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DYEING OF SILK YARN WITH EXTRACT FROM OLD LEAVES OF ARTOCARPUS HETEROPHYLLUS

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Abstract:

Jackfruit leaves are a renewable resource where there are frequently removed from the tree. However, its ability in utilising for natural coloration is beyond potential. In this research, old leaves from Jackfruits (Artocarpus Heterophyllus) was studied to uncover the dyeing capabilities on silk yarn. The modern extraction method through micro-wave oven was applied in three procedures pre mordanting and dyeing, simultaneous mordanting, and post mordanting. The established natural colours have been studies on its dyeing ability on silk yarn by using aluminium sulphate and tannin as the mordant. Through visual observation, it was discovered that the shade of colour from Pre-mordanting and dyeing showed excellent results in the range of dark-brown colour. The lightest shade appeared through Post mordanting and dyeing where Simultaneous mordanting and control samples showed a similar range of mid-brown colour. Therefore, the application of renewable resources such as the Jackfruit leaves will become a matter of significant importance for the establishment of safe and eco local textile products.

Keyword:

Jackfruit, Mordanting, Natural Dyeing, Silk Fabric

Introduction

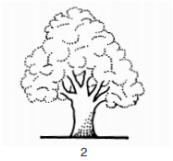
In the history of Malay textiles, natural dyes have become a colouring or dyeing resource utilised by local weavers to enhance the beauty of a base woven textile mainly the *kain limar, cindai* and *songket*. Its natural colour is not only regarded as an element of decoration but also plays a significant role in differentiating various levels of hierarchy in the Malay social structure (Ismail, 2006). Hues or colours applied in the making of these textiles in the past were carefully made in order to suit the rank of the wearers. Colours or dyes extracted from our magnificent local environment have existed prior to the emergence of synthetic dyes into this country in the 1920's. Among all colours, red *kesumba* or *Merah kesumba* colour from Bixa

Orellana's seed is considered the most preferred among local dyers to dye their yarns (Azah, 2006). Green colours from *pandan* leaves and yellow from turmeric's (Curcuma longa) tuber are among others extracted from nature for textile dyeing (Faridah, 2006). Hues come from the extract of jackfruit tree or in scientific name *Artocarpus heterophyllous* is also considered a familiar colour to beautify the traditional textile. Fraser-Lu (1988) described that yellow dye from the heartwood of jackfruit was among the common colour used to dye textiles in the Southeast Asian region in the past.

Traditionally, dyes derived from parts of jackfruit plant was extracted through stages of processes to obtain its natural origin prior to dyeing and weaving (Fraser-Lu, 1989). The order began with the selection of suitable parts of raw material; the inner wood, the bark, or even the skin of the fruits. The selected substance was cut, chopped, sliced to bits and pieces or left in the open area for drying before the extraction process took place. In the next stage of processes, the accumulated resources were placed in a pot and boiled alongside with mordant for hours to allow the fixation of colour onto the fibre. However, in some other extraction processes, mordant were later combined in a separate procedure to obtain different hues and shades. Only experience dyers or craftsmen managed to carry out the procedures effectively (Therik, 1989). Lime, salt, leaves and some other raw materials which contain alum and iron compounds were considered the natural mordant to be included in the mordanting and dyeing processes (Barkeshli et al., 2003).

Jackfruit is a seasonal fruit and a tropical evergreen tree taking the botanical name *Artocarpus heterophyllous lam*. Under species *Artocarpus* and family Moraceae (Alam et al., 2011). Jackfruit is an important tropical fruit in India, Bangladesh, Sri Lanka, southern China, Southeast Asian countries (Alam & Aslani, 2017). Artocarpus heterophyllus grows in tropical regions, adjacent to tropical and subtropical regions. This tree is also able to withstand lower temperatures and frosts it results in latitude up to 30 degrees north and south, with good plants at 25 degrees north and south. Even for optimum production, it requires a warm, humid climate and equally rainy weather (Artocarpus heterophyllus, n.d.).

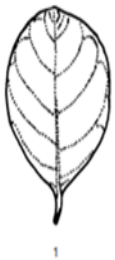
Jackfruit is a medium-sized, evergreen tree that typically attains a height of 8–25 m (26–82 ft.) and a stem diameter of 30–80 cm (12–32 in). The canopy shape is usually conical or pyramidal in young trees and becomes spreading and domed in older trees. The canopy diameter at 5 years old ranges from 3.5–6.7 m (11–22 ft.) and can reach 10 m or more in older trees. The tree casts a very dense shade. Heavy side branching usually begins near the ground. All parts of the tree exude a sticky white latex when injured (Elevitch et al., 2006).

