Waste Technology (WasTech)
Journal homepage: http://ejournal.undip.ac.id/index.php/wastech
An International Journal

Utilization of Rambutan (*Naphelium lappaceum* L) Peel's Waste is Becoming More Useful As a Natural Dye of Fabrics

Heny Kusumayanti, Vita Paramita, Rizka Amalia, Wahyuningsih

Chemical Engineering, Vocational School, Diponegoro University, Jl. Prof. Soedarto, Semarang, Central Java, Indonesia
e-mail: henykusuma_yanti@yahoo.co.id

Abstract – The demand to find an alternatives source of fabric dyes is increasing nowadays, specifically for natural dye. Applying natural dye in fabric, giving important effect of more environmentally friendly than synthetic dye. One of the natural colors that can be used is Naphelium lappaceum L peel's waste. The method used is dyeing a cloth with extract of Naphelium lappaceum L peels. Variables applied are extract concentration, type of fixation and concentration of fixation. The results of dyeing cotton fabric using Naphelium lappaceum L peel extract show that the use of alum solution as fixation materials provides brown light color, yellowish brown for lime, and blackish grey for ferro sulphate. The different extract concentration resulted significant effect on the colour radiance on fabric.

Keywords *– natural dye, rambutan peels, alum, lime, ferro sulphate.*

Submission: Februari 18, 2020 Correction: March 1, 2020 Accepted: April 8, 2020

Doi: http://dx.doi.org/10.12777/wastech.8.1.25-28

[How to cite this article: Kusumayanti, H., Paramita, V., Amalia, R., Wahyuningsih,W. (2020). Utilization of Rambutan (*Naphelium lappaceum* L) Peel's Waste is Becoming More Useful As a Natural Dye of Fabrics. *Waste Technology, 8*(1),25-28. doi: http://dx.doi.org/10.12777/wastech.8.1.25-28]

1. Introduction

Dyeing is an ancient art which already took place in centuries ago. From commercial pont of view, synthetic dye is prefer due to its strong color. However it usually come from heavy metal which is carcinogenic photosynthesis inhibition[1]. Germany was the first country to take the initiative to place certain restrictions in the manufacture of synthetic dyes with heavy metals and its application. Netherlands, India, and other countries also follow this prohibition[2].

In natural fabric dyes, color is a result of complex dyeing process, reproductive outcomes, limited nuance, blending problems and adequate colorfast properties[3]. These issue are resolved with a mordant. Mordant is metal salts that produce affinity between fabric and dye [4,5]. Natural Dyes are dyes or colorant derived from plant, invertebrates or mineral. The majority of natural dyes are from plant sources. A great sources for natural dyes can be found right in own back yard like roots, nuts, leaf and flowers are just a few common natural ways to get natural dyes[5].

Natural dye material are scarce and expensive and synthetic dye. All colors fade with light exposure, brighter tones are obtained in fading natural dyes. While synthetic dyes fade very quickly, unevenly, there are stains. The impurities of natural dyes may comprise from 25% of the dyes[5,6].

Rambutan (*Naphelium lappaceum L*), grow well in tropical country. The plant grow well at 30 – 500 m above sea level and need humid with rainfall 1500-2500 per annum. There are 22 varietes of *Naphelium lappaceum L* available in the world, derived from pure variety and also grafting 2 or more varieties. Characteristics of the *Naphelium lappaceum L* fruit are transparent, high water content, white coat and hairy on the peels. Several varieties are often cultivated due to it is high economic value. One gram of *Naphelium lappaceum L* fruit can be consumed only 0,4 gr (40%) while remaining 0.6 gr (60%) is peel and seed. The rambutan peels are waste and have not been used[7]. Figure 1. shows *Naphelium lappaceum L* fruit.

Figure 1. *Naphelium lappaceum L* fruit

The vibrant color *Naphelium lappaceum L* is very exciting. This research about *Naphelium lappaceum L p*eel as a natural dye of fabrics.

