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# PEFORMANCE OF BALI CATTLES FED COMPLETE FEED BASED OIL PALM FROND THAT ADDED WITH RUMEN MICROBES GROWTH FACTOR ( RMGF)

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**Abstract–**The research objective was to determine effect forage : concentrate ratio (F:C) on the productivity of cattle fed a complete ration with ammoniatted based of oil palm-frond supplemented by Rumen Microbes Growth Factor (RMGF). The research used Randomized Block Design applying 4 rations as treatment and 4 groups cattle. The experiment diets were: A (60% oil palm frond ammoniated + 40% concentrate + RMGF); B (50% oil palm frond ammoniated + 50% concentrate + RMGF); C (40% oil palm frond ammoniated + 60% concentrate + RMGF); and D (30% oil palm frond ammoniated + 70% concentrate + RMGF). The measured parameters were dry matter (DM) and organic matter (OM) intake, daily weight gain (DWG), feed efficiency, total digestible nutrient (TDN), and digestibility of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose, hemicellulose. The result showed that the treatment had no significant effect (P> 0.05) on DM intake, OM intake, daily weight gain, feed efficiency, digestibility of DM, OM, CP, TDN, NDF, hemicellulose but had highly significant effect (P <0.01) on digestibility of ADF and cellulose. All treatments with different ratio of F:C (oil palm frond ammoniated : concentrate + RMGF) had no different effect on cattle productivities.

## INTRODUCTION

The reducing production and increasing import of meat in Indonesia due to land conversion are used for the manufacture of the housing and estates. To meet the needs of forage it is necessary to find a replacement for forage. One of which is the production of oil palm frond that increasingly abundant and does not compete with human needs. Oil palm plantations in 2015 was 11.260.300 hectares, in 2016 was 11.914.500 million hectares with the grow rate of 4.69 % (Directorate General of Plantation Indonesia, 2016).

The limiting factor in oil palm frond for feeding cattle is the high lignin content resulting in lower digestibility. Chemical processing technology (alkali treatment and ammoniation) can improve feed digestibility (Zain *et al*., 2014). Ammoniation using urea is able to loosen the ties of lignocellulose and lignohemilcellulose, and increasing the nitrogen content of the treated material. Ishida and Abu Hasan (1992) reported that ammoniated oil palm frond with 3 % urea was able to produce the better digestibility of dry matter (DM).

In this study, the used rumen microbes growth factor (RMGF) consists of mineral phosphorus (P), sulfur (S), and *Saccharomyces sp*., which has function to improve digestibility in cattle. RMGF is a living microbe, thus RMGF given will increase the and activity and microbial population in the rumen which lead to the increasing of digestibility. This is in line with the research conducted by Zain *et al*. (2011, 2015), where addition of probiotics in the diet can stimulate the growth of microbes in the rumen and improve feed digestibility in ruminants.

Phosphorus (P) and sulfur (S) are required

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mineral for rumen microbes.The supplementation of P (0.4%) and S (0.3%) gave a positive effect on the performance of cattle (Zain *et al*., 2010). Improved digestibility is very likely due to the improvement of rumen microbial growth, especially fungi. The addition of phosphorus and sulfur also requires the support of a feed additive.

Feed additives are also very useful in maintaining and improving rumen microbial growth. One of feed additives is the direct feed microbials (DFM) that intentionally added to livestock rations. One DFM which can be used are yeast (*Saccharomyces sp*). Suryani *et al* (2016) and Zain *et al*, (2011) reported that *Saccharomyces sp* supplementation can effectively improve the digestibility of nutrients more than without supplementation. The addition of DFM such as *Saccharomyces cerriviseae* into the ration of cattle was increasing the digestion capacity of rumen microbes, improving feed efficiency, and simultaneously increasing livestock performance. (Chaucheyras *et al*., 1995; Haddad and Goussous, 2005; Elseed *et al*., 2007, Zain *et al*, 2016). Combination of feed processing technologi (ammoniation) with the addition of RMGF in the utilization of palm frond would provide great hope in increasing the productivity of livestock.

