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Effect of bio activator use on corn cobs as a complete feed on performance and digestibility of local sheep

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Abstract. This study was conducted in Binjai City in two stages for 3 months. Stage I aims to determine changes in the chemical components of corn cobs which are fermented with various bioactivators. This study used a completely randomized design (CRD) with 5 treatments and 3 replications. The results of the diversity analysis showed the use of various bio activators significantly ($P < 0.05$) on crude protein content and crude fibre content. Stage II aims to determine the response of local sheep that are fed complete based on corn cobs fermented on feed performance and digestibility. This study used 20 local rams with an average weight of 19.82 kg using a completely randomized design (CRD) with 5 treatments and 4 replications. The results showed that corn cobs administration had a significant effect ($P < 0.05$) on feed performance and digestibility. The highest income over feed ratio is found in the P4 treatment of Rp. 334,400. From this study it can be concluded that the best treatment is found in P4 treatment which has the lowest feed conversion value and the most economical IOFC value.

1. Introduction

Sheep are small ruminant animals that have high economic value. This is because sheep are fast breeding, the number of children birth is more than one head and the short distance between births. In addition, sheep have a high adaptability that is able to survive in a bad environment by utilizing feed (especially forage) which is low in nutrients. So far the pattern of sheep breeding is still done in the traditional way by utilizing the availability of forage that is around. So that during the rainy season the availability of forage is abundant while in the dry season the forage is limited. Therefore, it is necessary to use local food ingredients that are cheap, easily available and available continuously. One alternative food that is cheap and continuously available is the result of corn waste of corn crops, namely corn cobs. Corn cobs are wastes from dried corn shells which are now becoming increasingly in demand by farmers to be used as feed with abundant availability as well as the proportion of waste products by 20% from corn. However, the utilization of corn cobs is still of low quality with high crude fibre content and low protein content that requires a touch of technology such as fermentation in order to improve its quality and can be used as a more optimal feed.

Fermentation products usually have a higher nutritional value than the original ingredients because of the enzymes produced from the microbes themselves. In the process, fermentation of corn cobs can be done by the addition of commercial microbes, local microorganisms (MOL) and fungi to accelerate the completion of complete compounds to be simpler. Therefore, this study was conducted with the aim to optimize the utilization of fermented corn cobs using various bioactivators so as to improve their



nutritional quality, so that they can be utilized optimally. and is able to replace HMT that is difficult to obtain during the dry season and improve production performance in local sheep breeding.

2. Materials and methods

The study was conducted in the village of Headland Ibus hamlet II, districts Secanggang, Langkat Regency. Feed analysis was carried out at the Laboratory of Nutrition and Feed Science, Faculty of Animal Husbandry and Agriculture, Diponegoro University. The study was carried out for 90 days or for 3 months (including a 1-month adaptation period) from December 2017 to February 2018. This study consisted of two stages, namely the test phase of the nutritional content of corn cobs fermented with several bioactivators (proximate analysis) and the testing phase of corn cobs fermentation in sheep (appearance and digestibility of feed).

Table 1. Ration Structure

Feed ingredients	Treatment				
	P0	P1	P2	P3	P4
Corn bran ^a	5	5	5	5	5
Rice bran ^a	6	6	6	6	6
Palm kernel cake (BIS) ^b	5	5	5	5	5
Coconut meal	6	6	6	6	6
Soybean meal	8	8	8	8	8
Corn pile	4	4	4	4	4
Field grass ^c	24	25	25	25	25
Fermented corn cobs ^f	40	0	0	0	0
Promix fermented corn cobs ^f	0	40	0	0	0
MOIYL fermented corn cobs ^f	0	0	40	0	0
Fermented Corn Cob <i>A. niger</i> ^f	0	0	0	40	0
Fermented corn cobs <i>A. niger</i> + <i>Saccharomyces cerevisiae</i> ^f	0	0	0	0	40
Mineral flour	1	1	1	1	1
Urea	1	0	0	0	0
Amount	100%	100%	100%	100%	100%
PK (%)	13.20	14.33	14.48	14.37	14.24
TDN (%)	60.31	64.70	64.76	65.29	65.02
Ca (%)	0.61	0.61	0.61	0.61	0.61
P (%)	0.53	0.53	0.53	0.53	0.53

