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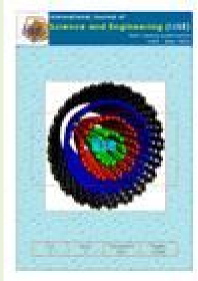

Nutrient Potency of Rice Straw Processed with Amofer as Cattle Feed Stuff in East Kalimantan

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Abstract–*Forage demand can be supplied from rice straw which processed with certain feed technology innovation. Some advantages can be derived under this technology i.e. increasing nutrient content, optimizing the utilization, improving the efficiency and reducing production cost by minimizing feed cost. Ammoniation fermentation (amofer) as an applied technology could give solution over the limitation of rice straw availability. The objective of this research was to determine the potency of rice straw processed with amofer (amofer-rice straw) as raw material to formulate complete feed. The experiment was carried out with randomized block design with three treatments and six replications. Amofer treatment was carried out by adding urea 3% from the total material and then placed into plastic jar ±12 liter and then incubated under an-aerobic process for 18 days. Fermentation material i.e. biology starter by 1% of total material was added at the ninth day. Dry Matter (DM) content resulted from each treatments was 87,28%, 85,96% and 84,61% for T_1, T_2 and T_3, respectively. Crude Protein (CP) content was T_1=24,48%, T_2=21,04%; and T_3=24,46%, Crude Fiber (CF) content was T_1=31,30%; T_2=31,30%; and T_3=31,39%. Total Digestible Nutrient (TDN) for version 1 was T_1=57,29; T_2=56,19; and T_3=56,89 and version 2 was T_1=53,11%; T_2=52,28%; and T_3=51,10%. The average value of Non Nitrogen Free Extract (NNFE) was T_1=23,49%; T_2=28,08%; and T_3=26,57%. The utilization of amofer as applicable technology is considered as the most appropriate method to increase the quality of rice straw by significantly increase nutrient content in term of crude protein (CP) and reduce crude fiber (CF) content. This increasing quality can be seen from the result of proximate analysis, NNFE and TDN content.*

Keywords:*Potency, nutrient, rice straw, amofer, feed, cattle(;)*

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I. Introduction

Feed plays important role for cattle including optimizing the productivity during growth, pregnancy and lactation phase. Feed also plays on the ability of cattle to survive and produce milk, calf, meat and energy. In addition, feed roles to maintain durability and health at a good performance. However, feed should be in a good quality and fed at enough amount in accordance with the cattle needs and production (Mayulu *et al*., 2013; Mayulu, 2012; Mayulu *et al*., 2010; Kuswandi, 2011).

Feed is an important element in the production of beef cattle especially to support their productivity. Limit availability of forage due to land conversion gives direct impact on low productivity of beef cattle business. The utilization of biomass such as rice straw may give good opportunity to supply beef cattle's feed with cheaper price. However, direct usage of bulky-rice straw contains low quality of feed material.

Technology innovation is much needed in order to supply feed material for cattle business to avoid competition with human and or other animals. Minimizing the production cost of cattle business requires technology innovation to manage and increase nutrient content of rice straw. Needs of forage can be supplied from rice straw which available in abundant amount under certain feed processing technology. Ammoniation fermentation (amofer) technology is an applied technology which could increase the nutrient content of rice straw.

Ammoniation fermentation can be carried out by adding urea and life micro-organism which contained in biology starter (starbio) consisted of lactic acid bacteria, lactobacillus genus and *bifidobactaria* genes and fungi (*saccharomyces cerevisiae*). The addition of urea and micro-organism works together to increase the nitrogen content, palatability, consumption and digestibility of rice straw. The addition of urea for ammoniation could increase nutrient content such as protein, metabolic energy and could degrade complex compound into simple compound. Fermentation process is a set of degradation process from physically, chemically and biologically hard structure into simple structure which in turn can increase the digestibility and leads to improving efficiency (Mayulu, 2014; Zakariah, 2012; Mayulu *et al*., 2009; Bata, 2008).