## MATERIALS AND METHOD

### Research Materials

Materials used in this study were 16 Bali cattle aged about 2 years old with their weight range of 106-138 kg, ration (ammoniated oil palm fronds (F) and concentrates (C) + RMGF( mineral P and S and *Saccharomyces sp)* which were used for supplementation,

### Research method

This study used a randomized block design (RBD), consisted of four treatments and four replications, namely: (A) 60% ammoniated oil palm frond + 40% concentrate + RMGF; (B)50% ammoniated oil palm frond + 50% concentrate + RMGF; (C) 40% ammoniated oil palm frond + 60 % concentrate + RMGF; (D) 30% ammoniated oil palm frond + 70% concentrate + RMGF. The variables observed were dry matter intake (DMI), organic matter intake (OMI), digestibility of nutrients (dry matter, organic matter, crude protein, NDF, ADF, cellulose, hemicellulose), daily weight gain (DWG), and feed efficiency

Animals had free access to water throughout the experiment. Concentrate and forage were manually mixed (according to experiment design) and bagged off site, and sufficient diets were prepared for the entire study. The cattles were fed the mixed diets twice daily, at 08:00 and 16:00 h for 3% dry of matter intake of body weight. The experiment lasted for 60 d, and the amounts of feed offered and refused were recorded daily for each animal throughout the trial. Body weight was measured at the beginning and the end of the experiment.

### Measurements, sample collection and analyses

The feed intake was determined daily for each cattles. Average daily gain (ADG) was calculated for throughout the trial. Feed efficiency was calculated as the ratio between ADG and dry matter intake (DMI). A total of 100 g mixed feed was collected and dried in a forced-air oven at 60°C for 48 h and ground through a 1- mm sieve before being analyzed. The DM, ash, and N, contents were determined according to the AOAC (1999). The NDF and ADF contents were analyzed according to Van Soest *et al*. (1991).

The data obtained were analyzed statistically by analysis of variance ( ANOVA ) and difference it would be tested by Duncan 's Multiple Range Test (Steel and Torrie, 1980).

## RESULTS

Table 4 showed that digestibility of dry matter ranged from 67.29 to 72.61%, organic matter from

**Table 1.** Nutrient content of palm fronds before and after ammoniation.

| Nutrient | Before ammoniation (%) | After ammoniation ( % ) |
|---|---|---|
| Dry matter | 39.5 | 42.5 |
| Organic matter | 97.60 | 96.74 |
| Crude protein | 2.23 | 6.19 |
| Crude fiber | 46.0 | 37.0 |
| Ether extract | 3.04 | 1.85 |
| Ash | 2.4 | 3.26 |
| NDF | 76.09 | 67.04 |
| ADF | 57.58 | 53.59 |
| Cellulose | 43.14 | 41.11 |
| Hemicellulose | 18.51 | 13.44 |
| Lignin | 14.23 | 12.33 |
| Silica | 0.21 | 0.15 |

Source : Ruminant Nutrition Laboratory Andalas University (2015).

70.17 to 74.82%, CP from 76.68 to 80.01%, NDF ranged from 57.28 to 61.35% ADF ranged from 32.71 to 48.34%, cellulose ranges between 31 30 to 55.35% and hemicellulose ranged from 75.47 to 84.75%. Statistical analysis showed that the treatments had no significant effect (P> 0.05) on DM, OM, CP, NDF, and hemicellulose digestibility and provide highly significant effect (P <0.01) on ADF and Cellulose digestibility

**Table 2.** The composition of the ration (% DM)

| Materials | Ration (%) | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Ammoniated oil palm frond | 60 | 50 | 40 | 30 |
| Rice bran | 5 | 5 | 20 | 31.5 |
| Palm kernel cake | 15.5 | 33.5 | 33.5 | 35 |
| Corn | 18 | 10 | 5 | 2 |
| Mineral | 1 | 1 | 1 | 1 |
| Salt | 0.5 | 0.5 | 0.5 | 0.5 |
| **Amount** | 100 | 100 | 100 | 100 |
| Supplement | | | | |
| Mineral P | 0.4 | 0.4 | 0.4 | 0.4 |
| Mineral S | 0.3 | 0.3 | 0.3 | 0.3 |
| *Saccharomyces* | 1 | 1 | 1 | 1 |

From Table 5 it can be seen the DM intake ranged from 3.33 to 3.75 kg/d and from 2.60 to 2.83% body weight (BW), OM intake ranged from 2.89 to 3.33 kg/d , ADG ranged from 0.62 to 0.79, and feed efficiency ranged from 9.86 to 21.78. Statistical analysis showed that the treatments had no significant effect (P> 0.05) on DM intake, OM intake, daily weight gain and feed efficiency.

## DISCUSSION

### Digestibility of nutrient

Digestibilty of nutrient not significant for all treatments. It means the supplementation P, S and *Saccharomyces sp* could increase the digestibility of the ration that haved higher fiber until 50% ammoniated palm fond involved in ration.