Note:

^aBased on the results of the proximate analysis at the Sei Putih-North Sumatra Goat Research Station

^bBased on the results of a proximate analysis at the Laboratory of Animal Food Sciences, USU Department of Animal Husbandry

^cBased on the results of a proximate analysis at the Laboratory of Nutrition and Feed Science, Diponegoro University Semarang

^fBased on the results of a proximate analysis at the Laboratory of Nutrition and Feed Sciences, Diponegoro University Semarang

2.1. Stage I: fermenting corn cobs with various bioactivators

The first stage is an analysis of crude protein content and crude fibre content of corn cobs that have undergone a fermentation process using proximate analysis [1]. This study uses a Completely Randomized Design (CRD) consisting of 5 treatments and 3 replications.

The treatment given is as follows:

- P0= control (unfermented corn cobs)
- P1 = cob of fermented corn with premix
- P2 = fermented corn cobs with MOIYL
- P3 = fermented corn cobs with *A. Niger*
- P4 = fermented corn cobs with *A. niger* + *S. cerevisiae*

Fermentation of corn cobs was done by mixing 1% bioactivator, 5% molasses and 1% urea from the total corn cobs. Fermentation is carried out with 60% humidity for 7 days in a burlap sack that has been anaerobically coated.

2.2. Stage II: Performance and digestibility of sheep

The second step is to determine the performance and digestibility of feed. This study used 20 local rams with an average weight of 19.82 kg and rations consisting of rice bran, corn bran, BIS, coconut cake, soybean meal, corn pellets, field grass, mineral flour, vitamins and medicines (Table 1).

The research method used was a Completely Randomized Design (CRD) consisting of 5 treatments and 4 replications. The treatment given is as follows:

- R0 = ration + 40% unfermented corn cobs
- R1 = ration + 40% fermented corn cobs with premix
- R2 = ration + 40% fermentation corncob with MOIYL
- R3 = ration + 40% fermented corn cobs with *A. Niger*
- R4 = ration + 40% fermented corn cobs with *A. niger* + *S. cerevisiae*

Feed given as much as 10% of body weight by feeding in the morning and evening while drinking water is given ad libitum. Ingredients collection of feed consumption is carried out every day for 2 months (60 days), weighing is carried out every week and taking a sample of food digestibility is carried out 1 week before the study is complete.

3. Results and discussion

3.1. Stage I: fermenting corn cobs with various bio activators

3.1.1. Crude protein and coarse fibre

To be able to know the chemical components of the corn cobs, all the treatments on the variables observed were analysed proximate so that the nutrient content of crude protein and crude fibre from each treatment could be known. The results of the proximate analysis of each treatment are presented in Table 2.

Table 2. Content of crude protein and crude fibre of fermented corn cobs

Treatment	Crude Protein (%)	Coarse Fibre (%)
P0	3.49 ^a	33.37 ^b
P1	4.74 ^b	17.33 ^a
P2	5.38 ^c	15.87 ^a
P3	4.84 ^b	15.60 ^a
P4	4.68 ^b	14.39 ^a

Note: Different superscripts in the same column show real differences (P<0,05)

Table 2 shows the lowest average protein content of fermentation was 3.49% (P0) and the highest was 5.38% (P2). This is because the bio activator contains microbes that play a role in the fermentation process to degrade the substrate. Changes in crude protein content in addition to occurring because of the results of substrate degradation are also caused by microbial growth because the microbial body

frame itself is a protein. Microbial growth is more optimal with the addition of urea. Addition of urea as a nitrogen source aims to increase N levels to supply microbial needs. According to [2] urea as a source of nitrogen is a macronutrient for the growth of microorganisms that will form microbial components. This is also justified by [3] which states that an increase in the value of protein content in fermented products due to the added urea will be converted by microorganisms into proteins.

