

Quality Improvement of Raw Material of Natural Fibre Preparation using Pectinase Enzyme Case Study: The Harvest of Kenaf Fibre in Laren District, Lamongan Regency, East Java

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Abstract
This research focuses on the attempt to improve the quality of kenaf natural fibers grade-c (low quality). The fibers are harvested from kenaf plantation in Laren District, Lamongan Regency, East Java. This attempt is to enable the fibers to have a good standard of quality, so that it can be made as a potential textile raw material. All this time, quality of grade-c has been considered as a bad quality fiber, therefore, the utilization is merely as gunny sacks, which at the other side, the demand of gunny sacks is reducing each day since there are plastic sacks as the competitor. To improve the quality of kenaf fiber, it is required an experiment process where pectinase enzyme is used in the preparation stage. This process will result the fiber to have a quality improvement from low quality to good quality, so that it can be processed to a more advanced production of textile material to be made as raw material of innovative and high-selling-valued textile product.
Keywords: kenaf fiber, pectinase enzyme, fiber preparation, exploration, textiles

1. Introduction

As a tropical country, Indonesia is the right place for varies of plants, including Kenaf (Hibiscus cannabinus L.) as one of a plant species that produces natural fibre. Kenaf has been well known among Indonesian since the program of ISKARA (Intensifikasi Serat Karung Rakyat) – Intensification of Civil Sack Fiber in 1978, which at that time most of the use of fiber grade-c was for gunny sack industry. This type of fiber had not yet been optimally used and it was considered as a low selling valued fibre. It was because there was not sufficient exploration, especially in textile, as well as the lack of its innovation development towards product. Nevertheless, the quality of kenaf fibre grade Super and grade-a has attracted industrial business owners to use them as raw materials for high valued businesses such as geo-textile, fiber board and particle board. Kenaf plantations spread within Indonesia, including in Java and Kalimantan. Below is Kenaf plantation areal data:

Tabel 1. Areal Data of Kenaf Plantations in Indonesia

No	**Location**		**Area (Hectare)**	
1	West Java	Garut	80	158
2		Cirebon	78	
3	Central Java	Blora	147	245
4		Pati	98	
5	East Java	Lamongan	2150	2262
6		Jombang	21	
7		Nganjuk	34	
8		Malang	36	
9		Banyuwangi	21	
10	Kalimantan	Kutai Kartanegara	323	679
11		East Kutai	206	
12		Samarinda	150	
		Total		**3344**

The reasons why kenaf fibre grade-c was considered as a low quality fiber, compares to kenaf fiber grade-a and grade-b, is that physical conditions of kenaf fibre are at the lowest quality of tensile strength, softness and elongation which these are the benchmark of a fiber's standard qualities.

Table 2. Comparison of Physical Qualities of Cellulose Fiber and Kenaf Fibre Grade-C

Standard quality	**Quality of kenaf fiber Grade A**	**Quality of kenaf fiber Grade C**	**Remarks**
Tensile strength	5-15 gram/tex	- Max. 13.6 gr/tex - Lowest: failed	Kenaf fiber grade-a and grade-b have homogenous length of filament, while kenaf fiber grade-c has inhomogenous filament on its strand.
Softness	5 – 10 denier	- Max. 28.7 denier - Lowest: 87.9 denier	
Elongation	Max. 5%	- Max. 2.6% - Lowest: failed	

Tabel 3. Classification of Fibre Quality

No	**Standard Quality of Fiber**	**Picture of Fiber**	**Description of the Characteristics of Kenaf Fiber**
1	Grade-A (Super Quality)		Fiber is soft, white, shiny, cleared of gum, and not tangled
2	Grade-B (Good Quality)		Softness and sparkles are good, still contains a small amount of gum, slighthly matted, dull white colored
3	Grade-C (Low Quality)		Fibet\r is coarse and stiff, still contains parts of bark, matted, brittle, dirty, and blackish brown colored

2. Experiment of Stage of lignine extraction on kenaf fiber

Lignine extraction process on kenaf fiber is an initial stage of fiber preparation which uses pectinase enzyme, it aims to determine level of lignine contained in the fiber sample. Thereafter, can be precisely decided the amount of buffer and pectinase enzyme required. From 200 grams kenaf fiber, extracted lignine is 0.449 gram or approximately 2% from the total weight.

Figure 1. Lignine Extraction on Kenaf Fibre

Steps in lignine extraction are as follows:

- 20 grams sample of kenaf fiber grade-c + 400 ml water + 10 mlNaOH 1N, then heat them for approximately 15 minutes,
- Increase volume of fluid mixture of extraction up to 500 ml, then filter it using filter paper,
- Add 50 ml CH3COOH 1N, and leave it for 5 minutes,
- Add 25 CACL2 1N by keep stirring it, then leave it until 1 hour,
- Heat them for 1-2 minutes, filter them again with filter paper,
- Bake filter result to get lignine extract on the filter paper.
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2. Experiment of Stage of lignine degradation on kenaf fibre grade – c using pectinase enzyme.

After done with lignine extraction and acquired number of lignine in fiber sample, thereafter it can be determined buffer desirably used to degrade lignine on every kenaf fiber grade-c that is being researched.

