



The Application of CNC Machine Creating Lai Batik with Natural Dyes from Lai Leaves (*DURIO KUTHEJENSIS*)

Hesti Rosita Dwi Putri¹, Rizka Ayu Yuniar¹ and Fulkha Tajri M¹

¹Kalimantan Institute of Technology, Indonesia
hesti.rosita@lecturer.itk.ac.id

Abstract. Batik in the Penajam Paser Utara (PPU) region of East Kalimantan is increasingly in demand by the public, the high market demand requires faster batik production, however, batik craftsmen are still very few in the PPU region. The use of CNC machine technology is utilized by the Sekar Buen batik business in the PPU region to meet market demand. Lai (*Durio Kutejensis*) is one of the endemic durian species in Kalimantan which is not widely known by people outside the island of Kalimantan, the uniqueness of the Lai fruit can be an inspiration in creating batik designs and its leaves can be used as batik natural dyes. The utilization of Lai as a motif and dye can add to the uniqueness of East Kalimantan batik. The research method uses a work design method by applying the lai motif to the fabric using a CNC machine and colored with natural dyes derived from lai leaves. The results show that CNC machines in the future can be an alternative to meet the needs of batik whose region lacks batik craftsmen. The use of lai leaves as a dye can be an option in utilizing raw materials from local potential so that the resulting color character is identical to the area.

Keywords: Batik, Machine CNC, Lai, Natural Dyes, Penajam Paser Utara

1 Introduction

Batik is one of the intangible cultural heritages that has been recognized by UNESCO [1]. Batik has 2 meanings for the people of Indonesia, namely the first is a legacy from the ancestors of the Indonesian people, the second is batik as an industrial work that is a livelihood or employment for the community. Various regions in Indonesia such as Sumatra, Java, Kalimantan, Bali, Lombok to Papua, batik has its own character.

The batik of East Kalimantan has different characteristics from other regions, this is influenced by local motifs of Dayak tribal decorations combined with local flora and fauna such as deer motifs, mangrove motifs, *pesut* fish motifs etc[2]. At the batik production site in Penajam Paser Utara, East Kalimantan, namely Sekar Buen, apart from using written and stamped batik, it also uses computer numerical control (CNC) Machine as a tool in making motifs on cloth using wax (lilin malam). The use of technology in the form of CNC machines can accelerate batik production faster and neater quality [3]. Batik is a skill that is obtained by diligent and tenacious practice, at first the

batik skills in Bangun Mulya Penajam Paser Utara village were only a few people then they formed a group to learn batik skills together, until 2021 started production for sale. The products made began to be in demand by the public and increased market demand. The high demand for batik causes the need to add craftsmen to meet this demand, but public interest in batik is still low. So that the use of CNC machine is an alternative in accelerating the production process to meet market needs, the CNC machine in Bangun Mulya village is a collaboration with the government.

Indonesia has biodiversity that is widely spread in various forests in the territory of the Republic of Indonesia. One of the wealth that needs to be explored more deeply is the type of fruit located in tropical forests. East Kalimantan Province is one of the areas rich in durian germplasm sources where the largest distribution of *Durio* genus plants is found, where 9 of the 18 species can be consumed [4]

Lai (*Durio kutejensis*) is one of the endemic durian species in Kalimantan which is not widely known by people outside the island of Kalimantan. The characteristics of Lai fruit and Durian fruit are similar both from the structure of the tree, leaves and fruit. The only difference is the aroma, color and texture of the fruit itself. Lai trees are scattered in forests and community gardens, many Lai trees in the East Kalimantan region have not been utilized other than the fruit produced.

The uniqueness of the *lai* fruit which is the endemic durian species in Kalimantan has not been utilized in regional handicrafts even though the uniqueness of the fruit can be an idea in creating batik motifs with character. The use of CNC machines can be an alternative to meet the needs in Bangun Mulya village Penajam Paser Utara (PPU) in meeting market demand while the number of batik craftsmen is still very limited. In addition, batik fabric dyes can also utilize raw materials from local potential in the region.

1.1 Problem Formulation

From the above background, the problem formulation is obtained, namely Lai as an idea in creating a typical East Kalimantan batik motif, applying lai motifs using CNC machines and utilizing lai leaves as an alternative to natural dyes from local natural potential.

1.2 Research Objectives

1. Creating a new batik motif that is typical of the local potential of East Kalimantan using a CNC machine
2. Conducting experiments to produce batik dyes from local natural resources so as to encourage craftsmen to use their respective regional raw materials.

2 Materials and Method

2.1 The Process of Designing Motifs

The idea of motif creation is inspired by the Lai fruit and its pistil, the character of the lai fruit shape is round, the spiny skin, has contents with a yellowish color.



