Simulation of Silage Production From Water Hyacinth (*Eichornia crassipes*) as Ruminants Feed Based on the Increase of *Aspergillus niger*

Agung Budi Santoso[1] Martha Aznury[2,*] Nova Rachmadona[3] Robert Junaidi[2] Fertarina Pratiwi[2]

[1] *Department of Biotechnology, Faculty of Agroindusty, Kasetsart University, Bangkok, Thailand*
[2] *Department of Chemical Engineering, Politeknik Negeri Sriwijaya, Palembang, Indonesia*
[3] *Department of Chemical Science and Engineering, Graduate School of Engineering, Kobe University, Japan*
[*] *Corresponding author. Email: martha_aznury@polsri.ac.id*

ABSTRACT
Silage is a fermented high-water content feed given to ruminants. The production of silage from water hyacinth (*Eichornia crassipes*) is carried out by combining the grindery and fermentation processes.This equipment had 1420 rpm of agitation and 0.5 hp of electricity.*Aspergillus niger*was used in the fermentation process. The result showed that the average of silage size was the same, the production effectiveness increased, and so does the protein levels. By increasing the amount of *Aspergillus niger*loading, it improved the amount of protein levels, 5.6 %, in the silage. In addition, this also increased the pH level inside the process more acidic than that of lower loading.

Keywords: *Water hyacinth, silage, Aspergillus niger, protein*

1. INTRODUCTION

Animal feed in Indonesia, especially on people's livestock is still inadequate for the nutritional needs of ruminants for basic living and production. This is due to lack of quantity and quality of the available feed. Generally, the use of usual feed derived from agricultural waste contains a high coarse fibrous that makes it difficult to digest inside stomach.

The water hyacinth as animal feed has a high protein content of 11.2%. Water hyacinth (*Eichornia crassipes*), however, contains a lot of crude fibre, 16.79%[1,2]. Fermented hyacinths can be used in feed ducks to 30% from fine bran[3]. In addition, water hyacinth can also be utilized as red tilapia fish feed [4]. Therefore, finding a good way to manage the water hyacinth into a good nutrientfeed ingredient called silage isimportant to make it easy to be digested by ruminants. This study investigated the combination of the grindery and fermentation processes for producing silage effectively.

2. MATERIAL AND METHODS

2.1. Material

All equipment was built in a laboratory at Universitas IBA (Palembang, Indonesia). All analysis was done in utility laboratory at Politeknik Negeri Sriwijaya (Palembang, Indonesia)

2.2. Silage Production

Water hyacinth was dried at 80 ºC to remove the water. 500 g water hyacinth, 375 g corn powder, 7.5 cc molasse, and *Aspergillus niger* (0, 0.3, 0.6, 0.9 % w/w) were added in the fermenter for 7 days. The silage was dried before it is feeded to the ruminant.

2.3. Analytical method

The analysis of protein content was done by using N Total Micro Semi Kjeldahlmethods[5]and crude fibre was performed by using H_2SO_4 heated for 30 min by the addition of NaOH.

3. RESULT AND DISCUSSION

3.1. The Effect of Water Content and Aspergillus niger Concentration in the Fermentation Process

The decrease during the ensilage was affected by the nutrient content of the raw material and the microorganisms. The respiratory phase converted glucose into H_2O during the ensilage process[6]. On the other hand, the dry matter that lost during the fermentation process was converted to N-ammonia, organic acids and gases such as CO_2 and heat[7]. The optimum water content for silage production was65% while the initial water content of the sample was 63.5% (without microbial addition)[8]. The water content, however, increased 66% when the addition of *Aspergillus niger*to 0.9% w/w shown in Figure 1. It indicated the higher concentration of *Aspergillus niger* the lower water content is while the fermentation time is getting longer.

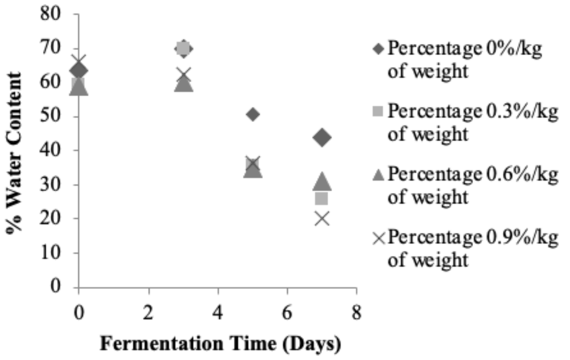

Figure 1. The effect of water content and *Aspergillus niger*concentration in the fermentation process

3.2. The Effect of Temperature and Aspergillus niger Concentration in the Fermentation Process

The quality of silage was also determined by the changing of the temperature from initial in the fermentation process. The result showed that the temperature slightly increased from 28 ºC to 34 ºC with (without) microbes at the 7th day shown in Figure 2. This indicated that the sugar will oxidize to CO_2, water and heat in the fermentation process. Therefore, the fermentation temperature should be controlled since it can affect the value of the silage that became black and decreased the protein content inside the feed.