2. Materials and Methods

Method used for extraction is developed from research of flower extraction flower[8]. In our research we use peels of *Naphaleum lapaceum*. Fig 2 shows the method use in this research. In this method, dye from *Naphaleum lapaceum L* peel's waste were extracted by preparing an aqueous solution (15%, 20%, 25%) of 1.5 kg peels of *Naphaleum lapaceum L* (in 10 L, 7.5 L, 6 L distilled water) and the extraction process was carried out by boiling the solution until 1/3 of boiled water is evaporated. Colouring materials from the *Naphaleum lapaceum L's* peel waste were extracted for dying of the fabric. After the extraction procedure is complete, the *Naphaleum lapaceum L* peel's waste were taken out from the liquor. In this research, cotton fabric was dyed by *Naphelium lappaceum L's* peel extract and followed by fixation process with a variety of extract concentration (15%, 20%, dan 25%), fixation materials (lime, alum, and ferro sulphate) and concentration of its solution (5 %, 25 % dan 45 %) as an independent variable. The independent variables are colour obtained from dyeing. The dyeing process in extract solution were then followed with mordanting by dipping the fabric in sugar solution three times. Mordanting was applied to increase the affinity for both the colouring

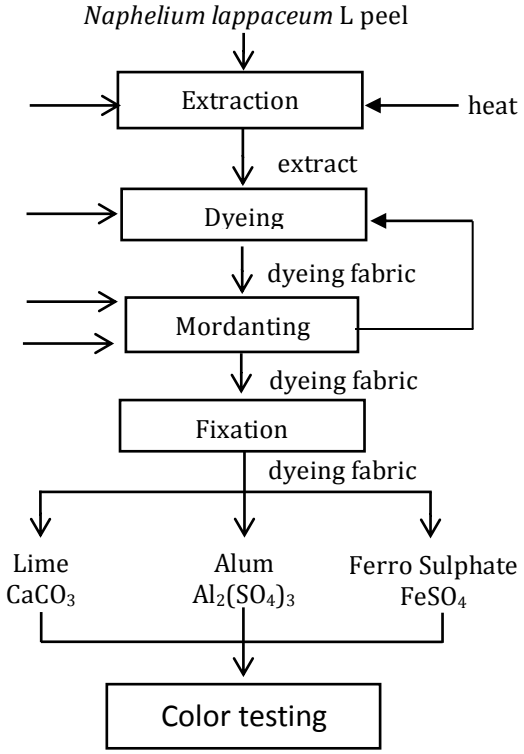


Figure 2. Experimental Scheme

matter and the fibre[6]. In order for the natural colors does not fade, fixation is done using lime, alum or ferro sulphate. Then the color intensity was analyzed.

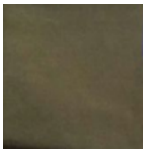
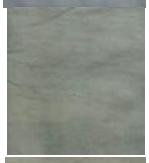
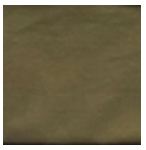
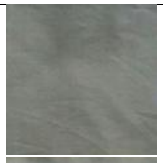
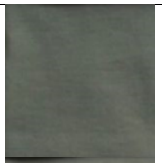
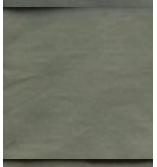
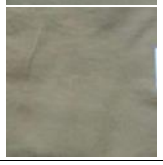
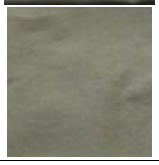
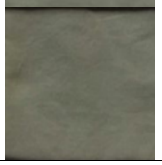
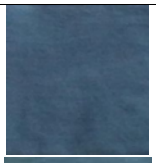
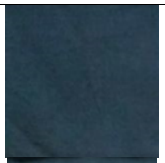
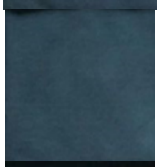
3. Results and discussion

Table 1 shows the difference in fixation substance used different colors. In addition to lock in the color on fabric, the metal salt fixator can also change the color of natural dyes direction according to the type of metal salts that bind5. Natural dyes have the ability to produce wide range of tints and shades, with the same dye material[9]. Fixation (post mordanting) improve the colour uptake, light fastness and colour retention for application of many natural dyes on textiles [10,11]. The other research, reported dyeing cotton fabric with turmeric dye by using different mordants like tannic acid, alum, ferrous sulphate, stannous chloride and potassium dichromate to obtain various shades of colour. All types of alum usually produces pale versions of the prevailing dye colour in the plant6. Ferrous sulphate is known as green vitriol and is readily soluble in water. It is used for darkening / browning and blackening of the colours / shades. Ferrous sulphate extensively used to get grey to black shades[6]. The result in Table 1 shows similar trend with previous reports.