The results of this study on *A. niger* use were higher than those of [4] and [5], namely crude protein content of 4.1% and 4%. BNJ's further test results showed that the P0 (control) treatment was significantly lower than other treatments. This indicates that the fermentation process can increase the crude protein content of corn cobs substrate. The increase in the crude protein content of the fermented substrate is due to the results of the substrate degradation process and the growth of microbial populations. P2 treatment was significantly higher than treatment P0, P1, P3, and P4. This indicates that the MOIYL bioactivator (P2) is able to degrade corn cob substrate more optimally than other treatments. It is suspected that the microbes found in MOIYL (P2) are able to synergize in degrading the nutrients in the corn cobs substrate and are more optimal than other treatments. [6] stated that the increase in protein content due to microbes can use (utilize) the substrate component for growth, high microbial growth will produce a high protein content because the microbial body itself is protein. Microbes use substrate as a carbon source for the formation of cells and energy sources, and nitrogen for the formation of protoplasm and cell tissue. The content of crude protein in the treatment of P1, P3 and P4 is not significantly different. This is thought to be the ability of microbes to degrade the substrate in treatment P1, P3 and P4 relatively the same. However, the use of *A. niger* (P3) microbes showed a higher trend than premix (P1) and *A. niger* + *S. cerevisiae* (P4). This shows that there is a higher degradation of the substrate by *A. niger* (P3) so that its growth is higher than other treatments. Whereas in P1 treatment it was suspected that the microbial promix was not optimally synergized in degrading the substrate. Likewise in P4 treatment where suspected *A. niger* microbes were not optimally synergized with *S. cerevisiae* in degrading corn cobs substrate.

BNJ's further test results showed that the crude fibre content of treatment P0 (without fermentation) was significantly higher than other treatment. The decrease in crude fibre content was due to bioactivators in each treatment to produce cellulose enzymes which function to degrade crude fibre. Cellulose enzyme is one of the enzymes produced by microorganisms that function to degrade cellulose into glukoka [7]. [8] added that the decrease in crude fibre content was thought to be due to the activity of cellulose enzymes produced by cellulolytic microbes contained in probiotics. In addition, the good growth of the addition of bioactivators in the corn cobs fermentation process is expected to produce more cellulose enzymes so that they can be used to remodel and reduce the crude fibre content of the substrate. The crude fibre content in P1 treatment was not significantly different from the treatments of P2, P3 and P4. It is assumed that enzyme activity produced by microbes in degrading crude fibre in the treatment of P1, P2, P3 and P4 is relatively the same. However, *A. niger* + *S. cerevisiae* (P4) microbial use showed lower crude fibre yields compared to premix (P1), MOIYL (P2) and *A. niger* (P3). This shows the growth of probiotics *A. niger* + *S. cerevisiae* (P4) is more synched in degrading crude fibre so that it produces more cellulose enzymes. Whereas in treatment P1 it was suspected that the growth of probiotics on premix was not optimally synergized in degrading crude fibre. Likewise in P2 and P3 treatment where it is suspected that probiotics used in the corn cobs substrate fermentation process are not optimally synergized.

3.2. Stage II: Performance and feed digestion

3.2.1. Performance

Feed consumption is calculated in dry matter. Sheep body weight gain is calculated based on the difference from weighing the initial body weight divided by the number of days. feed conversion can be searched by dividing the total amount of feed consumed divided by sheep body weight gain. Whereas IOFC is used to calculate the economic benefits obtained from the calculation of income minus the cost of feed during maintenance. The mean value of the performance in this study is presented in Table 3.

Table 3. Average performance of sheep during the research

Treatment	Consumption (dry ingredients) g/tail/days	PBB g/tail/days	Feed Conversion	<i>IOFC</i>
R0	609.18 ^a	57.14 ^a	10.76 ^b	229,200
R1	637.35 ^b	90.22 ^b	7.20 ^a	317,000
R2	643.92 ^b	92.67 ^b	7.01 ^a	326,000
R3	640.99 ^b	93.08 ^b	7.01 ^a	324,550
R4	655.15 ^b	95.62 ^b	6.79 ^a	334,400

Note: Different superscripts in the same column show real differences ($P < 0.05$)

