Content of fibre fraction complete feed silage based waste corn (*Zea mays*) in the fermentation process with local microorganism "Probiotic MOIYL"

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Abstract. There has been great emphasis on the recovery, recycling and reconditioning of food waste, particularly from the fresh and processed food. The study aimed to examine the use of “MOIYL Probiotic” on the content of complete feed grade silage fraction based on maize waste. This research was conducted at Nutrition Research Lab for Nutritional Research on Goat Cut Sei Putih and Lab Nutrition Microbiology Faculty of Agriculture University of Sumatera Utara from December 2017 to February 2018. The design used was complete randomized design (RAL) 4x3 factorial pattern with 3 replicates. Factor I is various level of “Probiotics MOIYL” are, 0%, 1%, 3%, and 5% “Probiotics MOIYL”. Factor II is the fermentation time of 7, 14 and 21 days. Parameters studied were NDF, ADF and hemicellulose levels. The result showed that the addiction of various levels of “Probiotics MOIYL” had no significant effect (P˃0.05) to on NDF and hemicellulose levels. However, the duration of fermentation had a very significant (P<0.01) to on NDF, ADF and hemicellulose. There is an interaction between MOIYL level and fermentation time to on ADF. The best addiction levels of probiotic MOIYL can used dose until 3% with fermentation time of 14 days.

1. Introduction
There has been great emphasis on the recovery, recycling and reconditioning of food waste, particularly from the fresh and processed food. Efforts have been made to use their wastes, effluents, residue and by product for the production of value added products [1]. Food wastes, rich in nutrients, could be used in the compost for the cultivation of fast growing plants, mainly vegetables [2], food production for the animals or fish [3], and generation of bio-diesel [4]. Therefore, it is necessary to develop an ensilage from of ready meals residues, by using the lactic fermentation until obtaining the acidification that allows its conservation with minimum losses of nutrients and small variability in its chemical composition, similar to the processes carried out to obtain the silage from of agricultural products [5]. However, the utilization of agriculture industrial waste in Indonesia has not been highly used which is make the economic value still low. There is also still required more effort to find out the natural antibiotic as a natural feed additive for organic livestock productivity [6]. Organic wastes include animal manure, crop reminders and food processing wastes, municipal bio-solids and wastes from some industries. They are typically by product of the field as well as of municipalities enterprises o industrial activities. They are called “wastes” for not being the primary products. These can be used for fertilizer, ground restorer, energy resource (heat, liquid fuels, electricity) and the production of chemicals (organic volatile acid, ammonium products, alcohols) [7].
One of the main problems faced in developing ruminant livestock, especially in dry seasons, is the difficulty to get good feed in terms of quantity and quality. Provision of quality feed can be fed to animals with not only natural grasses, but also with the use of various agricultural waste. One of the agricultural waste that can be utilized optimally is corn crop waste [8]. Corn crop waste is a potential source of feed ingredients because it is available throughout the year in sufficient quantities abundantly in Indonesia [9]. Meanwhile, the main constrain of corn waste utilization as feed is low nutrient value especially high fibre content (33.58%) and low protein content (5.56%). So when corn used as a feed required the addition of feed ingredients that have good quality such as concentrates to meet the nutritional needs and increase livestock productivity. However, these constraints can be overcome with feed processing technology, one of which is complete feed silage [10]. The basic principle of silage making is fermentation of forage by microbes that produce lactic acid. The main purpose of using the additives when making silage is to maintain a lactic acid fermentation that results in a well preserved silage, preventing the secondary fermentation and to decrease butyric acid production. The effectiveness of additives depends on the degree of preventing such fermentation in the silages [11]. During the anaerobic treatment of lactic fermentation, some changes in the wastes take place caused by the decomposition of polymerized structures of the organic substance to simpler configurations, which could be immediately metabolized by the microorganisms, and used directly by the plants [12]. The lactic fermentation has been proposed as one alternative for the stabilization of waste since it offers advantage, mainly related to the low cost of investment, important in places where there is no good infrastructure and an integral use of wastes is required, separating the products of high commercial value as chitin, pigment, proteins and lipids [13]. The most dominant microbes are homo fermentative from Lactobacillus plantarum groups capable of fermentation under aerobic and anaerobic conditions. Lactic acid produced during fermentation acts as a preservative which can avoid forage from damage or attack of decomposing bacteria [14]. MOIYL is an indigenous micro-organism based on palm oil waste containing bacteria, fungi and yeast of Bacillus sp. YLB1, Trichoderma sp. YLF8 and Saccharomyces sp. YLY3 including microbes that have high ability in degrading fibre (lignocellulose). Through indigenous microbial exploration will be produced multi enzyme that is very instrumental in the processing of feed. Processing of fermented feed using indigenous microbes will optimize the ability of rumen microorganisms in digesting high fibre feed [15, 16]. This study aims to determine how big the role of local microorganisms as probiotic MOIYL in degradation fibre-based corn waste so as to improve the quality of waste-based feed as an energy source.

