www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 2440-2443

www.thepharmajournal.com
Received: 03-07-2023
Accepted: 08-08-2023

Sharmeen Jahan Ansari
Research Scholar, Department of Clothing and Textiles, College of Home Science, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

Shahnaz Jahan
Professor & H.O.D, Department of Clothing and Textiles, College of Home Science, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

Corresponding Author:
Sharmeen Jahan Ansari
Research Scholar, Department of Clothing and Textiles, College of Home Science, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

Natural dye from *Manilkara zapota* Bark

Sharmeen Jahan Ansari and Shahnaz Jahan

Abstract
Fabric was traditionally dyed with natural dyes, but after the discovery of synthetic dyes in the year 1856, the usage of natural dyes gradually decline. Today, however, people are increasingly concerned with both, the environment and human health. Natural dyes have more benefits than synthetic dyes. Natural dyes are easily biodegradable in nature, eco-friendly and non-allergic to human skin. The methodology included, bark of the *Manilkara zapota* plant from which dye can be extracted in acidic, basic, and neutral mediums. Dye extracted from bark of the *Manilkara zapota* plant were used for dyeing of silk, cotton, and wool fabrics and evaluated. The criteria for evaluation of the best dye colour obtained from bark of the *Manilkara zapota* plant included visual evaluation, colour strength (K/S) and wash fastness of the dyed samples.

Keywords: Natural dyes, visual evaluation, colour strength (K/S), wash fastness

1. Introduction
History reveals that the Chinese have recorded the use of dyestuffs even before 2600 BC. Natural dyes were used to colour clothing or other textiles, but by the mid-1800s, chemists began to produce synthetic substitutes for them (Gokhale *et al.*, 2004) [1]. Nature has provided us with a wealth of plants and these plants have been used for the purpose of dyeing textiles and food products since antiquity. Until the mid-19th century, all dyestuffs were made from natural materials mainly from vegetable and animal sources (Wisniak, 2004) [2]. Natural dyes are the dyes which are derived from the natural sources such as flora, fauna and minerals (Samanta and Konar, 2011) [3]. By the early 20th century, only a small percentage of textile dyes were extracted from plants. The most common parts of the plants used for extracting dyes were seeds, flowers, leaves, berries, stems, bark, and roots. Natural dyes were best with natural fibres such as cotton, linen, wool, silk, jute, ramie and sisal (Gokhale *et al.*, 2004) [1]. Primitive men used to decorate their bodies, hair, and clothes with natural dyes, similar to what they do today in Africa, New Guinea and the Amazon Rainforest (Krizova, 2013) [4]. With the use of natural dyes, one can give uniqueness and novelty to their products by adding functional properties (Gupta *et al.*, 2004) [5]. A good dye should be soluble in water or dispersible in solvent and transferable to the fabric (Ozougwu and Anyakoha, 2017) [6]. A dye is a coloured organic compound that absorbs light from the visible region and can firmly be attached to the molecules of fibre due to the formation of physical and chemical bonds between the fibre group and the dye group. A dye should be fast to light, rubbing and washing to be of commercial importance (Iqbal, 2011) [7].
An experimental study was done using bark of the *Manilkara zapota* plant. *Manilkara* is a genus of trees in the family *Sapotaceae*, consisting of about 79 species. *Manilkara zapota*, commonly known as sapodilla, chiku and chicle, grows well in tropical conditions and is widely cultivated world-wide in tropical countries for various benefits like edible fruits, timber, latex, etc. (Uekane *et al.*, 2017) [8]. *Manilkar zapota* plant is known by different vernacular names in different languages in India like in Hindi Chickoo, Sapota; Tamil Simaiyiluppai; Gujarati Chicku; Bengali Sopeta, Sofeda; Malayalam, Telugu Sapota, Sapotasima; Marathi Chikku; Oriya Sapeta; and in Urdu Cheeku. (Milind, P. and Preeti, M., 2015) [9]. *Manilkara zapota*, fruit holds tremendous nutritional value as it is rich in sucrose and fructose. The fruit is consumed fresh or used to produce jams, compotes, and beverages (Shafii *et al.*, 2017) [10]. The *Manilkara zapota* plant contains several phytochemical constituents belonging to categories such as tannins, flavonoids, alkaloids, carbohydrates, triterpenes, and glycosides, etc. It also contains ascorbic acid, amino acids, carotenoids, proteins, phenols and minerals like iron, copper, zinc, calcium and potassium. The concentration of constituents varies in leaves, fruits, latex, seeds, and bark of the plant.