Digestibility of dry matter, organic matter and crude protein were similar in this study indicate that treatment of ammoniation on palm frond is capable of loosening lignocellulose and lignohemiselulose bounds, so that the palm frond can be digested by cattle. Ammoniation with urea on oil palm fronds in this study led to Loosening the bonds between lignin and cellulose or hemicellulose that is easily digestible carbohydrates. During the process of ammoniation with urea, urea is formed to NH4OH. Ammonium hydroxide is an alkaline compound, much like lye soap, and serves to solubilize hemicellulose by breaking chemical bonds holding lignin and hemicellulose together and partially break down the structure of cellulose by disrupting hydrogen bonds. This reaction causes a swelling of the fiber and allows cellulase (the enzyme responsible for cellulose digestion) better

**Table 3.** Nutrient content of the ration (%DM).

| Nutrition contents | Ration (%) | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Dry matter | 66.08 | 70.24 | 73.70 | 77.75 |
| Organic matter | 86.77 | 87.81 | 88.82 | 88.86 |
| Crude Protein | 12.95 | 12.98 | 14.34 | 14.82 |
| Crude fiber | 27.80 | 23.72 | 20.73 | 17.49 |
| Ether extract | 3.5 | 4.57 | 4.82 | 5.87 |
| Ash | 13.23 | 12.19 | 11.94 | 11.14 |
| Nitrogen Free Extract | 42.52 | 46.54 | 48.17 | 50.68 |
| TDN | 61.60 | 62.30 | 62.85 | 63.71 |
| NDF | 48.63 | 43.31 | 42.26 | 42.21 |
| ADF | 28.25 | 25.21 | 21.59 | 20.61 |
| Cellulose | 18.28 | 16.05 | 13.74 | 13.18 |
| Hemicellulose | 20.38 | 18.1 | 20.67 | 21.6 |
| Lignin | 8.37 | 7.74 | 6.92 | 6.7 |
| Silica | 1.6 | 1.42 | 0.93 | 0.73 |
| Mineral P | 0.64 | 0.96 | 0.84 | 0.81 |
| Mineral S | 0.16 | 0.13 | 0.17 | 0.19 |

Source : Ruminant Nutrition Laboratory Andalas University ( 2015 )

access to the fiber for digestion (Church, 1988).

Ammoniation can also increase the crude protein content, so that the availability of nitrogen for microbial growth can be better. Technology processing is teechnology for improving the energy of good qualityfor small scalae dairy system (Albarran *et al*. 2012). Urea ammoniation process was thus found to be complete after 3 weeks of incubation at 30-38$^0$C (Bhar *et al*, 1998). Almost 80% of rumen microbes require nitrogen to synthesize their body protein. Palm frond containing lignin as limiting factor on digestibility after ammoniation process can be reduced, so that the digestibility can be increased compared to not amoniated (Nguyen *et al*., 1998; Granzin and Dryden, 2003). This similar digestibility could be stated that the feed quality became better because of supplementation RMGF could support rumen microbial growth as reported by Zain *et al*, 2010, 2011, 2015, Suryani, 2016.

The mean digestibility of NDF in each treatment tend to be the same but the ADF digestibility in treatment A was higher compared to other treatments, because supplementation of mineral P, S and *Saccharomyces sp* can work better at the optimum high-fiber feed. This is in accordance with the opinion of Wiedmeier *et al.*, (1987); Callaway and Martin, (1997) that *Saccharomyces cerevisiae* working in fermentation metabolite (vitamin B, amino acids, organic acids) and specific work is digesting fiber. *Saccharomyces sp* supplementation in the ration treatment helps microbial activity in the rumen to digest fiber (Zain *et al*., 2011).

The cell wall contained in ammoniated palm frond overhauled with the help of *Saccharomyces sp* improving digestibility through the synergy effect of rumen bacteria that digest especially fiber. DFM types of mushrooms can enhance cellulolytic microbial population (Callaway and Martin, 1997). Zain *et al*., (2011) added that *Saccharomyces cerevisiae* optimally working to digest fiber together with cellulolytic bacteria. Saccharomyces sp is capable of using oxygen presenting in the rumen so, that pH of the rumen becomes conducive to microbial growth, especially cellulolytic bacteria.

### Nutrien intake, Daily Weight Gain, and Feed Efficiency

Nutrient intake, faily weight gain and feed efficiency in this study not different. It means that the physical texture of the complete ration was fine enough to prevent the cattle do selection during eating, and cause the same capacity in consuming dry matter and organic matter inspite of increasing part of ammoniated palm frond in the rations. In accordance with Tafaj *et al*., (2007) stated that complete rations can influence feed intake and