 1	Pyramid
 2	Broadly Pyramidal

 3	Spherical
 4	Oblong
 5	Semi-circular
 6	Elliptical
 7	Irregular

Figure 1: Jackfruit Shape

Sources: Elevitch et al., 2006

 1	Obovate

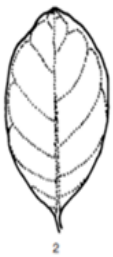
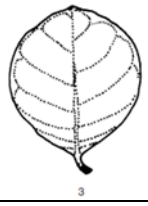
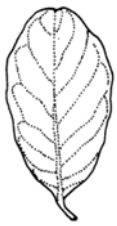
	Elliptic
	Broadly Elliptic
	Narrowly Elliptic
	Oblong
	Lyrate (Wavy)

Figure 2: Leaf Blade Shape

Sources: Elevitch et al., 2006

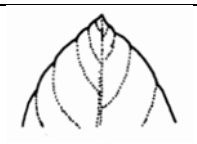
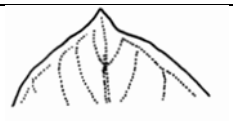
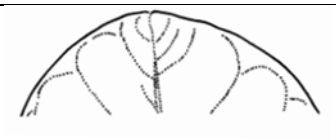
	Acute
	Acuminate
	Retuse
	Obtuse

Figure 3: Leaf Apex Shape

Sources: Elevitch et al., 2006

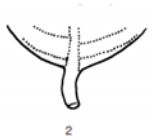
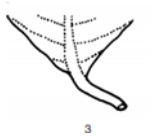
	Oblique
	Rounded
	Cuneate
	Shorty Attenuate

Figure 4: Leaf Base Shape

Sources: Elevitch et al., 2006

Jackfruit leaf is a potential source of tannin used as protein protection. This is because the jackfruit tree thrives in the tropics and is quite familiar to farmers and ranchers. Sasongko et al., (2010) reported that the total content of tannins and tannins condensed on jackfruit leaves

was 7.08 and 5.57%. Nevertheless, driven by the unique characteristics of hues produced by the plants, efforts are currently being made by researchers, educational institutions and textiles dyers to revive the extraction process. With the advancement of scientific and technological methods and tools, the process of extracting and establishing colours from its natural origin has been further improved in various countries.

Furthermore, procedures for extracting the colours also contribute to the establishment of fascinating shades for the textiles. Boling is considered the most common and traditional method of extracting the dyes from parts of jackfruit plant. Fraser-Lu (1988) described that a moderately invariable yellow-orange dye can be obtained from boiling of wood chips or sawdust of heartwood of jackfruit in the water. A wide variety of hues from the same extract can also be achieved through the addition of aluminium mordant to the solution in which has resulted in a range of colours of muddy-yellow to golden and orange-yellow, and to apricot and tan.

Nevertheless, driven by the unique characteristics of hues produced by the plants, efforts are currently being made by researchers, educational institutions and textiles dyers to revive the extraction process. With the advancement of scientific and technological methods and tools, the process of extracting and establishing colours from its natural origin has been further improved in various countries. Vankar, Shanker et al., (2011), in their studies described that through innovative extraction of *ultrasound energy*, dyes from the bark of jackfruit plant allowed good uptake of colourant for silk (68-70%) and wool (59-73%) at a different level. A combination of metal mordant and natural properties of the bark permits effective dye adherence and fastness properties on the fibres where hues ranging from light brown to greenish brown were established. This result confirmed that interaction between metal mordant, natural properties of the bark (tannin) and protein fibres capable to establish a range of significant hues.

Another research by Febriana, Gala and Mahfud (2017) shows that the application of an *Ultrasound-assisted extraction* (UAE) to extract dye from jackfruit's wood had intensified the amount of extraction solution. The result achieved by combining the dust of the wood with concentrated 96%'s ethanol as a solvent. The volume ratio of the ethanol concentration is however adjusted within the prearranged time range and (20 to 50 minutes). The outcome indicates that not only new methodological extraction process is able to influence the yield of extracts from wood but also the addition of alcohol (ethanol) alongside the process plays a significant role to obtain magnificent colours. Saxena and Raja (2014) in their research also explained that *Microwave* and *Ultrasonic-assisted extraction method* are also the feasible extraction procedures. The result showed that the amount of required solvent, time and temperature applied in these processes are greatly reduced. The application of the maximum level of temperature and pressure enables an intensification of extraction, thus allowing concentrated dyes to be produced within a short period of time. This procedure can also be accomplished at a lower temperature where the result illustrates that heat-sensitive dye particles are formed at a better state.

Furthermore, Saxena and Raja (2014) also explained that organic solvents such as acetone, chloroform, petroleum, ethanol and mixture of solvents can also be used in extracting natural dyes. The yield extract was found higher as compared to the traditional aqueous method. A large number of concentrated colours obtained at the end of the procedure prove a combination of various solution able to accelerate the long extracting hours spent in a single procedure. Similarly, the application of different mordanting procedures also contributes to the yield of

hues and colourfastness properties on fibre materials. Samanta, Agarwal et al (2006), in their research, showed that single and double mordanting procedures affect the final results of overall mordanting and dying of extract from jackfruit wood. Even though Prabhu and Bhute (2012) described that cellulosic fibre is less dye-receptivity, dye-affinity and low absorbency, different mordanting procedures allowed good dyes yielding and overall colour fastness properties on cotton fibres. Not only the natural mordant from the wood (tannin) allowed the fixation of colours and hues, the addition of other metal salts with different concentration of colour-source material (jackfruit) and the ratio (material-to-liquor) also contributed to the overall result. The purpose of this study was to extract colour from the Jackfruit Leaf to be applied on silk fabric. The originality mordant method was applied to extract its natural colourant. The established extracts were studied their dyeing ability by experimenting through old leave of Jackfruit on a sample of silk fabric.