(Baskar, M., Hemalatha, G., and Muneeshwari, P., 2020) [11]. Experiments were conducted to screen out the medium of extraction and fabric to get the best colour from the *Manikara zapota* dye source. Fabric samples dyed with *Manikara zapota* dye were visually evaluated. Colour strength (K/S) and washing fastness was also tested.

2. Materials and Methods

Raw materials including cotton, silk, and wool fabrics were purchased from Sri Gandhi Ashram Pantnagar and bark of the *Manilkara zapota* plant was collected from Pantnagar university campus, shade dried and powdered for the extraction of natural dye. The extraction of dye was carried out in acidic, basic and neutral medium. The dye extraction was done by using 2 g of dye powder in 100 ml of distilled water at 80°C for 60 minutes. Then the solution was filtered and the presoaked (cotton, silk, and wool) fabric samples of 1 g each were dyed separately in the extracted dye solution for 60 minutes in different mediums. The best colour obtained on fabric was selected on the basis of visual evaluation, colour strength (K/S) and wash fastness of the dyed samples.

2.1 Visual evaluation of dyed samples

The criteria for visual evaluation of dyed fabrics included various attributes, viz., depth of shade, luster of dye, evenness of dye, and overall appearance. Evaluation was done by a panel of 50 judges including postgraduate students as well as teaching faculty from the Department of Clothing and Textiles, College of Home Science, G.B.P.U.A.T, Pantnagar. There were a total of four attributes, and a maximum of five marks were allotted to each attribute, so the maximum number of marks allotted was 20. The percentage of marks obtained through visual evaluation was calculated using the following formula:

$$\text{Percentage of marks} = \frac{\text{Marks obtained}}{\text{Total marks alloted}} \text{x } 100$$

2.2 Analysis of colour strength (K/S) of dyed samples

The strength of any dye is related to its absorption property. The Kubelka-Munk equation defines the following relation between reflectance, absorbance, and scattering characteristics of dyed samples as follows:

$K/S = [(1-R)^2/2R]$

Where, K = a constant about the light absorption of the dyed fabric

S = a constant about the light scattering of the dyed fabric

R = reflectance of the dyed fabric, expressed in fractional form

The colour strength of dyed samples was determined using a "Premier Colorscan SS5100A" spectrophotometer. The samples were placed in the sample holder, and light was projected onto it. The computer screen directly gives the reflectance. The orientation of the sample was changed three times and readings were recorded. The K/S values and colour coordinates (CIELAB) L*, a*, b*C and h° were recorded directly from the computer.

2.3 Determination of wash fastness of dyed samples

The wash fastness test was carried out as per the recommendations of IS: 3361-1979 (Test 2) in the launder meter. Each composite sample was placed in separate containers and soap solution previously heated at 50±2 °C was added to each container maintaining 50:1 liquor to material ratio. These specimens were treated for 45 minutes at 50±2 °C. AATCC (1975) rating scale is used for assigning wash fastness scores for change in colour and degree of staining which is given in table 1.

Table 1: Rating scale of wash fastness

Rating scale for change in colour	Rating scale for staining
Negligible or no change	Negligible staining
Slightly change	Slightly stained
Noticeably changed	Noticeably stained
Considerably change	Considerably stained
Much change	Heavily stained

3. Results and Discussion

Experiments were conducted to extract the natural dye from bark of the *Manilkara zapota* plant and fabric samples were dyed. On dyeing the cotton, silk and wool fabric with *Manilkara zapota* dye in acidic, basic, and in neutral medium, various tints and shades were produced as shown in sample sheet 1. Dyeing was carried out at 80°C for 60 minutes in a dye bath. The results of visual evaluation, colour strength (K/S), and wash fastness are shown in table 2, 3, and 4.

Among different mediums, highest percentage of marks obtained by cotton fabric is 72.2 % and silk fabric is 81% when it was dyed in neutral medium whereas wool obtained 78.3% marks when dye was extracted in basic medium. The results are shown in table 2.

Highest colour strength obtained by cotton fabric (1.929) dyed in basic medium, silk fabric obtained (3.56) in neutral medium whereas wool fabric obtained (2.525) in acidic medium when these samples were dyed with *Manilkara zapota* bark dye as shown in table 3.

Wash fastness of cotton sample showed noticeably change in colour (3) in all the medium of extraction i.e., acidic, basic and in neutral medium whereas silk and wool sample shown slightly change in colour (4) in all three mediums. Negligible staining (5) was found in all the three dyed fabrics as well as all three mediums when dyed with bark of the *Manilkara zapota* dye as shown in table 4.