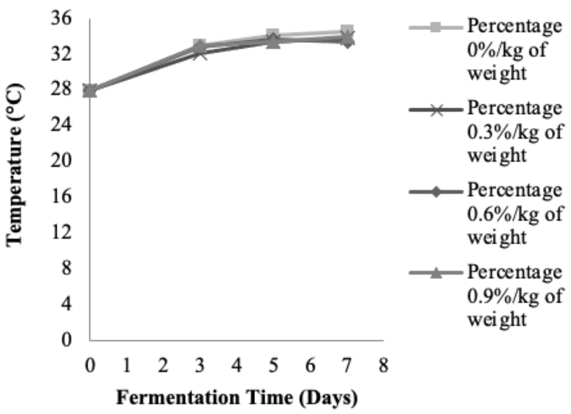

Figure 2. The effect of temperature and *Aspergillus niger* concentration in the fermentation process

3.3. The Effect of pH and Aspergillus niger Concentration in the Fermentation Process

Higher concentration of *Aspergillus niger* affected the quality in the fermentation process became more acidic than without *Aspergillus niger*. By using 0.9% w/w of *Aspergillus niger*, pH achieved at 3.2 as presented in Figure 3. This result indicated that microbe could affect the pH in the reaction which could inhibit the activity of the bacteria.

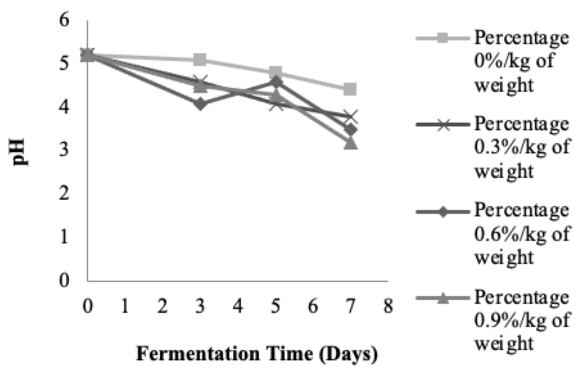

Figure 3. The effect of pH and *Aspergillus niger*concentration in the fermentation process

3.4. The Effect of Crude Fibre and Aspergillus niger Concentration in the Fermentation Process

Figure 4 showed that the increase of *Aspergillus niger* concentration in the fermentation process decreased the crude fibre inside the silage from 66% without microbes to 23.73% with 0.9% w/w microbes due to the activation of cellulose and hemicellulose during ensilage process. The decrease of crude fibre indicated that the quality of silage improved and the digestibility value increased inside the silage.

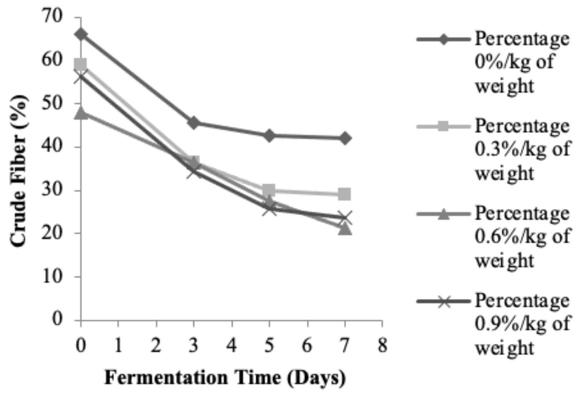

Figure 4. The effect of crude fibre and *Aspergillus niger*concentration in the fermentation process

3.5. The Effect of Protein Content and Aspergillus niger Concentration in the Fermentation Process

Microbe consists a single cell protein that could increase the silage protein content. Figure 5 presented the effect of protein content by the addition of microbe (*Aspergillus oryzae*) in the fermentation process. Higher concentration of *Aspergillus oryzae* higher protein content in the silage is. In addition, the longer fermentation time the higher protein content increased. This indicated that the microbial activity and degradation resulted the silage components presented in the feed. Figure 5 showed that the protein content increase from 4.24% at the 3rd day to 4.61% at 7th day with 0.6% concentration of *Aspergillus niger*. Therefore, this fermentation process could increase the protein content in silage from water hyacinth.

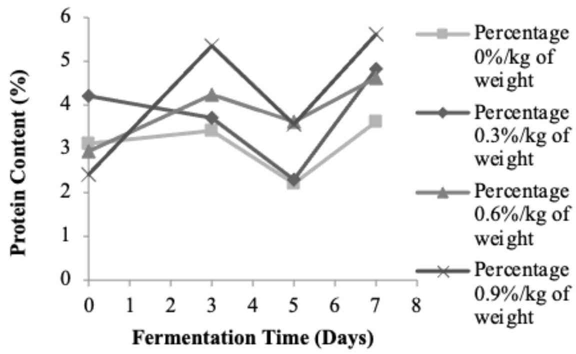

Figure 5. The effect of protein content in silage and *Aspergillus niger*concentration in the fermentation process

4. CONCLUSION

The silage production from water hyacinth by combining the grindery and fermentation process with the addition of *Aspergillus niger* successfully increased the protein content and decreased the crude fibre. This process could also reduce the enumeration time in the process. The optimum condition was obtained 5.6% protein content in the silage by using 0.9% w/w concentration of *Aspergillus niger* at 7 days reaction time. This condition also decreased the crude fibre content in the silage from 34.34% to 23.73%.

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