Optimum utilization of amofer-rice straw can be conducted further by processing this material into complete feed. However, the utilization of amofer-rice straw as complete feed material should consider the nutrient content and price. The composition of complete feed should meet with the needs of cattle and the price should be affordable for cattle farmers. Precise formulation of amofer rice straw-based complete feed could give maximum productivity thus business players will gain more profit (Mayulu *et al*., 2010; Haryanto, 2009; Tangendjaya, 2009; Mayulu *et al*., 2009; Salem and Smith, 2008). The objective of this research was to determine the nutrient potency of amofer-rice straw to be used for raw material of complete feed.

II. RESEARCH METHOD

The experiment was taken place in Laboratory of Animal Husbandry Nutrient, Faculty of Agriculture, Mulawarman University and Laboratory of Animal Husbandry Nutrient, Diponegoro University, Semarang. The experiment was initially started by chopping, drying and milling the rice straw. Drying was carried out to determine the dry weight which taken place at a shaded place free of direct sunlight.

Amofer treatment on rice straw was carried out using Randomized Block Design (RBD) with three treatments and six replications. Experiment was initially started by adding urea as much as 3% of a total weight and then placed into plastic jar ±12 liter and incubated under an-aerobic condition for 18 days. Biology starter (starbio) as fermentation agent was applied at the ninth day by 1% of total weight (Mayulu, 2008; Mayulu, 2012).

At the end of amofer experiment, the amofer-rice straw was weighed and milled to determine the nutrient content using proximate analysis. Prior carrying out proximate analysis, dry matter (DM) of amofer-rice straw was determined first by placing the material into oven with 105^{o}C for three or four hours until reaching constant weight (Adiwimarta, 2012). Data analysis used in this research to determine the quality of each amofer-rice straw result was Analysis of Variance (ANOVA) which followed by Duncan Multiple Test Range (DMRT) if different occurred

III.RESULT ANDDISCUSSION

Technology Introduction

a. Ammoniation

Ammoniation is one of chemical treatment using urea which popularly known can increase the nutrient content and digestibility of high fiber-waste. Ammoniation involves of alkaloid process and can dissolve hemicellulose, lignin and silica, saponification of ureic acid and acetic acid ester, neutralize free nitric acid as well as reduce lignin content of cell wall. A decreasing of cellulose crystallinity will ease the penetration of rumen microbe cellulose enzyme (Mayulu, 2014; Mayulu *et al*., 2013; Mayulu, 2012; Trisnadewi *et al*, 2011).

b. Fermentation

Fermentation is a process of producing primer and secondary metabolic using microbe in a controlled environment. Fermentation is the oldest application or technology from bio-technology science. The term of fermentation was initially used to describe the conversion process of glucose into alcohol in an-aerobic condition (Mayulu, 2014; Mayulu *et al*., 2013).

c. Amofer

Ammoniation and fermentation of rice straw is a technology which combines ammoniation and fermentation technique that can increase protein content and digestibility. Ammoniation and fermentation can break down cellulose, hemicellulose and lignin content of rice straw thus easier to be digested (Mayulu, 2014; Mayulu *et al*., 2013; Mayulu, 2012).

Nutrient Potency of Amofer-Rice Straw

Applied technology approach by utilizing applicable technology such as amofer is the best known method to increase the quality of rice straw especially the nutrient content by increasing crude protein (CP) and reducing crude fiber (CF). The average value of rice straw after amofer application is shown in Table 1 indicating significant quality increment which can be seen from proximate analysis result, non nitrogen free extract (NNFE) and total digestible nutrient (TDN).

Based on variance analysis ($p<0,05$), the water content of amofer-rice straw was significantly different among treatments. This result informed that the DM of T_2 was 87,28% followed by T_1=85,96%, and T_3=84,61%. *Duncan's Multiple Range Test* showed that the highest DMwas produced by T_2 (Kutai Kartanegara rice straw sample) and followed by T_3 (Berau sample) and T_1 (North Penajam Paser sample). The experiment also reported that amofer treatment did not significantly reduce DM. The decreasing DM during amofer might occur due to degradation of lignin, cellulose and hemicellulose and degradation by microbe during incubation. This condition is in agreement with research resulted by Bata (2008) which reports that fermentation causes softening and breaking down of complex lignin, hemicellulose and increases cellulose which have positive impact on microbe activity.