Table 2: Percentage of marks obtained by different samples dyed with the *Manilkara zapota* bark dye

S. No.	Name of the plant	Part of the plant used	Medium of extraction	Percentage (%) of marks obtained		
				Cotton fabric	Silk fabric	Wool fabric
1.	*Manilkara zapota*	Bark	Acidic	67.4	73.8	67.5
			Basic	71.2	79.1	78.3*
			Neutral	72.2*	81*	72.9

* Highest percentage of marks

Sample sheet 1: Dyed samples

Where: A = Acidic, B= Basic, N= Neutral, C=Cotton, S= Silk, W= Wool

Table 3: Color strength (K/S) values obtained by different fabric samples with the *Manilkara zapota* bark dye

S. No.	Name of the plant	Part of the plant used	Medium of extraction	Colour strength (K/S)		
				Cotton fabric	Silk fabric	Wool fabric
1.	*Manilkara zapota*	Bark	Acidic	1.219	3.091	2.525*
			Basic	1.929*	3.369	2.277
			Neutral	1.178	3.56*	2.181

* Highest colour strength (K/S) value

Table 4: Wash fastness of different fabric samples with the *Manilkara zapota* bark dye

S. No.	Name of the Plant	Part of the plant used	Medium of extraction	Wash fastness					
				Cotton fabric		Silk fabric		Wool fabric	
				CC	SC	CC	SS	CC	SW
1.	*Manilkara zapota*	Bark	Acidic	3*	5***	4**	5***	4**	5***
			Basic	3*	5***	4**	5***	4**	5***
			Neutral	3*	5***	4**	5***	4**	5***

Where: CC= Change in colour, SC= Staining on cotton, SS=Staining on silk, SW=Staining on wool
* Noticeably change in colour
** Slightly change in colour
*** Negligible staining

4. Conclusion

Silk fabric dyed in a neutral medium got the highest percentage of marks among cotton, silk, and wool fabrics when evaluated by the respondents. This sample also got the highest colour strength. Noticeable and slight change in colour was found when all the samples washed and evaluated. Whereas slight change in colour was found in both silk and wool dyed fabrics. Only negligible staining was found in all the three fabric samples. Silk was selected as it got highest % of marks as well as highest colour strength and slight change in colour and negligible staining on silk undyed fabric.

5. Acknowledgement

First of all, I am very thankful to the Almighty for his countless blessings. I am extremely grateful to Dr. Shahnaz Jahan, Professor and Head of the Department, for guiding me throughout the work and permitting the use of lab instruments in the department. Sincere thanks to the GBPUA&T for providing me with financial support and other facilities required for the research work.

6. References

1. Gokhale SB, Tatiya AU, Bakliwal SR, and Fursule RA. Natural dye yielding plants in India. Natural Product Radiance. 2004;3(4):228-234.
2. Wisniak, J. Dyes from antiquity to synthesis. Indian Journal of History of Science. 2004;39(1):75-100.
3. Samanta AK, Konar A. Natural Dyes. Edn 1, In Tech, Croatia; c2011. p. 29-56.
4. Krizova H. Textile Dyeing - Theory and Applications. Edn 1, The University Company TUL, S.R.O, Liberec; c2013. p. 317-334.
5. Gupta D, Khare SK, Laha A. Antimicrobial properties of natural dyes against Gram – negative bacteria. Coloration Technology. 2004;120:167-171.
6. Ozougwu SU, Anyakoha U. Analysis of colorfastness of fabrics treated with dyes extracted from Roselle calyces. African Journal of Agricultural Research.

2017;12(3):133-144.
7. Iqbal. Dyes and colour; c2011. www.fibre2fashion.com. Visited on 14 February, 2023.
8. Uekane TM, Nicolotti L, Griglione A, Bizzo HR, Rubiolo P, Bicchi C, *et al.* Studies on the volatile fraction composition of three native Amazonian-Brazilian fruits: Murici (*Byrsonima crassifolia* L., Malpighiaceae), bacuri (*Platonia insignis* M., Clusiaceae), and sapodilla (*Manilkara zapota* L., Sapotaceae). Food Chem 2017;219:13-22.
9. Milind P, Preeti M. Chickoo: A wonderful gift from nature. Int J Res Ayurveda Pharm. 2015;6(4):544-550.
10. Shafii ZA, Basri M, Malek EA, Ismail M. Phytochemical and antioxidant properties of *Manilkara zapota* (L.) P Royen fruit extracts and its formulation for cosmeceutical application. Asian J Plant Sci. Res. 2017;7:29- 41.
11. Baskar M, Hemalatha G, Muneeshwari P. Traditional and medicinal importance of sapota – Review. International Journal of Current Microbiology and Applied Sciences. 2020;9(1):1711-1717.