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Assessment processes and characteristics of pineapple leaf fiber woven fabric (Ananas comosus (L.) Merr.) and ambon banana stem midrib (Musa paradisiaca var. sapientum(L.) Kunt.)

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ABSTRACT

Pineapple leaves and banana stem midribs are agricultural wastes that can be used as natural fibers and processed into fabric. The fabric processed by woven method. The aims of this research were to analyze the stages of the production process of making woven fabric from pineapple leaf fibers and Ambon banana stem midribs and to analyze the characteristics of fabrics from pineapple leaf fibers and Ambon banana stem midribs. The method used was experiment method. The process of made woven fabric was used hand loom. The result of this research that have the best woven fabric was fabric from pineapple leaf fibers with the L* 64.33; a* 0.75; b* 15.83; H 87.26; tensile strength 53.34 kgf (weft); 23.95 kgf (warp); elongation value 10.77% (weft); 56.27% (warp); tear strength 28.42 kgf (weft); 3.73 kgf (warp); air permeability 133.80 cm3/cm2/s. The value of tensile strength and tear strength was in accordance with Indonesian National Standard 08-0056-2006 woven fabric quality requirements for suit. The use of fabric from nature fibers suggested for raw material of craft.

Keywords: hand loom, natural fibers, woven fabric.

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INTRODUCTION

In Indonesia, being widely cultivated Horticultural crops, among which are pineapple and banana plants. Pineapple and banana plants are a type of plant used the fruit for consumption. However, there are some parts of the plants that become waste. For pineapple plants, the highest percentage of total waste pineapple plant is in the leaves, which reached 90%. In each hectare, the pineapple plantation area produces ± 80 tons of pineapple leaf waste per year (Ministry of Industry, 2004). Likewise, with banana plants, also, there is a fruit that can to be consumed; there are some parts that ultimately are called waste. According to (Indonesian Regency Cooperation Agency, 2008), Banana stem waste am estimate at 640,000 stems with the assumption that waste production reaches 80% of around 800,000 trees.

Waste plant produced from the harvest can utilize as a product that increases the use-value of the waste. Chemical constituents associated with the use of natural fibers from plant cellulose is to be determined by the content of fiber (Malkapuram et al., 2009), Good leaf midrib pineapple and banana trees, both of which have an element of cellulose therein. Natural fiber has many advantages compared with synthetic fibers(Situmorang et al., 2017). The use of natural fibers is expecting to replace synthetic fibers that have an impact on the environment.

Wijana et al (2016) conduct research on the use of pineapple leaf fiber as the weft in the manufacture of woven fabrics. Handayani (2007) conducted a study on the utilization of the stem of banana stem fiber into a woven fabric for curtains, but still specific tests of fiber frond woven fabric produced banana stems.

Further research conducted by Fauziah (2016), fiber banana frond stems processed into materials. In the study still did not use fiber extracting machine banana tree frond or commonly called machine decorticator. Pineapple leaf fiber-making process and the stem of the banana stem in this study conducted using decorticator machine.

Research on alternative natural fiber into fabric is still rarely performed. That's because there are still not many people who know the technology. Therefore, a study conducted this research on the process and characteristics of pineapple leaf fiber woven fabric (Ananas comosus (L.) Merr.) And the stem of a banana tree. Varieties of bananas that can to be draw texture are ambon bananas (Musaparadisiaca var. sapientum (L.) Kunt.).

The objectives of this research are: 1) to analyze the physical and mechanical characteristics of pineapple leaf fiber woven cloth and ambon banana fronds. Physical symptoms include color fabrics. Includes automatic features, tensile strength and elongation, high tear strength and air permeability fabrics; to analyze the phases of the production process consists of raw materials, namely fiber pineapple leaf and stem of ambon bananas to be woven; 3) compare the characteristics of pineapple leaf fiber woven fabric and the stem of ambon banana with SNI woven fabrics for suits, namely, SNI 08-0056-2006.