The quality improvement of rice straw based on proximate analysis was indicated by the increment of CP i.e. T_1=24,48%; T_2=21,04%; and T_3=24,46%. Variance analysis showed significant different ($p<0,05$). This phenomenon reflected that the increment of CP of three treatments were different even with the same amofer period of time (18 days).

This different result could be due to different origins of the samples. Different CF particularly was due to different of field condition, sunlight exposure length time, rice age and variety.Incubation length time significantly influenced the number of microbe growth during fermentation period thus leading to increment of CP. Hastuti *et al*. (2011) revealed that decreasing CF during incubation period proportionally increase the CP content.

Table 1. Proximate Analysis of Amofer-Rice Straw

Treatment	DM	CP	Crude Fat	CF	NNFE	TDN[1]	TDN[2]
T_1U_1	85,79	24,25	1,80	31,29	23,52	57,07	2,45
T_1U_2	86,12	24,78	1,65	31,21	23,13	57,40	53,16
T_1U_3	85,95	23,68	1,44	31,19	24,74	56,80	53,27
T_1U_4	85,87	25,98	1,54	31,48	21,68	57,84	53,67
T_1U_5	86,00	23,52	1,45	31,26	24,56	57,17	52,91
T_1U_6	86,06	24,64	1,58	31,34	23,34	57,48	53,19
Average	85,96	24,48	1,58	31,30	23,49	57,29	53,11
T_2U_1	87,69	20,36	1,08	31,26	29,09	55,94	52,20
T_2U_2	86,98	21,20	1,13	31,21	28,00	56,31	52,58
T_2U_3	87,34	21,49	1,25	31,22	27,45	56,52	52,54
T_2U_4	87,16	21,35	1,44	31,48	27,60	55,94	52,21
T_2U_5	87,25	20,78	1,52	31,33	28,19	56,11	51,91
T_2U_6	87,28	21,07	1,53	31,34	28,17	56,35	52,23
Average	87,28	21,04	1,33	31,31	28,08	56,19	52,28
T_2U_1	85,10	24,69	1,52	33,46	22,99	54,57	46,79
T_2U_2	84,77	24,50	1,45	32,70	24,23	55,75	49,17
T_2U_3	83,92	25,17	1,33	31,58	25,94	56,42	51,34
T_2U_4	84,51	24,66	1,48	31,18	26,10	58,07	51,30
T_2U_5	84,43	24,30	1,40	30,00	30,79	57,58	54,14
T_2U_6	84,93	23,44	1,37	29,43	29,35	58,95	53,88
Average	84,61	24,46	1,43	31,39	26,57	56,89	51,10

Remark: [1]Sutardi, (2001); [2]Hartadi *et al*. (1997).

Duncan's Multiple Range Test at $p<0,05$ resulted that CP content among treatments was significantly different. T_1 treatment resulted higher CP (24,48%) compared with T_3 (24,46%) and T_2 (21,04%). Different CP resulted from each treatment could be due to substrate amount needed by microbe to support growth produced from amofer process was different. Toha *et al*., (1998) stated that protein microbe which was degraded by other microbe was converted into ammonia, to compose body and some parts are evaporated.

Research that had been conducted by Harnum and Usman (2011) reported that protein hydrolysis into amino acid is basically followed by deamination process to release ammonia. Following stage is utilization of ammonia by microbe to synthesize microbe protein where it must be supported with enough energy availability. Other research conducted by Sitorus (2012) mentioned that CP increment due to incubation length

time during fermentation process give opportunity for microbe to perform growth and fermentation. Long duration of incubation increases microbe number and simultaneously increases CP content.

Proximate analysis result showed that amofer treatment on rice straw reduced CF content. The experiment resulted CF content of each treatment was T_1=31,30%; T_2=31,30%; and T_3=31,39%, however variance analysis showed no significant different among treatments. Originally, CF content of rice straw sample obtained from Penajam Paser Utara, Kutai Kartanegara and Berau was 37,60%; 46,69%; and 38,93%, respectively. The reducing CF content under amofer treatment during 18 days hadn't reached ideal condition of CF (<18%). However, this treatment depicted that decreasing content of CF during amofer treatment could be due to ammonia content contained in urea.