Observation using spectrophotometer UV-VIS wavelength 400 nm

From Figure 3 it can be seen that the effects of the fixative type (ie, lime, alum and ferrous sulfate) and fixative concentrations (5%, 25% and 45%) with the concentration of *Naphelium lappaceum L* skin extract (15%, 20% and 25%)) at the color intensity, as an absorbance unit. Using 45% lime as a fixative containing 15% concentration of *Naphelium lappaceum L* skin extract, the lowest color intensity value (0.068 ? 0.009 AU) and dark yellowish brown color were obtained. Whereas the highest color intensity value was obtained at 0.543 ± 0.001 AU for dark chocolate with 45% alum as a fixative with a 15% extract concentration of *Naphelium lappaceum L*. peels even though with the type of natural dyes extracted at the same concentration, different fixative types produced a different color light different on fabric. The development of natural dyes extracted from plants can be used successfully as an effective and more environmentally friendly alternative cleaner as a substitute for synthetic dyes which are gradually used in the textile coloring industry[12]. Vedaraman postulates that the nuances obtained with natural dye extracts combined with mordan are in accordance with the nuances of fashion obtained using synthetic dyes and can be recommended as replacing synthetic dyes for coloring substrates such as leather and cotton fabrics for environmentally friendly[13]. Applying lime for fixation with concentration 5% given higher color intensity, while using Alum fixation with concentration 45% given higher color intensity using ferro sulphate for fixation shows highest color intensity at concentration 25% and 45%.

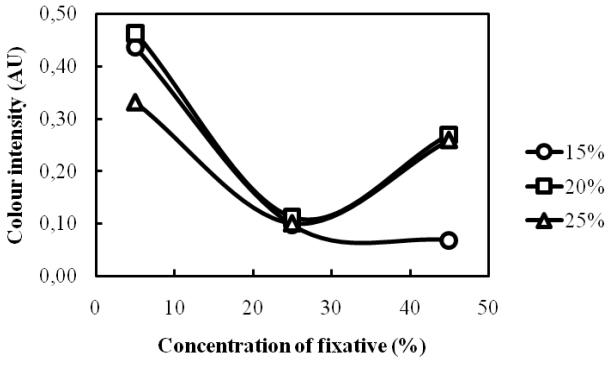
Table 1. Dyeing cloth at varied extract of of *naphelium lappaceum* L fruit and fixation concentrations regarding to the type of fixation (lime, alum and ferro sulfat)

Concentration of *Naphelium lappaceum* L peel extract (%)	Concentration of fixative (%)		
	5	25	45
	Type of fixative: Lime ($CaCO_3$)		
15			
20			
25			
	Type of fixative: Alum ($Al_2(SO_4)_3$)		
15			
20			
25			
	Type of fixative: Ferro Sulphate ($FeSO_4$)		
15			
20			
25			

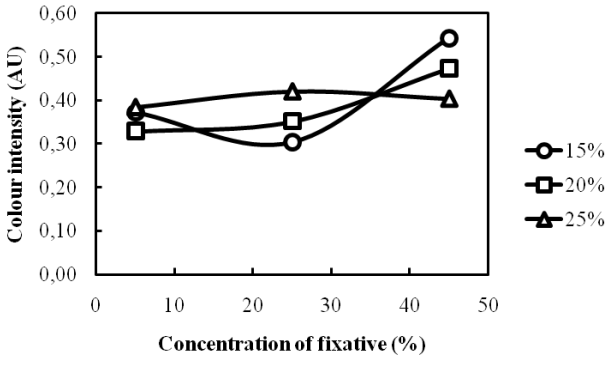
4. Conclusions

Dyeing of cotton fabric could be made using natural dyes. The advantages of using natural dyes are cheap, environmentally friendly, and soft color produced. One of natural dyes that derived from waste is Naphelium lappaceum L's peel. The results of dyeing cotton fabric