RESEARCH METHODS

The method used in this research is the experimental method. The tools used in the study include the gauge (meter, stopwatch, analytical balance, digital scales). Machine making cloth (not the engine room), testing (stationery, calculators, trusting, bowls, bottles weigh, desiccator, oven, Hunter Lab - ColorFlex EZ, Tenso Code 5000 Lab 2515, Instron Machine: S / N H1324, air permeability tester FX 3300 texts Lab instruments Air).

The location of the study in Majalaya conducted, West Java, for the manufacture of woven fabrics, Bandung STTT Physics Laboratory for testing fiber and woven fabrics, as well as in the Laboratory of Postharvest Technology and Process Engineering of Agricultural University of Padjadjaran for testing water content and color.

Tests performed fabric characteristics consist of: (1) Physical characteristics: the color of the fabric covering the L *, a *, b *, and H; (2) Mechanical characteristics: tensile strength and elongation of fabric (SNI 08-0276-1989) (National Standardization Agency 1989a); fabric tear strength (SNI 08-1269-1989) (National Standardization Agency, 1989b); Air permeability tests (SNI 08-0988-1989) (National Standardization Agency, 1989c).

RESULTS AND DISCUSSION

Characteristics Fabric

The resulting woven fabric can saw in Figures 1 and 2. Characteristics of material are be analyzed, namely physical and mechanical components.

Figure 1. Pineapple leaf fiber is a woven fabric.

Figure 2. Woven fiber ambon banana frond stems

Physical characteristics

The physical characteristics of the fabric are analyzed the color of the material.

Color Fabric

Fabric color testing consists of L*, a*, b*, and H. The results of color measurements of pineapple fiber and banana fronds can sew in Table 1.

Tabel 1. Color fabric

Cloth type	L*± SD	a*± SD	b*± SD	H*± SD	Color
Pineapple Leaf Fiber Cloth	64.33 ± 0.61	0.75 ± 0.18	15.83 ± 0.07	87.26 ± 0.68	Yellow Red
Trunk fiber fabric sheaths Ambon banana	67.05 ± 0.50	4.28 ± 0.16	16.27 ± 0.51	75.26 ± 0.25	Yellow Red

The value of a* of pineapple leaf fiber cloth and ambon banana frond stems, which are positive, which means the fabric has a red color. Banana stem fronds have the highest a* value. Pineapple leaf fibers before being processing into material has value of a* that are in the green an increase in the amount of a* after transforming into fabrics. Pineapple leaf fiber cloth and banana frond stems produce b* value of 15.83 and 16.27. This value indicates that the material has a yellowish color. The parameters in determining the final color of the fabric that is the degree of hue (H). Hue value adjusted to the color chromaticity range of areas so that the color of the fiber can be determined. The degree of hue of pineapple leaf fiber cloth and ambon banana stems fiber cloth shows that the pineapple leaf fiber cloth and ambon banana stem fiber have a yellow, red color. There were changes in chromaticity on pineapple leaf fiber woven fabric before being made. Chromaticity pineapple leaf fibers are in the yellow chromaticity. While once used as the material becomes yellow-red. The color change affected by differences in chromaticity values of a * and b * on the fibers and fabrics are producing.

Mechanical characteristics

Mechanical characteristics examined, i.e., tensile strength and elongation, high tear strength, and air permeability. Tensile strength and elongation testing was performing using Tenso Lab cloth, fabric tear strength test using Instron, and for testing the air permeability of fabric using the air permeability tester.

Pull strength and elongation Fabrics

The tensile strength of the fabric was testing to determine the maximum load that can be retained by the material. Tests carried out on the feed direction and the direction of the warp. The test results are showed in Table 2.