2. Materials and methods
This research was carried out took place at Nutrition of Microbiology Laboratory of Faculty of Agriculture University of Sumatera Utara and at Laboratory of Nutrition Feed of Loka Goat Research Station of Sei Puthih Village of Galang Sub-district of Deli Serdang Regency of North Sumatera, from December 2017 until February 2018. Materials and tools used are corn waste (stem, leaf, bark) rice bran, soybean meal, coconut meal, fish meal, minerals, urea, molasses and probiotics MOIYL, chopper, scales, blades, clear plastic 1kg, black plastic measuring 2kg, rubber bands and tools laboratory in the analysis of Acid Detergent Fibre (ADF), Neutral Detergent Fibre (NDF) and hemicellulose.

The research design used was RAL Factorial 4x3 with 3 replications. Factor I = Probiotics Levels “MOIYL”
A0: Complete Feed Silage + No Probiotic “MOIYL” (Control);
A1: Complete Feed Silage + 1% Probiotic “MOIYL”;
A2: Complete Feed Silage + 3% Probiotic “MOIYL”;
A3: Complete Feed Silage + 5% Probiotic “MOIYL”.
Factor II = Fermentation length
L1: 7 days
L2: 14 days
L3: 21 days
2.1. Probiotics and silage procedure of experiment
Making of probiotics “MOIYL” using several materials, among others sterile water 1.5 litters as a solvent, rice bran 3%, urea 1%, fertilizer SP 36 0.5%, fish meal 1%, shrimp paste 0.5%, brown sugar 1.5%, molasses 1.5% and mixed inoculum 10%. All ingredients are inserted into 5-liter jerry cans, do it usability for all the ingredients mixed. Then covered with plastic and tied rubber. Checking is done from day 1 to day 7. If the plastic swell it can be that the fermentation process has occurred and there is gas in it. Then microorganism indigenous “MOIYL” is ready for use (for detail information (Figure 1).

(a) Scheme of Making Probiotics (MOIYL) [16].

(b) Scheme of Making Complete Feed of Silage

3. Results and discussion
3.1. Content of neutral detergent fibre (NDF)
The complete feeding silage fermented with local microorganism obtained the lowest NDF in A2L2 (3% MOIYL + 14 days Fermentation Time) is 46.590%. While the highest NDF content in A3L3 (5% MOIYL + 21 days Fermentation Time) is 55.143%. The content of NDF can be seen on Table 1.

The results of the diversity analysis showed no interaction between the addition of probiotic “MOIYL” with the duration of fermentation. The fermentation duration very significant effect (P<0.01) on the decrease of NDF content, while the addition of probiotic “MOIYL” is no significant effect (P>0.05) to content of NDF complete feed silage based on waste corn. Data on Table 1 showed that
complete feed of silage A2L2 (MOIYL 3% with length of fermentation 14 days) have the lowest NDF content because there are activity of mixed inoculum indigenous microbes.

**Table 1.** Means content of NDF complete feed silage based on waste corn (*Zea mays*).

| Dose Probiotic “MOIYL” | Fermentation Time (days) | Means  |
|------------------------|--------------------------|--------|
|                        | L1 (7)                   | L2 (14)| L3 (21)|        |
| A0 (No MOIYL)          | 49.280                   | 49.333 | 48.363 | 48.992 |
| A1 (1%)                | 52.293                   | 47.760 | 53.200 | 51.084 |
| A2 (3%)                | 52.987                   | 46.590 | 49.897 | 49.824 |
| A3 (5%)                | 55.143                   | 49.443 | 52.160 | 52.249 |
| Means                  | 52.426<sup>a</sup>       | 48.282<sup>b</sup> | 50.905<sup>a</sup> | 50.537 |

Note: Different superscripts on the same column show no significant difference (P>0.05)

This is in accordance with [16] that indigenous microbes produce multiple enzymes (endo-β-1,4-glukanase, xylanase, manganese and ligniperoxidase) and synergize each other in degrading fibres. That decrease in NDF content is also due to positive synergize between bacteria, fungi and yeasts that continue to increase in activity. The increased NDF content on A3L3 (MOIYL 5% with length of fermentation 21 days) because during the microbial fermentation process utilizing cell content in advance to support its growth, then followed by a reshuffle of cell walls. Cell contents are relatively easy to use and cell wall reshuffling is relatively slow due to the presence of insoluble N compounds in NDF that limit the enzymes activity in cell wall reshuffling. The result of research [16] in the fermented palm frond also showed an increase in the NDF content along with the duration. That decrease in NDF content is due to a decrease in hemicellulose, where hemicellulose and cellulose are components of cell walls that can be digested by microbes.