Based on further tests of Honest Real Difference (BNJ) it was found that the consumption of R0 treatment rations had a significant effect ($P < 0.05$) lower than other treatments. This is because the R0 ration has a less fragrant aroma that affects the level of palatability. Unlike the case with ration consumption in the treatment of R1, R2, R3 and R4 which tend to be higher. The high ration consumption in the treatment is caused by fermentation feed will produce a fragrant aroma (typical) so as to increase palatability. This is consistent with the statement of [8] that fermentation can add flavour and aroma and increase the content of vitamins & minerals. The consumption of treatment ration P1, P2, P3 and P4 is not significantly different. This is thought to be caused by ration palatability which is not significantly different. The aroma and taste that are not significantly different will cause palatability that is not real, so that it is implemented in the consumption ration of the treatment. In addition, the crude fibre content which is not significantly different causes the rate of emptying food in the digestive tract is not significantly different. This will be shown by the consumption of the ration. In addition, low consumption of R0 treatment rations can also be caused by high crude fibre content of 33.47%. This is consistent with the opinion of [9] that the high content of crude fibre in feed causes the material to be difficult to digest, so that the flow velocity is low. This will limit the ability of livestock to consume feed because of the limited rumen capacity, rumen space is not available for the addition of feed and will result in decreased consumption. The addition of feed consumption speed is in accordance with the increased digestibility of food. In addition, maximum consumption is highly dependent on the balance of nutrients in digestion [10]. The high content of crude fibre in the ration gives a different response to the activity of rumen microorganisms in the process of digestion of dry matter. This causes the rate of fermentation in the rumen to be slower so that it affects the fast or slow rumen emptying process which ultimately affects the consumption of dry matter. Thus the ration consumption will decrease (low) if the crude fibre content is high [6].

Based on the results of the BNJ test showed that sheep body weight gain in the R0 treatment (control) significantly ($P < 0.05$) was lower than other treatments. This is because the ration in the R0 treatment has a high crude fibre content, causing less feed consumption which results in a decrease in the fulfilment of nutrient feed. This has resulted in sheep weight gain in the R0 treatment being lower than other treatments. According to [11], differences in daily body weight gain due to fermentation of agricultural waste with local microbes can increase crude protein content & reduce crude fibre. Added further by [12] sheep that were given fermented agricultural waste feed tend to have higher body weight compared to livestock that were only given field grass feed. The body weight gain in R1 treatment is not significantly different from the treatments of R2, R3 and R4. This body weight gain response. This happens because the crude fibre content of fermentation is not significantly different by feed. The substance for meat formation is relatively the same.

The results of the diversity analysis showed the use of various bioactivators significantly ($P < 0.05$) on feed conversion. Lamb feed conversion in this study is in accordance with [13] statement that feed conversion in sheep ranged from 6.38 to 8.02. BNJ test results showed that the treatments R1, R2, R3 and R4 were significantly lower than the R0 (control) treatment. This is caused by the crude fibre content in the treatment which undergoes a lower fermentation process. This is justified by [14] who said that the conversion of feed, especially sheep (small ruminants) is influenced by the quality of feed,

digestibility and dimensions of using nutrients in the metabolic processes in the body tissues of cattle. The better the quality of feed consumed by livestock will be followed by high body weight gain. This will result in a decrease in feed conversion value so that it will increase the efficiency of the feed used. Added further by [15] which states that the smaller feed conversion shows that sheep will be better at utilizing feed to increase their body weight. Sheep feed conversion in R1 treatment was not significantly different from R2, R3 & R4 treatment. This indicates that each treatment using various types of bioactivators provides the same feed conversion response. This happens because the treatment that undergoes a fermentation process has almost the same quality of feed and the same body weight gain. So as to improve feed efficiency and provide feed conversion values that are not significantly different.

Based on Table 3. above it can be seen that the highest profit in fattening sheep fed fermented corn cobs is in the R4 treatment of IDR 334,400 / head. The high value of IOFC in R4 treatment was caused by the fact that the sheep in the treatment had the lowest feed conversion value, which resulted in livestock being more efficient in utilizing rations. This will result in sheep in the treatment being able to produce a higher body weight gain so that it provides maximum benefits even though the cost of feed is also relatively high. In contrast to the R0 treatment which has the lowest IOFC value, sheep that do not receive fermentation treatment produce the highest feed conversion so that the sheep growth is not optimal and provides a smaller profit despite low feed costs. Low feed costs do not always provide big profits. This is consistent with the opinion of [16] which states that good growth does not necessarily guarantee profit, but good growth and good feed conversion and minimum feed costs will get maximum profit.