Table 2. The tensile strength and elongation of the fabric

Material	Directions Cain	Tensile Strength (kgf)	Elongation (%)
Pineapple Leaf Fiber Cloth	Lusi	23.95	56.27
	Woof	53.34	10.77
Trunk fiber fabric sheaths Ambon banana	Lusi	21.09	37.98
	Woof	52.68	11.87

Tensile strength values were higher on pineapple leaf fiber cloth that is to the direction of feed, with an amount of 53.34 kgf, as well as banana stem fiber fabric has a tensile strength values are higher for the course of feed that is equal to 52.68 kgf. The most upper tensile strength generated by either pineapple leaf fiber fabric, weft, and warp directions. According to Fauziah (2016), Woven from banana stem fiber frond combined with cotton yarn has a tensile strength of 52 kgf to the direction of feed. The results of this study have a value that is similar to research done by (Fauziah, 2006),

The value of tensile strength woven fabric based on SNI 08-0056-2006 (National Standardization Agency, 2006) if you want to use for setting (suiting), which is required to have a minimum tensile strength of fabrics by 23 kgf to 19 kgf direction of the warp and weft direction. Tensile strength value following the existing SNI, namely pineapple leaf fiber cloth, while the stem of banana stem fiber fabric tensile strength values in the course of the warp still does not meet SNI because the resulting cost is lower than 23 kgf.

Strong fiber becomes more rigid than the threads that are being or lack of strength. Therefore, for fabrics which must have a handle or palpation soft (soft) are advised to use fibers whose power is or less. Does not mean that to make a good cloth should use a weak fiber strength (Istinharoh, 2013), Fabric produced in this study demonstrates the value of high tensile strength. Therefore the fabric produced becomes more rigid. It allows the addition of natural fiber composites and synthetic fibers such as research (Septiyanto and Abdullah, 2015) to obtain palpation quality fabrics and tensile strength fabric products accordingly.

Pineapple leaf fiber cloth produces creep value obtained from the highest of the warp direction, with a value of 56.27%, as well as elongation value of banana stems fiber fabric midrib that is equal to 37.98%. The highest elongation value of the fabric is produced by banana stem fiber cloth for feed direction. In contrast, for the warp direction, the highest elongation value is created by pineapple leaf fiber cloth. Value creep in the course of feed and the direction of the warp have different values this is because different types of yarn used. Natural fiber from pineapple leaves and stem of banana stems tend to have little creep. After all, the thread still contains lignin in it, whereas for cotton yarn used has a high elongation for cotton yarn originating from the cotton fiber content of the lignin not detected, because it is shallow. Is because the cotton fiber has a primary and secondary walls, as well as cotton fibers contained within the lumen that is flexible and elastic (Krakhmalev and Paiziev, 2004).

The tensile strength of the woven fabric of both types of fiber have tremendous value; this is because a high cellulose content. However, due to the lignin content, which still contained in the fiber, the fiber has a small stretch value. Therefore, the tensile strength of the thread is woven fabric leaf midrib stem of pineapple and bananas tend to be high. At the same time, the lower her mouth (Fauziah, 2016), Lignin located between cells has a function as the glue between the cells, so it is not desirable. While in the cell wall, lignin is closely related to cellulose and serves to provide rigidity to the battery (Wibisono, 2002).

Tear strength Fabric

Tear strength of fabric made in the direction of feed and the course of the warp. Fabric tear strength tested to determine the durability of the material to tear. Results of testing the tear strength can sew in Table 3.

Table 3. Fabric tear strength

Material	Directions Cain	Tear strength (kgf) ± SD
Pineapple Leaf Fiber Cloth	Lusi	3.73± 0.42
	Woof	28.42± 4.88
Trunk fiber fabric sheaths Ambon banana	Lusi	4.18± 0.24
	Woof	25.63± 1.68

Fabric tear strength of the warp direction the highest obtained by the stem of banana stem fiber fabric that is equal to 4.18 kgf, whereas for the direction of feed obtained by pineapple leaf fiber cloth that is equal to 28.42 kgf. Differences tear strength value generated due to the different constituent materials. Natural fiber from pineapple leaves and stem of the banana stem has a higher tear strength than cotton yarn made from cotton fibers.