3.2. **Content of acid detergent fibre (ADF)**

The complete feeding silage fermented with local microorganism obtained the lowest ADF content in A2L2 (3% MOIYL + 14 days fermentation time) is 27.8967%. While the highest ADF content in A1L3 (1% MOIYL + 21 days fermentation time) is 33.2467%. Content of ADF can be seen in Table 2.

**Table 2.** Means content of ADF complete feed silage based on waste corn (*Zea mays*).

| Levels of “MOIYL” | Probiotic | Fermentation Time (days) | Means  |
|-------------------|-----------|--------------------------|--------|
|                   | L1 (7)    | L2 (14) | L3 (21) |        |
| A0 (No MOIYL)     | 28.336<sup>c</sup> | 28.053<sup>c</sup> | 31.396<sup>a</sup> | 29.262 |
| A1 (1%)           | 28.550<sup>c</sup> | 27.983<sup>c</sup> | 33.246<sup>a</sup> | 29.926 |
| A2 (3%)           | 28.160<sup>c</sup> | 27.896<sup>c</sup> | 27.970<sup>c</sup> | 28.008 |
| A3 (5%)           | 28.806<sup>c</sup> | 28.000<sup>c</sup> | 30.083<sup>bc</sup> | 28.963 |
| Means             | 28.463    | 27.983  | 30.674  | 29.04  |

Note : Different superscripts on the same column had significant difference (P<0.05)

The results showed interaction between the addiction of probiotics “MOIYL” with fermentation length. According of probiotic “MOIYL” had a very significant effect (P<0.01) to ADF content of complete feed silage based on waste corn. Decreased levels of ADF in (A2L2) due to reshuffle the cell wall into a simpler component of hemicellulose and glucose during the fermentation process. These findings is in agreement with [17], who reported that ADF levels decline due to the partial dissolution of cell wall proteins and hemicellulose in acid detergent solution there by increasing the portion of ADS and leading to decreased ADF levels. Data on Table 2 showed the ADF content tends to undergo different changes according to the fermentation time. This
condition is thought to be due to the utilization of cell content components containing lipids, sugars, organic acids and other water-soluble substances by cellulotic bacteria, so that the ADF content tends to experience fluctuating changes as the length of fermentation increase. This supported by [18], who reported that the content of ADF and NDF during fermentation undergoes a fluctuating change that is affected by fermentation duration. At the time of 14 days fermentation, there was a decrease of ADF content compared with the fermentation time of 7 days, it is assumed that the time needed by the microbe was optimum in degrading the hemicellulose particles but the substrate requirement was not sufficient so there was no significant decrease, the microbial activity was stable so the ADF content decreased. The results is supported by [19], who reported that in microbial growth fermentation reaches its maximum at the exponential phase, once the cell reaches the maximum growing speed then in the end the number of cell will remain, referred to as the stationary phase. This phase will be followed by a decrease in the number of cell called the death phase. Then the ADF content increased during fermentation 21 days allegedly the addition of fermentation time causes the activity of microorganisms that have decreased again increased.

3.3. Content of hemicellulose

The lowest complete silk hemicellulose content of feed at A0L3 (No MOIYL + 21 days Fermentation time) is 16.667%, and the highest complete hemicellulose silage feed content in A3L1 (5 % MOIYL + 7 days Fermentation Time) is 26.337% (Table 3).

| Levels of Probiotic “MOIYL” | Fermentation Time (days) | Means |
|-----------------------------|--------------------------|-------|
|                            | L1 (7)                   | L2 (14) | L3 (21) |
| A0 (No MOIYL)              | 20.943                   | 21.280  | 16.667  | 19.630<sup>a</sup> |
| A1 (1%)                    | 23.743                   | 19.777  | 19.953  | 21.158<sup>a</sup> |
| A2 (3%)                    | 24.827                   | 18.693  | 21.827  | 21.782<sup>a</sup> |
| A3 (5%)                    | 26.337                   | 21.443  | 22.077  | 23.286<sup>a</sup> |
| Means                      | 23.963<sup>b</sup>       | 20.298<sup>b</sup> | 20.131<sup>b</sup> | 21.464 |

Note: Different superscripts on the same column had no significant difference (P>0.05)

The results of the analysis of diversity showed on interaction between the addiction of probiotics “MOIYL” with fermentation length. Addition of probiotics “MOIYL” had no significant effect (P>0.05) and fermentation time had a very significant effect (P<0.01) to Hemicellulose content of complete feed silage based on waste corn. The decrease in hemicellulose content might be because the longer the fermentation time will be the more hemicellulose is broken into pentose sugars so that the hemicellulose content becomes decreased. According to [20], the content of hemicellulose after ensilage is lower than before ensilage, because hemicellulose is broken into pentose sugar during the formation of the ensilage.

4. Conclusions

The conclusion the best addiction levels of probiotic MOIYL can used dose until 3% with fermentation time of 14 days.

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