Fig. 1. Lai Fruit [5]



Fig. 2. Lai Pistil [6]

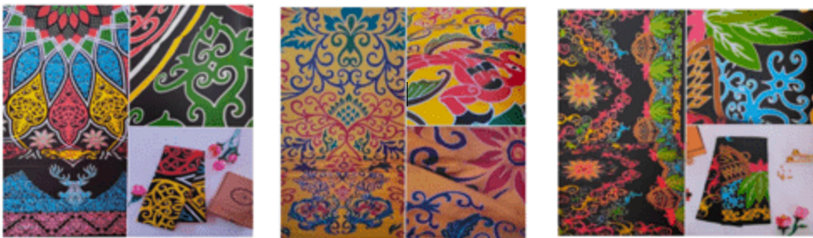


Fig. 3. Putera Samora Singgasa Motif, Gadisku Enggang Diskusi Motif, Ampiek Lotus Motif [3]

In the design process, several alternative designs were made, so that the selected motifs were obtained from the lai fruit and lai fruit pistil objects with a combination of curves that are typical of East Kalimantan motifs. The following is the selected design:

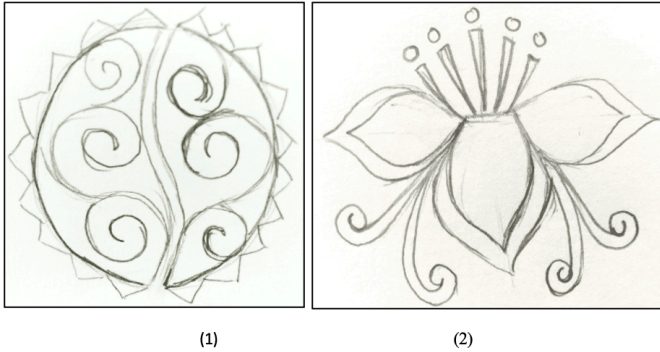


Fig. 4. (1) Lai motif, (2) Lai pistil motif

2.2 Batik Process with CNC Machine

CNC machine (Computer Numerical Control) is one of the developments in the field of technology in meeting industrial needs, machine control is carried out automatically using numeric values. One of the goals of the CNC machine is to meet the needs of batik craftsmen which are currently decreasing [7]. CNC machines in Bangun Mulya village are used to meet the needs but batik craftsmen are still very few. The CNC machine has a size of 2x3 m equipped with an adapter and pc to move the motif on the fabric. The nozzle or canting size is 0.7 mm so the design on the pc must be at a size of 2 pt. the feed rate used is 500mm/minutes with a temperature of 80°C.

In the process of transferring motifs to the fabric through the stage of making designs using the Corel Draw and Adobe Illustration applications then the motifs are arranged with a fabric size of 115 x 200 cm.

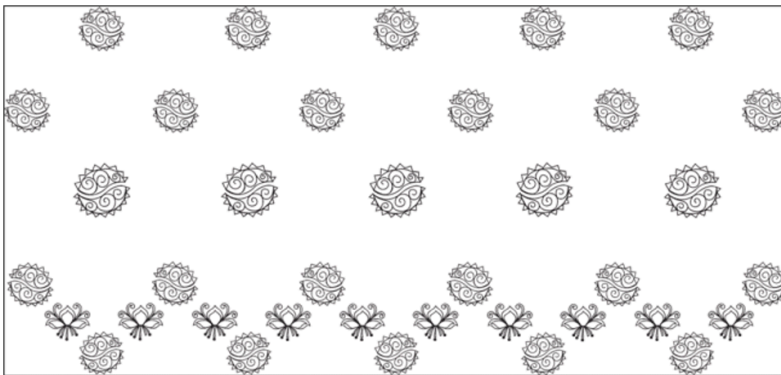


Fig. 5. The Design Of Lai Batik

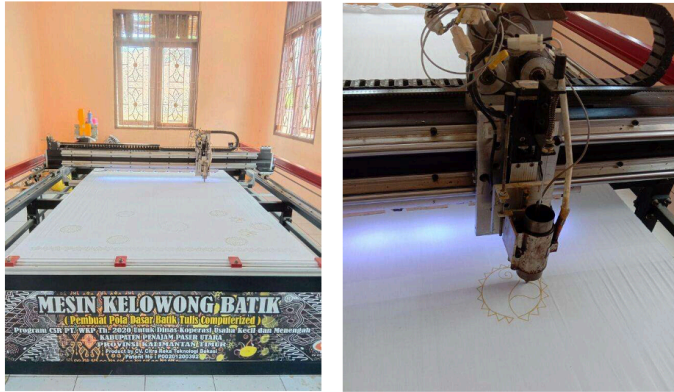





Fig. 6. (1) CNC Machine, (2) Motif Drawing Process

The CNC machine uses honey wax which has minimal impurities so that it does not easily clog the tip of the CNC machine canting, the fabric used is primisima material. The application of the lai motif with a 0.7 mm nozzle, with a speed of 500mm/minutes and a temperature of 80°C on 2 m primisima fabric.

