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ISOLATION AND CHARACTERIZATION OF α-CELLULOSE OF RICE LEAVES

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ABSTRACT

Isolation and characterization of α-cellulose of rice leaves had been carried out. The isolation process of α-cellulose was made through delignification using 3.5% HNO_3 - $NaNO_2$ and 17.5% NaOH treatment steps. The resulted α-cellulose was characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infra Red Spectroscopy (FTIR), and Thermogravimetric Analysis (TGA). Surface morphology of the resulted α-cellulose revealed that fiber appears as a long, smooth and lustrous cylinder. The FTIR spectra showed the sharp O-H stretching vibration at 3402 cm^{-1} and C-H stretching vibration at 2916 cm^{-1}. These vibration region indicate the cellulose system. It was supported spectra at 1373 and 609 cm^{-1}, these vibration indicate C-O stretching and C-O bending vibration, respectively. The TGA data showed a decomposition temperature at 350.01 ^oC with residue 10.77%. The results showed that the recovery of α-cellulose of rice leaves after bleaching 11,88 gram (15,84%) yield, the produced α-cellulose more pure and high thermal stability than fiber before 17.5% NaOH treatment.

Key words*: rice leaves, α-cellulose, isolation, characterization*

INTRODUCTION

Rice straw is agricultural waste which is quite large in number compared to other agricultural waste. According to Kim Dale, 2004 [1], to produce one ton of rice, it will be produced 1.4 ton of rice straw. The utilization of rice straw is not optimal yet, because it is burnt and/or piled on the rice field that can give rise to air polluton and be rat's lair [2]. Where as the rice straw has potential as source of natural fiber such as cellulose [3,4]. According to Sun *et al*, 2000, the composition of rice straw consisted of cellulose (36.5%), lignin (12.8%), silica (70.8%), wax (3.8%), and ash (13.3%) [4].

Natural cellulose usually still combined with ligin and hemicellulose, it necessary to separate cellulose from lignin and hemicellulose to get pure cellulose [5, 6, 7]. The α-selulosa had isolated from corn cob by way of delignification using HNO_3 3,5% - $NaNO_2$ mixture solution and 17.5% NaOH treatment [6].The previous reasearch of Yusnaidar, *et al*, 2014 showed that the rice leaves were treated 2% NaOH - 2% Na_2SO_3 which produced fine fibers with high thermal stability [8].

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The aim of this work was 1) isolation of α-selulosa of rice leave; 2) characterization of α-selulosa of rice leave were analyzed using Scanning Electron Microscopy (SEM), Fourier Transform Infra Red Spectroscopy (FTIR), and Thermogravimetric Analysis (TGA)

METHODOLOGY

Materials. Dried rice leaves, HNO_3 (E-Merck), $NaNO_2$ (E-Merck), NaOH (E-Merck), Na_2SO_3 (E-Merck), NaOCl (E-Merck), H_2O_2 (E-Merck).

Isolation of α-cellulose of rice leaves. Dried rice leaves obtained from field that have been cut into pieces of 2-3 cm was soaked or immersed within a 3.5% HNO_3 - $NaNO_2$ mixture solution and heated at 90 ^oC for 2 hours. The residue was filtered and washed until neutral pH. Neutral residue was digested with 2% NaOH - 2% Na_2SO_3 and heated at 50 ^oC for 1 hour. The residue was filtered and washed until neutral pH. Fibers were bleached with 1.75% NaOCl at boiling temperature for 30 minutes. The residue was filtered and washed until neutral pH. Neutral residue was treated with 17.5% NaOH at 80 ^oC for 30 minutes. The final resulting was filtered and washed until neutral pH, then the alpha cellulose was bleached with 10% H_2O_2. The residue was filtered and washed with water, then it was dried in an oven at temperature of 60 ^oC.

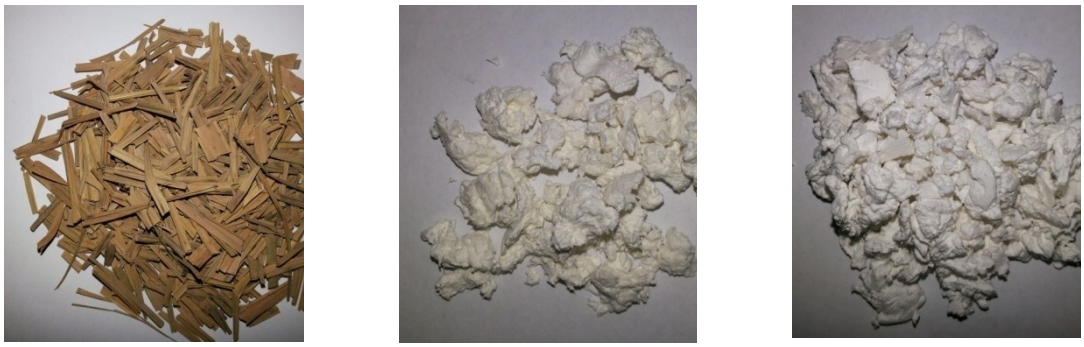
Characterization of α-cellulose of rice leaves. The fiber before 17.5% NaOH treatment and alpha cellulose were characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infra Red Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA).

