colour strength. The wash and light fastness are comparatively good when compare with direct and sulphur dyes. The rub fastness are quite good in dry when compare with wet condition (Ali, Nisar and Hussain, 2007).

Extraction of Natural Dyes from the Bark of the Walnut Tree

Juglans regia L is the botanical name of Walnut tree, belongs to Juglandaceae family. The walnut tree is valuable tree because the entire parts of the tree is useful (Doty, Haar and Kim, 2016). The walnut is the most valuable fruit and the shell is the waste material. The shell is tested and it has the potential dyeing substrate for different textile materials (Tutak and Benlİ, 2011; Tutak and Ebru Korkmaz, 2012). The primary compound present in the walnut tree is Juglone, (5-hydroxy-1, 4-naphthoquinone) in the bark of the walnut tree and produces the brown colour (Wei, Ma and Dong, 2010; Mirjalili, Nazarpoor and Karimi, 2011; Mirjalili and Karimi, 2013). The collected bark of walnut is dried in shadow. The dried bark is crushed into powder using the grinder. The powder is sieved to remove the coarse particles (Gobalakrishnan and Saravanan, 2017). The aqueous solution was used to extract the dye from the bark of the walnut. The required concentration of bark powder was soaked with the required M:L ratio. Normally, 1:20 was used for 12 hours. Then the temperature of the solution is increased to the simmering point (91oC-93oC) and maintained at that temperature for an hour. Then the solution is cooled to room temperature and filtered using the filter paper. The residue was treated again to extract the maximum colour from the powder. The extracted solution was used to dyeing the textile materials (Doğan-Sağlamtimur *et al.*, 2017). Ali khan et al., used to dye the wool fibre with dye extracted from the bark of the walnut tree. The dyeing of wool was carried out at the simmering point for 30 minutes along with the natural dye and mordant (Ali Khan, Shahid-Ul-Islam and Mohammad, 2016). Mordant is used to analyse the effectiveness of the fastness properties

of the natural dyeing. 10% potassium aluminium sulphate and 5% alum is used as mordant. The mordants were applied in pre-mordanting and post-mordanting process (Gokhale *et al.*, 2004; M Gobalakrishnan *et al.*, 2010; S. Mahesh, A. H. M. Reddy, 2011). The dyed wool fabric is soaped with 5g/l of Ezee soap solution to remove the unfixed natural dyes. After the soaping, the fabric is dried in room temperature. The dyed yarn and the control samples were tested for colour fastness like light, rub and wash fastness with Indian ISO standard (Sharma and Grover, 2011). The samples exhibits good fastness properties in pre-mordanting with 10% potassium aluminium sulphate and 5% alum (Khalid *et al.*, 2010). The samples dyed without mordant exhibits good light fastness (Sharma and Grover, 2011; Ali Khan, Shahid-Ul-Islam and Mohammad, 2016).

Extraction of Natural dyes from the bark of the Albizia Lebbeck (Siris tree)

Albizia Lebbeck (Siris tree) belongs to Albizia family (Htay and Khin, 2018). This family contains more than 150 species. Siris tree's native is forest in Asia to eastern Pakistan through India and Sri Lanka to Myanmar (Htay and Khin, 2018). The phytochemical test result shows the presence of tannin, steroid, phenolic compound and amino acids etc (Vinod *et al.*, 2010). The colour produced by the chemical components in the bark is light brown colour. Four types of solvents, aqueous, alkaline, acidic and alcoholic medium, used to extract this bark for producing the natural dye. In the alcoholic medium the dyes is extracted at 70%, 50%, 30% alcohol ratio. The mordant like common salts, alum, ferrous sulphate, lime, acetic acid, banana leaf (Barhanpurkar *et al.*, 2015), ash, copper sulphate has been using for this dyeing process. The extracted natural dye solution is used to dye the textile materials. The dyeing started at 80oC temperature with or without mordant. The bath was set with ML ratio of 1:30 and the dyeing is continued for another one hour. The concentration of dye is varied from 5% to 10%. The mordant was added either by pre-mordanting or post-mordanting technique. After the dyeing, the samples were washed thoroughly with water and soaping is given to remove the unfixed dyes. Then the fabric is washed and dried. The dried samples were subjected to the various colour fastness properties. The samples dyed with Albizia Lebbeck extracts, show fair to good in change in colour and virtually no staining. Colour fastness to rubbing is good against the wet and dry samples. The natural dyed samples, exhibits fair to good fastness against the light (Htay and Khin, 2018).

Extraction of Natural Dyes from the Bark of the Terminalia Arjuna (Marutha Maram) Tree

Terminalia arjuna (Marutha maram) is the evergreen tree. It can be found in south Asian regions. The bark of this tree was used for anti-dysenteric, anti- pyretic, astringent etc.,(Das *et al.*, 2010). Terminalia tree have phytoconstituents like triter periods for cardiovascular properties, tannin and flavonoids used for anti- cancer, anti- microbial properties. The presence of tannin which is useful to produce the natural colour for the tree. The natural dyes are extracted from the bark of Terminalia tree which is used for dyeing the cotton fabrics (Nema R *et al.*, 2012). The barks were cleaned up with water and dried with direct sunlight. The bark was converted in to powder state and weighed for 100 g and mixed with 1 litre of water. The mixers are heated in beaker which kept for two hours. Then the solution is filtered and used for dyeing the textile cotton fabrics. The cotton fabrics are used this dyeing process with M:L ratio of 1:30 at 80oC temperature for one hour time (Misra *et al.*, 2005). The mordants, alum, copper sulphate, nickel sulphate, potassium dichromate, ferrous sulphate and stannous chloride were used in this natural dyeing. The natural mordants, cow dung, banana sap, turmeric and myrobolan are also used. The mordants are using by three ways there are pre-mordanting method, post-mordanting method and simultaneous mordanting methods. The colour fastness properties are tested with IS standards. The wash fastness test results show the good against all commercial mordants and poor to fair fastness exhibits against the samples without mordanting. The natural mordanting methods gives the poor to fair fastness rating. The light-fastness is quite good against the with-mordanting method and fair fastness against the without-mordanting method. The rubbing fastness of the commercial mordants gives the good fastness to the fabric. Natural mordants based mordanting methods give fairly good fastness to the fabric (S Saivaraj, G Chandramohan and P Saravanan, 2018).

Conclusion

The natural dye extracted from the bark of the Pinus brutia ten, Mangrove tree, Eucalyptus camaldulensis tree, Walnut tree, Albizia Lebbeck (Siris tree), Terminalia arjuna (Marutha maram) produces the unique colour, that cannot be matched with regular synthetic dyeing methods. Mostly, the aqueous extraction method is followed for extraction of natural dye from the bark of the tree. The exhaustion method of dyeing is followed to apply the natural dyes and the boiling temperature is kept to dye the same. The fastness of the natural dye extracted from the bark of these trees shows fair to good rating. Overall, the natural dyes from these trees exhibits better properties.

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