Table 1. 1 Line Length Motifs

No	Motif	Motif size	Length of line	Motif count	Total line lenght
1		150x150 mm	26300 mm	5	131500 mm
2		100x100 mm	16050 mm	22	353100 mm
3		100x85 mm	13250 mm	10	132500 mm
Total all motifs					61710000 mm

To calculate the processing time using the formula:

$$T = s \sqrt{v}$$

$$T = 61710000 \text{ mm} \div 500\text{mm/minutes}$$

$$= 123.42 \text{ mm/minutes}$$

The processing time of the lai motif is 2.06 hours / 2 meters of cloth. So that in a day with a duration of working time of 8 hours / day, it can produce 4 pieces of lai motif batik cloth for one CNC machine.

The following are the results of the lai motif batik using a CNC machine:



Fig. 7. The Result Of Batik Lai That Has Been Applied To Fabric

The obstacles experienced when the batik process uses a CNC machine are in the design process on the PC the lines in the image are repeated, this causes the canting motif transfer process to follow the repetitive motion of the design process carried out on the PC, besides this, the arrangement of the motifs must be done in sequence so that the canting displacement is not too far away which causes the processing time to be much longer due to the process of moving from one motif to another. In the process of transferring cating motifs, it must always be ensured that there are no blockages that can prevent the release of wax.

2.3 Natural Dyes from leaves

The materials used are lai leaves (*Durio Kuthejensis*), filter cloth, blender, mordants (Ferrum, Allum and Vinegar), mesh, soda ash, pressure cooker.

250 gr of leaves was boiled in vaccum pressure cooker using 2 L of water for 15 mins until the dye was released. Remove the water using filter cloth then 10 gr soda ash was added to the filtrate. The brown of filtrate was boiled for 15 mins and this stored can be done for at least 1 hour at room temperature. The preparation of mordant using Alum, Ferrum and vinegar respectively 1 gr in 100 ml of water. The fabric was immersed at least 15 min until the color was absorbed. As shown Fig.1 the procedure of natural dyeing.



Fig. 8. Coloring Steps with Natural Dyes

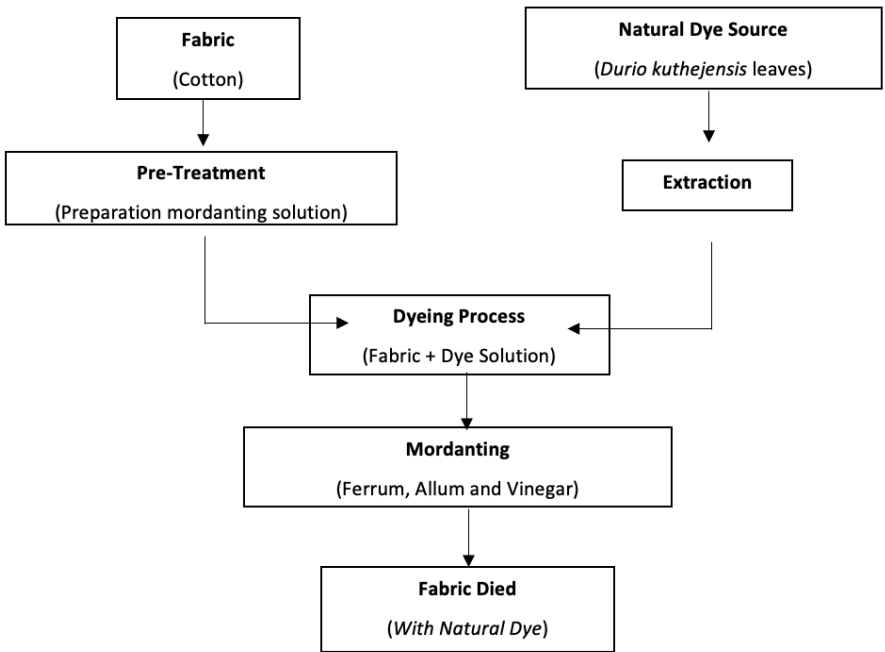


Fig. 9. Process of Natural Dyeing

3 Result and Discussion

3.1 Lai Batik



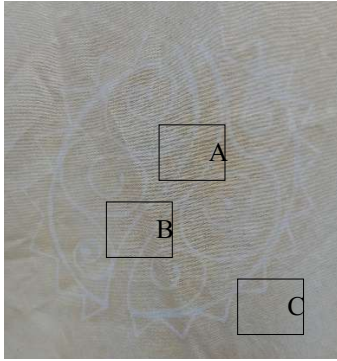




Fig. 10. Batik Lai Result



Fig. 11. Detail Motifs (1) Lai Motif, (2) Lai Pistil Motif

Based on the picture above, the results of coloring using lai leaves on a fabric measuring 115 x 200 cm show uneven colors, but in some parts there are very good results, the results of cutting wax using a CNC machine do not experience cracks, the wax lines are very clear and neat. On the resulting color batik cloth, 3 color samples were taken to find the color tone produced from the lai leaves dye.