<u>Stage of Making Citrate Buffer PH 5.8</u>

A = 35.6 grams Na_2HPO_4/litre

B = 21 $C_6H_8O_7.H_2O$/litre

A+B= 57 ml + 43 ml = 100 ml

Stage of Measuring Enzyme Stock

0.1 ml pectinase enzyme is mixed in 9.9 ml buffer until it reaches 10 ml of volume, then stirs it to make it well mixed.

Table 4. Lignine Degradation Process of Kenaf Grade-c fibre using Pectinase Enzyme

NO	Number of Samples (gr)	Stock of Enzyme (ml)	Citrate buffer adding (ml)	Total Citrate Buffer (ml)	Incubation period (in 60° C)
1.	5	0.25	99.75	100	30 minutes
					60 minutes
					120 minutes
2.	5	0.5	99.5	100	30 minutes
					60 minutes
					120 minutes
3.	5	0.75	99.25	100	30 minutes
					60 minutes
					120 minutes
4.	5	1	99	100	30 minutes
					60 minutes
					120 minutes
5	5	1.5	98.5	100	30 minutes
					60 minutes
					120 minutes

4. Test results of kenaf fiber grade-c after go through degradation process using pectinase enzyme.

Below are test results of fiber's quality after go through degradation process using pectinase enzyme to see variable of which gives best quality to fiber.

Table 5. Test Result of Kenaf Grade – C after Lignin Degradation using Pectinase Enzyme

Variable	Testing Techniques				Test Results		
	Number of enzyme stock (ml)	Citrate buffer adding (ml)	Fiber per citrate buffer (gr/ml)	Incubation period in 60°C temperature (minute)	Fiber's smoothness (denier)	Fiber's tensile strength (g/tex)	Fiber's elongation (%)
A	0.25	99.75	5/100	30	51.5	6.5	1.6
				60	56.7	9.1	2.2
				120	54.0	8.2	1.9
B	0.5	99.5	5/100	30	44.6	10.9	2.1
				60	87.9	6.5	1.5
				120	28.7	6.9	2.5
C	0.75	99.25	5/100	30	83.7	5.1	2.4
				60	38.6	13.6	2.6
				120	40.3	7.2	2.4
D	1	99	5/100	30	57.6	7.6	2.0
				60	47.9	4.3	1.7
				120	33.7	9.3	2.6
E	1.5	98.5	5/100	30	56.6	10.0	2.6
				60	47.3	7.4	2.5
				120	58.0	X	X

5. Analysis and Conclusion

Based on the above acquired data, it can be analyzed and concluded as follows:

a. Standard of qualities of fibers that are tested are:
   - Fiber's smoothness (in denier): conducted to determine smoothness level in each bundle of fiber with regard to its tactile quality when it is made into sheets of fabric/textile. For cellulose, its fiber is

considered to have good smoothness quality when it reaches 5 to 10 denier, after initially go through fiber preparation processes. The smaller is the resulting number the better fiber's smoothness quality is. Based on the acquired data, it is known that the highest smoothness level is 28.7 denier (data on variabel C, within 120 minutes incubation period in 60° temperature).

- Tensile strength: conducted to determine each bundle of fiber's power to hold pull force without being cut off. Fiber's tensile strength can be measured through the resulting number. The higher is the resulting number the better the fiber's tensile strength is. Based on the acquired data, it is known that the biggest tensile strength is 13.6 gram / tex (data on variabel C within 120 minutes incubation period in 60° temperature).
- Fiber's elongation: conducted to determine fiber's level of elasticity when it is pulled and elongated until it is finally cut off. A good fiber's elongation depends on the type of textile wish to be produced instead of the number of its fiber's elongation. If it is expected to produce a high-fiber's elongation-textile, number of fiber's elongation should be high as well and vice versa.

b. Results of fibers quality tests on each variable generally show as follows:
   - Average numbers of fibers' smoothness quality on each variable (in denier) are: A(54.1), B(68.6), C(54.2), D(46.4), E(53.9). Based on the acquired data, there is no difference that matters. Numbers acquired do not show consistent fluctuated movements, so it can be said that this process does not give a significant effect.
   - Average numbers of fibers' tensile strength on each variable (in gram/tex) are: A(7.9), B(8.1), C(8.6), D(7.1), E(not valid because of broken or unable-to-process data). The acquired data shows that numbers do not move consistently, so that it can be said that these variable differences do not show significant effect towards result.
   - Average numbers of fibers elongation are: A(1.9), B(2.0), C(2.5), D(2.1), E(not valid because of broken or unable-to-process data). The acquired data shows that numbers do not move consistently, even though there is no significant difference between those numbers. However generally speaking, specifically for type of kenaf fiber grade-c, these variable differences do not show significant effect.

c. Test result towards the difference of fiber incubation periods in buffer shows irregular numbers of which can be concluded that kenaf fiber grade-c does not effected by incubation periods.

Based on the test and variable data results, can be concluded that preparation process of kenaf fiber grade-c through lignine degradation using pectinase enzyme does not give a significant result towards each of its comparison variable. The variable numbers are random and not indicating that each of those variables effects kenaf fibres grade-c which are produced. It is predicted that the cause might come from the fiber's raw material which does not meet the testing standard because of its low quality (below average). Based on the technical executor's statement at the testing laboratory of textile great hall (Pengujian Balai Besar Tekstil), that the tested fiber has low fiber's uniformity (on its length and diameter) so that when it is tested, there is no standardization of fiber's size uniformity.

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