RESULTS AND DISCUSSION

Isolation of α-cellulose of rice leaves. Recovery of fiber before 17.5% NaOH treatment and α-cellulose from 75 gram dried rice leaves was 19.28 gram (25.70%) and 11.88 gram (15.84%) respectively. This happens because the lignin and hemicellulose was dissolved during delignificaton process, holocellulose was dissolved during hydrolysis [8]. Fig. 1 showed dried rice leaves (a), fiber before 17.5% NaOH treatment (b), and α-cellulose of rice leaves (c).

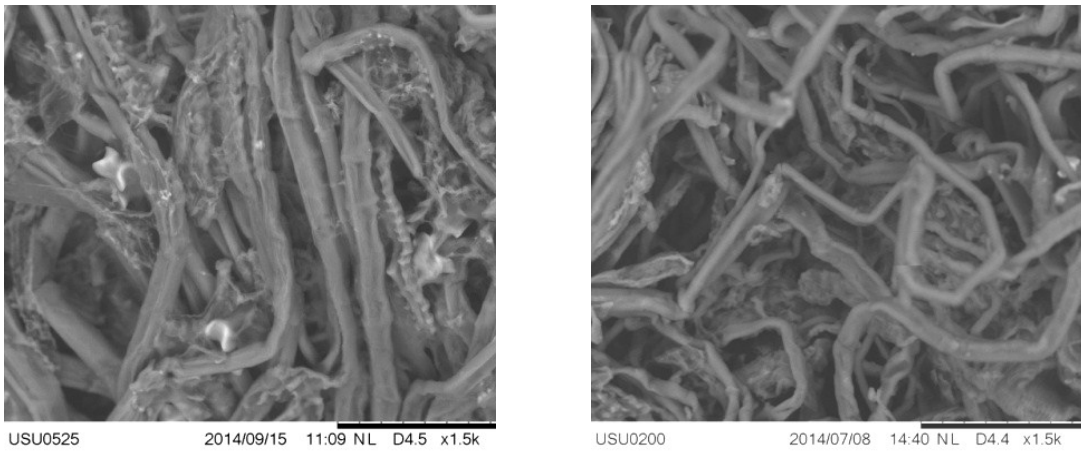
The fiber color before hydrolysis was cream-colored and the α-cellulose color was nearly white because the lignin, hemicellulose, and holocellulose were dissolved after 17.5% NaOH treatment.

Characterization of α-cellulose. The surface morphology of fiber before 17.5% NaOH treatment and α-cellulose was determined using SEM (Fig. 2). Both of fiber and α-cellulose have similar stucture but surface of α-cellulose (Fig. 2b) more clear than fiber (Fig. 2a). The structure of α-cellulose appears as a long, smooth and lustrous cylinder.



(a) **(b)** **(c)**

Fig. 1 Dried rice leaves (a), fibers before 17.5% NaOH treatment (b), α-cellulose rice leaves(c)



(a) **(b)**

Fig. 2. SEM image of fiber before 17.5% NaOH treatment (a) dan α-cellulose of rice leaves magnification 1500X)

The infra red spectra of standard α-cellulose, α-cellulose of rice leaves, and fiber before 17.5% NaOH treatment (Fig. 3). The infra red spectra showed there is a similar pattern of peaks between standard α-cellulose with α-cellulose of rice leaves. The magnitude of the wave number of α-cellulose of rice leaves compared with the standard α-cellulose that can determine the quality of α-cellulose of rice leaves. This also indicates that the α-cellulose of rice leaves more pure than the fiber before 17.5% NaOH treatment.

Fig. 3 shows the sharp O-H stretching vibration and C-H stretching vibration. This is supported by weak C-O stretching and C-O bending vibration that indicates cellulose system [9].

Decomposition temperature for α-cellulose of rice leaves and fiber before hydrolysis at 350.01^{o}C and 323.86^{o}C, respectively (Fig. 4). Minimum residue percentage in α-cellulose of rice leaves was 10.77%. This indicated the α-cellulose of rice leaves more pure and the thermal stability greater than fiber before 17.5% NaOH treatment.

