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Evaluation of Pulp from Napier Grass by Biochemical Pulping For Paper Industry

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Abstract. Malaysia has high rates of accelerating faster on depleting activities compared any other tropical countries in the world. This problem also affects the economic losses of some countries that face deforestation. To overcome this, Napier grass from non-wood was chosen between new methods by xylanase enzyme treatment for pulp production. This study going through the morphological characterization, pulpability at kappa number and the characteristic for biochemical pulping process. These conclude that biochemical had a high percentage of pulp yields; with a low screening rejects; good Kappa number by TAPPI method. Thus, xylanase enzyme has a potential to be sub-treatment for Malaysia's pulp and papermaking industry to produce a good waste-wealth product in future.

1. Introduction

Napier grass plant is a perennial grass, where it can grow to 2-4.4 meters, with leaves 30-120 centimeters [1]. Napier grass is also known as elephant grass. This grass has their scientific name, which is Pennisetum purpureum [2]. Like other non-wood material, Napier grass also contains hemicelluloses, cellulose and lignin content [3]. Enzymes are biological catalysts and therefore they have some basic properties as catalyst, e.g. they speed up the rate of chemical reactions without losing or changing by the reaction. Xylanases are of industrial importance, which can be used in paper manufacturing to bleach paper pulp, increasing the brightness of pulp and improving the digestibility of animal feed and for clarification of fruit juices [4]. Xylanase is structured within the secondary cell wall and is responsible for forming an interphase between lignin and other polysaccharides. Most likely xylan molecules were covalently bound with lignin phenolic residues and other polysaccharides, such as pectin and glucan [5].



2. Material and Method

2.1. Preparation of Material

Napier grass samples were collected manually from Rusli Parit Sulong Farm, Johor, Malaysia. The leaf and bast have been cut in pieces of section of 2cm [6]. The samples of Napier grass put into open atmosphere for 3days of air drying. This steps required free water materials in which it would be able to dry completely before undergo biochemical pulp process [7].

2.2. Biochemical Pulping Porcess

Pre-treatment for dry Napier grass for 0.5% xylanase enzyme for 24 hours before cooked. Napier grass treat by xylanase undergoes the cooking process for chemical process in digester autoclave in table 1. The The content of material was weight and loaded into digester autoclaves [8,9]. The collected partially deligned pulps was washed and clean with tap water for neutralization of the reaction. The making of pulp papers follows TAPPI Method 205 om-8.

Table 1. Chemical cooking process biochemical pulping.

Pulping Process	NaOH (%)	Xylanase Dosage (%)	Time (minutes)	Temperature (°C)
Soda (Control)	16	-	120	150
Xylanase-NP	16	0.5	120	150

3. Results and Discussion

3.1. Pulp properties

Treatment by xylanase enzyme had maximizes the pulp potential to becoming great pulp fibre for paper industry [10]. Napier grass material shown mobilized fibre characteristic to significant with xylanase enzyme, which new in paper research [11]. From figure 1, treat pulp by xylanase enzyme in 0.5% shows a potential to use this additive for Napier grass in future. All analysis shows a high potential from biochemical compare soda pulping itself.

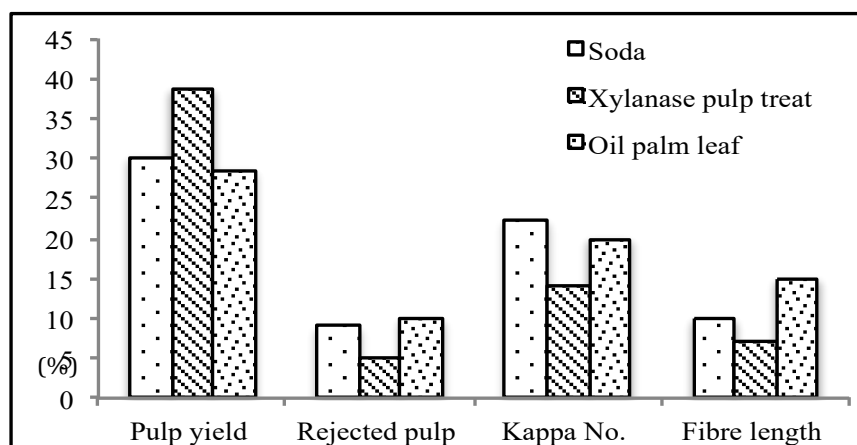


Figure 1. Pulpability analysis on treated Napier grass by xylanase enzyme [11].

As illustrated in figure 1, pulp yielding (36%) enzyme xylanase biochemical pulp shown higher production of pulp than past research studies. Enzyme treatment improves the material efficiency of the cooking process by chemically pulp and produces many pulp, in addition to the optimum process condition [12, 13]. In contrast with raw soda pulp about (9%), oil palm leaf about (12%) and reject pulp about (5%). The lower number of Kappa index about (12.7) and length of fiber about (9cm) yielding a best results and showing great paper pulp testing. It's shown in figure treated pulp with the lowest number of Kappa index and then compare fiber length with past research studies. The lowest number of Kappa index indicates pulps have small amount of lignin, however for future corresponding to minimum utilization of chemicals for bleached [14]. This distinguished research by state of variables that would provide an optimized cooking conditions for Napier grass.