3.2.2. Feed digestibility

The average digestibility of dry matter and organic matter is presented in Table 4.

Table 4. Average Feed Digestibility of Sheep (%)

Treatment	DMD	OMD
R0	54.81 ^a	55.99 ^a
R1	62.71 ^b	63.83 ^b
R2	62.85 ^b	64.37 ^b
R3	62.58 ^b	64.51 ^b
R4	63.07 ^b	65.29 ^b

Note: The numbers on the same row followed by lowercase letters show significant differ ($P < 0.05$)

The results of the analysis of variance showed that the utilization of fermented corn cobs with various bioactivators showed significant differences ($P < 0.05$) on dry matter digestibility. Dry matter digestibility is closely related to fibre and protein content. The results showed that the R0 treatment had the lowest dry matter digestibility compared to the treatments R1, R2, R3 & R4. The difference in dry matter digestibility is due to differences in consumption of dry matter and nutrient content in feed. In the R0 treatment it has a lower crude protein content and a higher crude fibre content than other treatments. This is in accordance with the opinion of [17] which states that increasing levels of crude protein in feed will increase the rate of breeding and rumen microbial population so that the ability to digest becomes large. Digestion which has a high digestibility value reflects the magnitude of the contribution of certain nutrients to livestock. Meanwhile, feed that has low digestibility indicates that the feed is less able to supply nutrients to be absorbed in meeting basic life needs [18]. BNJ further test also showed the dry matter digestibility in treatment P1, P2, P3 & P4 was not significantly different. This is caused by the consumption of the treatment feed which is not significantly different. The dry matter digestibility is tightly maintained by consumption, which is in feeding with crude fibre content which is not significantly different. Coarse fibre is very voluminous. Therefore, feeding the sheep with crude fibre content that is almost the same will have an impact on the rate of digestion of feed which is almost the same. So that it will produce the same dry matter digestibility.

The results of the analysis of variance showed that the use of fermented corn cobs with various bioactivators showed significant differences ($P < 0.05$) on the digestibility of organic matter. BNJ further test shows that the organic matter digestibility in R0 treatment is significantly lower than the treatments R1, R2, R3 & R4. This is because the R0 (control) treatment has a higher crude fibre content than other treatments. Coarse fibre is one of the factors that can affect the digestibility of organic matter [19]. The value of the digestibility coefficient of organic matter shows the amount of food substances such as fat, carbohydrates, proteins that can be digested by livestock which is a determinant of the quality of the feed itself [18]. This is related to the chemical composition of the treatment feed which can affect the digestibility of feed. The digestibility of a food depends on the harmony of the food substances contained in it. The digestibility of organic matter is closely related to the dry matter digestibility, because some of the dry matter consists of organic matter. The digestibility of organic matter in the treatment of R1, R2, R3 & R4 is not significantly different. This indicates that the relationship between organic matter digestibility is closely related to dry matter digestibility. Therefore, dry matter digestibility (KCBK) which is not significantly different between feed fermentation treatments will show the same results for organic matter digestibility (KCBO). Because the increase in dry matter digestibility (KCBK) is always accompanied by an increase in organic matter digestibility (KCBO). This is justified by [20] which states that increasing the digestibility of organic matter in line with the increase in dry matter digestibility, because most of the dry matter components consist of organic matter so that the factors that influence the high and low digestibility of dry matter will also affect the high and low digestibility organic matter.

4. Conclusions

Fermentation of corn cobs using various bio activators (premix, MOIYL, *A. niger* & *A. niger* + *S. cerevisiae*) can reduce crude fibre content and increase the crude protein content of corn cobs. The utilization of fermented corn cobs with various bioactivators as feed proved to be able to increase feed consumption, body weight gain, dry matter digestibility and digestibility of organic matter and able to reduce feed conversion in sheep. Based on the results of the IOFC analysis the highest profit was obtained from the R4 treatment (*A. niger* + *S. cerevisiae* fermentation) which was Rp. 334,400/head.

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