Research Wijana et al (2016), States that pineapple leaves fabric combined with cotton 50% : 50% has a fabric tear strength of 1381.33 gf or 1.39 kgf in the direction of the warp and 1306.67 gf or 1.31 kgf in the course of a feed. This value is smaller when compared with the results of the research that has done. Because of the study Wijana et al (2016), the Fiber-making process done mechanically and chemically, after which fibers produced from the fiber-making process using a machine decorticator, then threads soaked with lye. Soaking in an alkaline solution can reduce the strength of the fabric produced.

Woven fabric tear strength value if you want to use for setting (suiting) based on SNI 08-0056-2006, which has minimal fabric tear strength of 1.5 kgf in the direction of the warp and weft. Both fabrics produced following the existing SNI.

Translucent Power Air

Fabric composed of yarns composed of fibers, the majority volume of the material written of air space. The number, size, and distribution of the area dramatically affects the properties of the fabric, such as warmth and protection against wind, rain, and filtration efficiency of materials for industrial use (Khaerudin, 2013), Air permeability value can sew in Table 4.

Table 4. Air penetrating power

Material	Translucent Power Air ($cm^3/cm^2/s$) ± SD
Pineapple Leaf Fiber Cloth	133.80 ± 16.53
Trunk fiber fabric sheaths Ambon banana	150.20 ± 37.87

Air permeability value is the smallest is the pineapple leaf fiber cloth that is equal to 133.80 cm^3 / cm^2 / s. According to research (Fauziah, 2016), The value of the air permeability of banana stems fiber fabric frond combined with cotton yarn has a value of 50.8 cm^3 / cm^2 / s. Values air permeable fabric on research (Fauziah, 2016) different from the results of this study, it may be caused by, probably in the process of making fabric, type Not Weaving Machine Tools (handloom) are used differently by this study. There is a relationship between the meeting whether or fabric with air that can penetrate the fabric. The more open structure of the material will be the higher penetrating power of the air (Khaerudin, 2013),

Criteria Fabrics

1) Color of the cloth

Value L * represents the brightness of cloth. The higher the value of L *, the more bright. The amount of a * (+) states in red, the cost of a * (-) declared green. The more the value close to 0, the natural pigment of the lower fabric and the fabric brighter. The amount of b * (+) states in yellow, the value of b * (-) states blue. The more the value close to 0, the natural pigment of the lower fabric and the fabric brighter. Value hue can specify the range of color chromaticity region.

2) Tensile strength

The value of tensile strength woven fabric if you want to use for after (suiting) based on ISO is required to have a minimum tensile strength of 23 kgf cloth in the direction of feed and 19 kgf in the course of the warp (SNI 08-0056-2006).

3) Stretchy fabric

Fabric stretching is to find out the fabric's ability to grow longer when there is a tensile load experienced by the material before breaking.

4) Tear strength

Woven fabric tear strength value if you want to use for after (suiting) based on ISO requires to have a minimum tensile strength of 1.5 kgf cloth in the direction of the warp and weft (SNI 08-0056-2006).

5) Air penetrating power

The more open structure of the fabric will be the higher penetrating power of the air.

6) Recapitulation Fabric

Recapitulation of testing the characteristics of fabrics tested, namely the physical characteristics (Table 5) and the mechanical characteristics of the structure (Table 6).