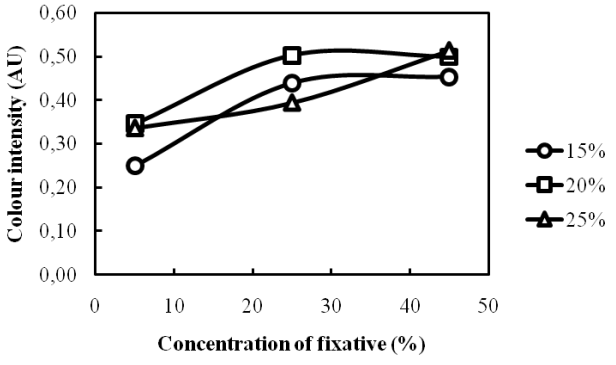
using Naphelium lappaceum L peel extract show that the using of alum solution as fixation materials provides brown light color for alum, yellowish brown for lime, and blackish grey for ferro sulphate.



(A) Lime



(B) Alum



(C) Ferro

Figure 3. Effect of type (A, lime; B, alum; C, ferro sulphate) and concentration (5%, 25% and 45%) of fixative regarding to the extract concentration of *Naphelium lappaceum* L peel (○, 15%; □, 20%; △, 25%) on the colour intensity, as absorbance unit.

References

[1] Adeel, S., Ali, S., Bhatti, I.A., Zsila, F., 2009. Dyeing of cotton fabric using pomegranate (Punica granatum) aqueous extract. *Asian Journal of Chemistry*, 21, 3493.

[2] Patel, N.K., 2011. Natural Dye Based Sindoor By Nk Patel. *Life Sciences Leaflets*, *11*, 355-361

[3] Sachan, K., Kapoor, V.P., 2007. Optimization of extraction and dyeing conditions for traditional turmeric dye. *Indian Journal of Traditional Knowledge*, 6, 270-278.

[4] Vankar, P.S., Shankar, R., Wijayapala, S., 2009. *New Trends in Natural Dyes for Textiles*. Woodhead Publishing *Journal of Textile and Apparel, Technology and Management*, 6, 1-10

[5] Samanta, A.K., Agarwal, P., 2009. Application of natural dyes on textiles. *Indian Journal of Fibre & Textile Research*, 34, 384–399.

[6] Samanta, A.K., Konar, A., 2011. *Dyeing of Textiles with Natural Dyes* (Department of Jute and Fibre Technology, Institute of Jute Technology, University of Calcutta India)

[7] Tindall, H.D., 1994. *Rambutan Cultivation In FAO Plant Production and Protection Devision* (FAO Plant Production and Protection Division).

[8] Grover, N., Patni, V., 2011. Extraction and application of natural dye preparations from the floral parts of Woodfordia fruticosa (Linn.) Kurz. *Indian Journal of Natural Product and Resources,* 2, 403-408

[9] Vinod, K.N., Puttaswamy, Gowda, K.N.N., Sudhakar, R., 2010. Natural colorant from the bark of Macaranga peltata : Kinetic and adsorption studies on silk. *Color Technology,* 126,48-53

[10] Maulik, S.R., Das, D., Bhattacharya, S.C., 2011. Modification of cotton fabric with acrylamide in the presence of K2S2O8 for improving dyeability of natural dyes. *The Journal of The Textile Institute*, 102,131-139.

[11] Das, D., Bhattacharya, S.C., Maulik, S.R., 2008. Colouration of wool and silk with Rheum emodi. *Indian Journal of Fibre & Textile Research,* 33, 163-170

[12] Yin, Y., Jia, J., Wang, T., Wang, C., 2017. Optimization of natural anthocyanin efficient extracting from purple sweet potato for silk fabric dyeing. *Journal of Cleaner Production*, *149*, 673-679.

[13] Vedaraman, N., Sandhya, K.V., Charukesh, N.R.B., Venkatakrishnan, B., Haribabu, K., Sridharan, M.R., Nagarajan, R., 2017. Ultrasonic extraction of natural dye from Rubia Cordifolia, optimisation using response surface methodology (RSM) & comparison with artificial neural network (ANN) model and its dyeing properties on different substrates. *Chemical Engineering and Processing: Process Intensification*, 114, 46-54.