Ammonia contained in urea has ability to degrade lignocellulose and ligno-hemicellulose bound causing to CF structure break down. Crude fiber is a structural fraction carbohydrate which cannot be digested or dissolved and also as filter residue after boiled for 30 minutes with liquid acid (H_2S0_4, O_3N) and liquid base (1,5 N). Nurhajati and Suprapto (2011) stated that cellulose, hemi-cellulose, lignin and polysaccharide which role as protector are involved as CF fraction. Utomo *et al.* (2008) stated that CF is portion of carbohydrate which difficult to be digested as it contains cellulose, hemicellulose and lignin. The energy and nutrient availability could be reduced because of high crude fiber content as it inhibits the flow of foods compound in digestive channel.

According to Akhardiarto (2009), the decreasing CF content of rice straw might be due to the urea and bacteria involved during amofer process break down the lignocellulose bound. Other research carried out by Hastuti *et al.* (2011) reported that the CF content in rice straw during amofer might be due to the activity of urea (ammoniation) could break down some bound of cellulose and lignin which then degraded by microbe during fermentation process.

The energy content of amofer-rice straw was calculated based on TDN formula. According to Sutardi (2001), the average value was T_1=57,29; T_2=56,19; and T_3=56,89 while according to Hartadi *et al*. (1997) the average value was 53,11%; 52,28%; dan 51,10%, respectively. Variance analysis showed no significant difference among treatments. However, experiment result showed increment of TDN compared with TDN of rice straw sample before amofer process (Penajam Paser

Utara 58,95% and 53,88%; Kutai kartanegra 49,63% and 42,84%; and Berau 42,57% and 38,52%).

National Research Council (2000) mentioned that TDN is the nutrient content which can be digested including all organic matters such as CF, CP, exthract ether (EE) and NNFE. The magnitude of TDN is obtained from biology test or calculation using proximate analysis data. Hastuti *et al.* (2011) stated that the increment of TDN of amofer-rice straw is caused by degradation of cellulose and lignin substrate by microbe continuously during amofer process takes place. This degradation process causes the increment of organic nutrient which can be digested easily such as CP, EE and NNFE.

The magnitude of NFE resulted from this experiment was T_1=23,49%; T_2=28,08%; and T_3=26,57%. Variance analysis ($p<0,05$) showed significant different among treatments indicating that different treatment will produce different NNFE. Basically, nitrogen free extract is a non-structural carbohydrate fraction which calculated from the deduction of 100% with water content, ash, CF, CP and crude fat. It results % NNFE. Laboratory of Animal Husbandry Nutrient of Diponegoro University give the scope of NNFE where it contains sugar, starch, fructose, hemicellulose, pectin, organic acid-soluble lignin, resin, tannin, pigment, water-soluble vitamin.

Amofer treatment is proven can improve the nutrient content of rice straw through the increment of CP and reduction of CF as well as increment of TDN and NNFE. Based on those result, amofer is recommended as alternative treatment to process rice straw. However, this improvement of quality is obtained with long duration of amofer process. Thus, shorter duration of process is further needed. Other alternatives that can be done to develop agribusiness activities in farmers' level are: 1) feed processing is taken place in feed milling, 2) farmers get feed material from feed milling; and 3) feed with good quality is provided throughout the year to meet with the feed demand of beef-cattle farming.

Limit availability of rice straw can be minimized through amofer treatment as an alternative to increase the nutrient content and reduce CF before fed to beef-cattle. Ammoniation is chemical treatment by adding urea to supply ammonia. Fermentation is a set of process through the application of microbe to supply primer and secondary metabolic in a controlled condition. Ammoniation fermentation is a treatment which combines ammoniation and fermentation which can be used as an applied technology through incubation technique. This combination treatment is able to increase CP and simultaneously reduce CF of rice straw. Ammoniation fermentation is a method of rice straw processing which able to break down the bound of cellulose, hemicellulose and lignin thus rice straw is easier to be digested.

CONCLUSION

Implementation of applicable technology (amofer) is considered as the best method to increase the quality of rice straw especially the nutrient content by increasing CP and reducing CF. In general, the nutrient content of rice straw after amofer treatment increased significantly. This can be seen from proximate analysis, NNFE and TDN calculation.

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