Material and Method

Material

In this experiment, the freshly collected old leave which concentrated in the average size of 1.5-2.0 cm were used for the experiments. The physical characteristics, the quality and condition leave (see Fig. 5), were the main aspect to be considered when collecting the source in a large amount. The parameters were set to ensure that only consistent amounts of jackfruit leave to be applied in each procedure. The collected jackfruits were thoroughly washed to make sure it is clean from any dirty influence based on environment factor that would not affect the final result. Finally, the old leave was dried for about half an hour by exposing to sunlight.

Figure 5: Jackfruit Tree

Sources: Taman Cenderawasih Kuantan

Extract Preparation

The Jackfruits Leave (Fig. 6), were weighed 100gram and that only clean extract would be used for the extraction process. Then, the samples were gradually dissolved in distilled water at a ratio 1:25 at room temperature. The microwave was heated up at 100℃ for 30minute to allow the release of dye absorbs into silk fabric. The selected substance was cut, chopped, sliced to bits and pieces or left in the open area for drying before the extraction process took place.

Figure 6: Jackfruit Leaf

Sources: Taman Cenderawasih Kuantan

Mordant

Aluminium Sulphate at 5gm application was used as mordant and mordanting procedures were carried out through Pre-mordanting, Simultaneous mordanting and Post-mordanting methodology.

	PRE-MORDANT	SIMULTANEOUS-MORDANT	POST-MORDANT
1.4	100 gm Fiber 500 gm Jackfruit Leaf 1000 ml Water		
1.1	100 gm Fiber 500 gm Jackfruit Leaf 1000 ml Water 5 gm Alum		
1.2		100 gm Fiber 500 gm Jackfruit Leaf 1000 ml Water 5 gm Alum	
1.3			100 gm Fiber 500 gm Jackfruit Leaf 1000 ml Water 5 gm Alum

Table 1: The Formulation for Mordanting Silk Yarn

Sources: -

Dyeing Procedure

The pre-mordanting dying, simultaneous mordanting dying and post-mordanting dyeing methodology were applied to ensure that all samples were treated, thus producing a variety of shades for further analysis. The application of a domestic microwave oven will be a rapid extraction method to exhaust the dyes extract from the leaves. The leaves will be set in the microwave with a range of power 100℃ and time of exposure to the radiation is for 5 min.

Dyeing Conditions	**Temperature**	**Time**	**Yarn Weight**
Dyeing without mordant • Old Leave	100w	30minute	100g
Dyeing Pre-Mordanting • Old Leave	100w	30minute	100g
Dyeing Simultaneous-Mordanting			

• Old Leave	100w	30minute	100g
Dyeing Post-Mordanting • Old Leave	100w	30minute	100g

Table 2: The Formulation for Mordanting Silk Yarn

Sources: -

Result and Discussion

The extraction of old leaf of Jackfruit successfully adapted to silk yarn. Colour of yarn obtain from all experiment procedures are dark brown shade and mid-brown shade the liquid are giving yellowish brown and dark brown shade which highlight the difference shade in the use of alum and tannin.

Silk Yarn	Procedures	Yarn	Liquid
Tannin	No Mordant		
Alum	Pre-Mordanting		
Alum	Simultaneous Mordanting		
Alum	Post Mordanting		

Table 3: Result on Silk Yarn

Sources: -

Conclusion

Throughout centuries natural dyes and their role as colouring agents for natural fabric remain significant in textile industries around the globe. With the advancement of scientific and technological methods and tools, the process of extracting the colours was further improved alongside the quality of hues and colourfastness property. Various ranges of hue can be

classified and recorded for further research development in this country and these consist of extract from vegetable, animals or insects, part of plants; roots, leaves, rhizomes, barks, wood, and minerals.

Base on this experiment extracted from old leaf of *Jackfruit* show excellent result in the range of dark-brown shade of colour from Pre-mordanting and dyeing. The lightest shade appeared through Post mordanting and dyeing where Simultaneous mordanting and control sample showed similar range of mid-brown colour. By using aluminium sulphate or tannin as mordant the result on silk yarn is not much difference it almost similar by giving brown colour on yarn. While the result of the liquid is seeming to produce difference colour scales but it doesn't have much effect to silk yarn. It can be concluded that using microwave as a method for this experiment will save more time compare to traditional method and it give a good result using silk yarn. Applying the technological tools during the procedure will enable the improvement and optimization of mordanting and dying of fibre materials. The use of eco-friendly natural dyes on textile is hopefully will become a matter of significant importance for the establishment of safe and eco local textile product. Thus, analysis of changes could be conducted to get darker brown colour and may also be adapted to other natural fiber beside silk yarn to be applied in other experiment procedures.

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