3.2. Surface characterization

The cross section SEM micrograph reveals fibrillation on Napier glass surface by xylanase enzyme treatment [15]. The non-wood fibrillation materials can see in fiber from cross section. The fibrillation may be due to lignin removal as well as other structural impacts [16, 17]. The cross section of treated Napier seems to have a rough structural and fibers is more fully packed.

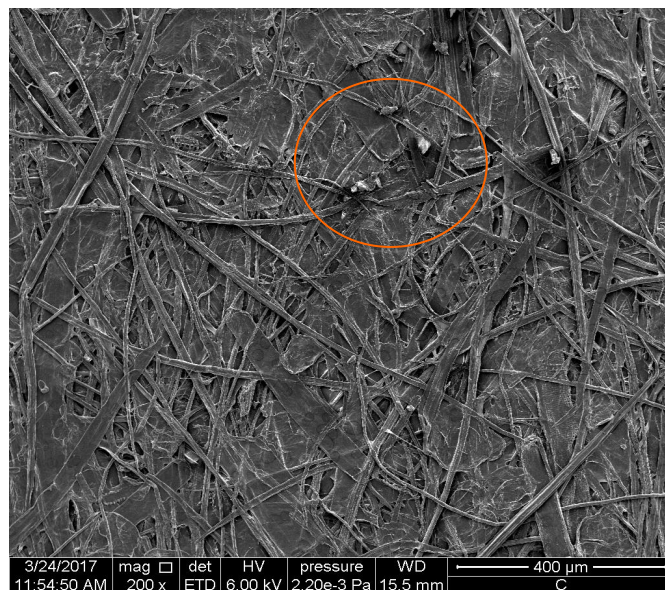


Figure 2. Napier grass fibre treat by xylanase enzyme for biochemical pulping magnificicant for 200x.

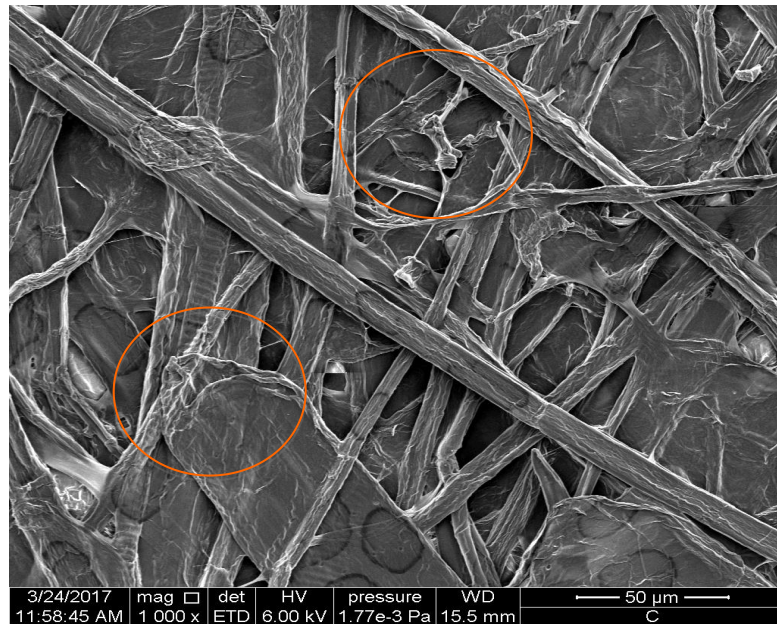


Figure 3. Napier grass fibre treat by xylanase enzyme for biochemical pulping magnificant for 1000x.

Treated fiber also has better quality of fibers because its structure. The design of treated well fiber packed closely than untreated fiber as illustrated in figure 3, where enzyme xylanase reveals that red circles allows a fiber joining with other fiber like glue. The configuration and packaging also impacts the production of paper by influencing quality and strength [18]. The condense fibers is important for the paper structure producing from nonwood materials [19]. Matrix fiber and fiber arrangement makes the fiber stronger, where paper and pulp quality can be produce [20]

4. Conclusion

Napier grass fibre has a high potential to become a substitute fibre in pulp and papermaking industry. Favorable xylanase enzyme treatment to Napier grass gives a higher quality paper and pulp are produced. By a new method by using biological microorganisms as additive, pulpability properties test (Pulp yield and Rejected pulp) shows a high of measurement where have a same property with wood materials. Besides that, the fibre surface treat pulp make the fibre become more strong and thick in conjunctions between the fibre-to-fibre matrix forms which created a potential for paper more strong. This Malaysia's agro waste material can become an effective source and has a high potential for alternative fibre in paper making industry.

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