Table 5. Recapitulation best fabrics based on physical characteristics

Parameter		Pineapple leaf fiber	Trunk fiber sheaths Ambon banana
	L*	64.33	67.05
Color	a*	0.75	4.28
	b*	15.83	16.27
	H	87.26	75.26

Table 6. Recapitulation best fabric based mechanical characteristics

Parameter		Pineapple leaf fiber	Trunk fiber sheaths Ambon banana
Tensile Strength (kgf)	Woof	53.34	52.68
	Lusi	23.95	21.10
Elongation (%)	Woof	10.77	11.87
	Lusi	56.27	37.98
Tear strength (kgf)	Woof	28.42	25.63
	Lusi	3.73	4.18
The penetration of air ($cm^3/cm^2/s$)		133.80	150.20

Description: Fields marked with yellow color is the best fabric

Working Capacity Not Weaving Machine Tools (handloom). Handloom used a modification so that the loom is different from the looms used to process large-scale industrial production. Handloom can sew in Figure 3.

Motif produced using a modified loom in the form of an ugly theme. During the process of manufacture of woven fabrics in progress, measurement of the working capacity of loom machines are using. Working capacity measurement results loom devices can sew in Table 7.

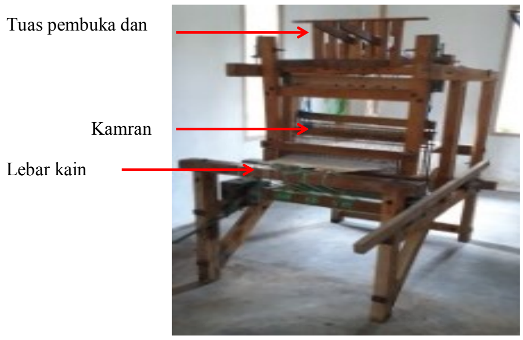

Figure 3. Loom machines

Table 7. Work capacity loom machines

Material	Working Capacity hand-loom (cm^2/sec) ± SD
Pineapple Leaf Fiber Cloth	0.20± 0.02
Trunk fiber fabric sheaths Ambon banana	0.18±0.01

Rated capacity is calculating to determine the amount of fabric produced by a specific time. The measurement results showed that the position of the working size of handloom when making fabric from pineapple leaf fiber is more significant than at the time of making cloth from banana stem fiber frond. Differences in the calculation, results handloom work capacity is dependent on the thickness of the strands of fiber are used; also be influenced by the long and the short textures used if the fiber length will further facilitate the weaving process.

Pineapple leaf fiber woven fabric produced, which has a size of 197 × 35 cm with a mass of pineapple leaf fibers are using as many as 185 g of pineapple leaf fiber plus 32.17 g of cotton yarn. In contrast, the midrib fiber woven fabric produced banana stem has a size of 201 × 35 cm with a mass of fibers used as many as 109 g fiber banana frond stems plus 44.43 g cotton yarn.

CONCLUSION

The conclusion that can be drawn based on the results of this research has done that is, the test results of physical and mechanical characteristics of the fabric can be concluding that the best materials are fabrics with a pineapple leaf fibers L*. Value of 64.33; a* 0.75; b* 15.83; tensile strength of 53.34 kgf feed direction; the direction of the warp of 23.95 kgf; tear strength in the course of feeding of 28.42 kgf; 3.73 kgf in the direction of the thread; 133.80 air permeability cm3 / cm2 / s. Handloom work capacity during the process of manufacture of woven fabrics of pineapple leaf fiber and fiber frond stems of banana that is equal to 0.20 cm2 / sec and 0.18 cm2 / sec. Pineapple leaf fiber fabric has a tensile strength values following the existing SNI, while for the stem of banana stem fiber fabric tensile strength values in the direction of the warp still does not meet standards.

The advice that can to be given to improve and develop this research, among others, should be tested characteristics of cotton yarn to be used as supplementary material fabric manufacture. We recommend checking the fabric for other parameters according to the quality requirements of woven fabrics, which hold the thread in the seam slippage, dimensional changes, the appearance of structures after repeated washing and colorfastness. The resulting fabric conforms with the cloth SNI only uncomfortable when used as raw material for clothing. Therefore, the natural fiber fabric with a combination of cotton yarn recommended for use as raw material for non-clothing textile craft used as prayer mats, bags, tablecloths, even a skullcap.

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