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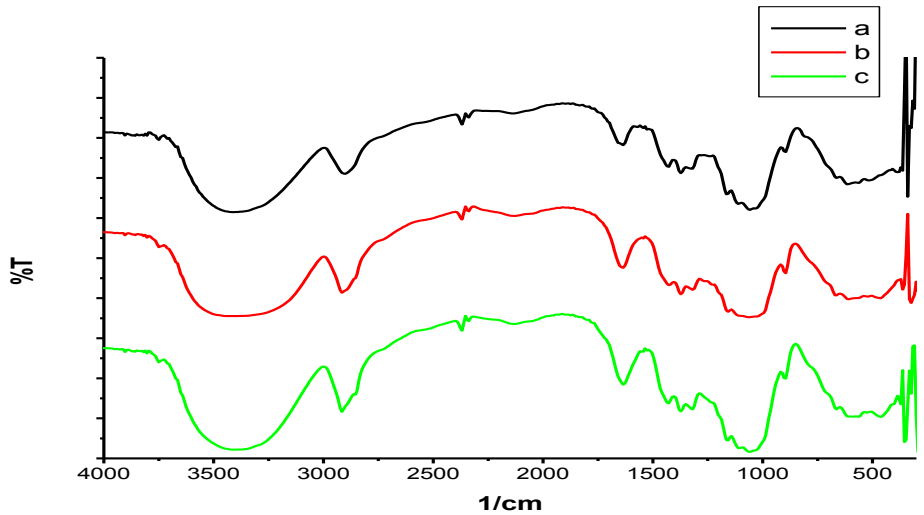
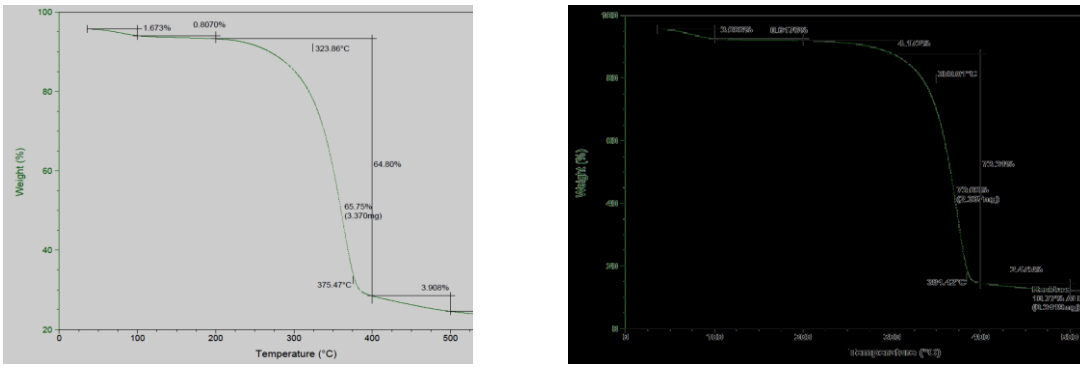


Fig. 3. FT-IR spectra of standard α-cellulose d (a), α-cellulose of rice leave (b), and fiber before 17.5% NaOH treatment (c)

Table 1. The main functional groups of standard α-cellulose, α-selulosa rice leaves and fiber before hydrolysis

Wave number (1/cm)			
a	b	c	Functional Groups
Standard α-cellulose	α-cellulose of rice leaves	Fiber before 17.5% NaOH treatment	
3410	3402	3410	O-H stretching
2900	2916	2916	C-H stretching
898	894	894	
1373	1373	1373	C-O stretching
617	609	-	C-O bending



(a) **(b)**

Fig. 4. TGA graph of α-cellulose of rice leaves (a) and fiber before hydrolysis (b)

CONCLUSION

Recovery of α-cellulose of rice leaves after bleaching was 11.88 gram (15.84%) of dried rice leaves mass. The surface morphology revealed that α-cellulose of rice leaves as a long, smooth and lustrous cylinder. The FTIR spectra showed the peaks of α-cellulose of rice leaves

were sharp O-H stretching (3402 cm^{-1}) and C-H stretching 2916 (cm^{-1}) vibration which indicated the main functional groups of cellulose. The TGA data showed the thermal stability of α-cellulose of rice leaves was greater than fiber before hydrolysis that is equal to 350.01°C. The α-cellulose of rice leaves was more pure and the thermal stability greater than fiber before 17.5% NaOH treatment.

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