Table 2. Result Color Grade

Sample	HEX	RGB	CMYK
	HEX #948a79	RGB (148,138,121)	CMYK (0,7,18,42)
	HEX #96948d	RGB (150,148,141)	CMYK (0,1,6,41)
	HEX #999b9a	RGB (153,155,154)	CMYK (1,0,1,39)
			

3.2 Natural Dyes and Mordanting

Fig.12 shows images of the *Durio kurthejensis* leaves and aqueous extract used in this study. The extract was visually dark brown and had an acidic pH.



Fig. 12. (a) Images of the *Durio kurthejensis* Leaves; (b) Aqueous extract Process of Dyeing with Natural Color

A unique feature of textile dyeing has been the mordanting procedure. This procedure increases the fabric's fastness and provides a range of colors. Inner complex compounds that are insoluble are created as a result of interactions between cellulose-wool molecules and metal cations. Soda ash was added into pure dye liquor, the process as shown figure 13.

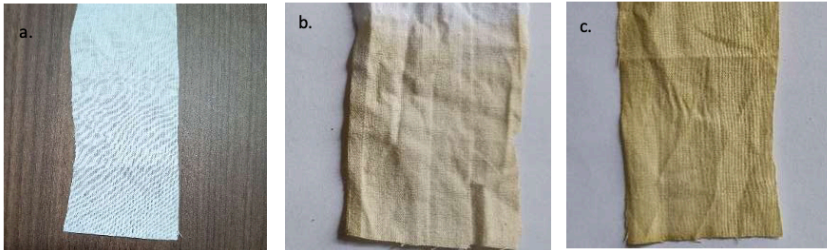


Fig. 13. (a) Fabric Without Dyeing; (b) Natural Dye Without Soda Ash; (c) Natural Dye with soda Ash

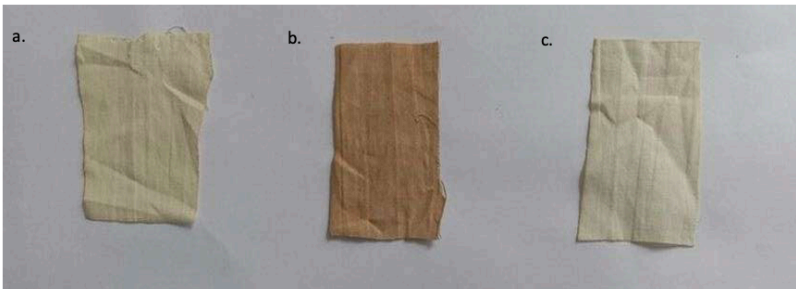


Fig. 14. Mordanting with (a) Allum (b) Ferrum (c) Vinegar

Based on Fig 14, fabrics that have been dipped in natural dyes with a repetition of 3 times, are fixed with various mordants. Mordants used include Allum, Ferrum and Vinegar so as to produce different colors. In Fig 4a. The resulting color tends to have no change or is neutral, while in Figure 4b the resulting color is more intense and in Figure 4c the resulting color is more faded due to the acidic nature of vinegar. The level of color is also influenced by the absorbency of the fabric, the suitability of the type of dye to the type of fabric and the intensity of dyeing natural dyes [7]. Furthermore, color dyeing is carried out on fabrics that have batik patterns with wax using ferrum mordant because the resulting color is more intense. The concentrated color produced due to the presence of $Fe + 2$ ions reacts with dye molecules to produce a large bond. [8] In Figure 1, it can be seen that the color produced is uneven, this is because the size of the container for dyeing is inadequate and the fabric is not completely immersed in the dye.

4 Conclusion

The result of this research lai can be potential of the signature batik motifs of East Kalimantan because this fruit is very special to the region, The use of CNC machines in the future can be an alternative to meet the needs of batik whose region lacks batik craftsmen. The use of lai leaves as a dye can be an option in utilizing raw materials from local potential so that the resulting color character is identical to the area. Further research is needed to make a variety of motifs from lai fruit and more even coloring, besides that it is necessary to conduct a washing and heat resistance lab test on fabrics with lai leaf dyes.

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