**Table 4.** Digestibility of DM, OM, CP, NDF, ADF, cellulose and hemicellulose

| Variable | Treatment | | | | SE |
|---|---|---|---|---|---|
| | A | B | C | D | |
| DM digestibility (%) | 67.29 | 68.61 | 69.91 | 72.61 | 1.18 |
| OM digestibility (%) | 70.17 | 72.44 | 73.66 | 74.82 | 1.03 |
| CP digestibility (%) | 76.68 | 77.01 | 78.04 | 80.01 | 1.47 |
| NDF digestibility (%) | 61.35 | 58.48 | 57.84 | 57.28 | 2.23 |
| ADF digestibility (%) | 48.34$^{a}$ | 43.88$^{ab}$ | 39.82$^{bc}$ | 32.71$^{c}$ | 2.27 |
| Cellulose digestibility (%) | 55.35$^{a}$ | 42.07$^{bc}$ | 32.61$^{c}$ | 31.30$^{c}$ | 3.70 |
| Hemicellulose digestibility (%) | 79.08 | 80.13 | 75.47 | 84.75 | 4.17 |

Description: different superscripts in the same row show highly significant effect (P< 0.01).

**Table 5.** Dry matter intake (kg/d and % body weight (BW)), organic matter intake, daily weight gain and feed efficiency

| Variables | Treatment | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | SE |
| DM intake (kg/d) | 3.33 | 3.45 | 3.75 | 3.73 | 0.26 |
| DM intake(% BW) | 2.60 | 2.67 | 2.77 | 2.83 | 0.20 |
| OM intake(kg/d) | 2.89 | 3.03 | 3.33 | 3.31 | 0.23 |
| Daily weight gain (kg/d) | 0.62 | 0.68 | 0.77 | 0.79 | 0.11 |
| Feed efficiency (%) | 19.86 | 19.87 | 20.14 | 21.78 | 3.46 |

Description : The treatment had no significant effect ( P > 0.05 )

avoid rejection by the cow to feed which is not preferred.

In addition, the lignin bound to cellulose as hydrolysis barrier was successfully passed down through the oil palm frond ammoniation treatment so that the fiber fraction could be easily digested by rumen microbes which in turn would also equalize the feed consumption. Leng (1991) stated that besides ammoniation treatment using urea on fibrous feed may loosen the bonds and it is easier to digest, rumen microbes may get nitrogen supply they need.

DM and OM intake resulted in this study tend to be similar, this is due to the cattle same age, so that the ability of their feed intake could be the same. According to *Pond et al.*, (1995) DM consumption for all young cattle increased per unit of body weight during the early days of life compared to subsequent periods. The similar result as reported by Cantalapiedra- Hijar *et al.* (2014) where DMI was not affected with the percentage of concentrate increasing in the diet from 30% to 70% in goats. According to Aguerre *et al.* (2011) increasing F:C ratios (47:53, 54:46, 61:39, and 68:32) in the diet had no effect on DMI of Holstein cows. Agle *et al.* (2010), also reported no change in DMI of lactating dairy cows fed diets contained 52% and 72% concentrate feeds.

Feed intake were similar in each treatment into which mineral P and S and Saccharomyces supplemented, and might cause the same nutrient digestibility and also it would be related to the same rate of passage of rumen contents. Microbial growth and metabolism in the rumen can run together with the same rumen condition because P is an essential component for microbial growth especially maintaining the integrity of cell membranes and cell walls, components of nucleic acids, and portions of the molecules of high energy (ATP, ADP and others) (Komisarczuk and Durand, 1991). It is also in accordance with Karsil and Russell (2001) which stated that the microbial protein synthesis is inhibited if there is not enough mineral P.

Statistical analysis showed that the treatments had no significant effect (P> 0.05) on the daily weight gain. There are no different daily weight gain with different ratio oil plam frond ammoniated and concentrates in this study. The same result as reported by Mahal *et al.* (1997) that no differences in live weight changes at forage:concentrates ratios of 50:50, 60:40 and 70:30 in cows diet. The same consumption and digestibility will also produce the same daily weight gain anyway. This is due to the same dry matter intake which had a direct impact on the consumption of organic matter and likely to produce the digestibility of nutrients the same as well. The same body weight gain associated with digestibility and the amount of nutrients that can be utilized further for the growth of body tissues. The growth is asssociated with feed intake because the level of feed intake and energy, especially crude protein directly affects muscle growth. According to Anggorodi (1994) the deficiency of nutrient slows the growth while a perfect meal accelerates the growth.

*Saccharomyces sp*. could stimulate the growth of rumen cellulolytic bacteria, especially bacteria that affect feed intake and digestibility. Callaway and Martin (1997) reported that the consumption of ration dry matter, organic matter, and feed consumption affect body weight gain. Wallace et al., (1994) stated that one of the benefitting effect of DFM especially in adult ruminant livestock is on meat production. This result is higher than the value obtained by Nurhaita *et al*. (2014) which used ammoniated palm frond ration with the addition of P and S as well as cassava meal is 0.49 kg /head /day.

Judging from the average value, feed efficiency of each treatment tends to equal among ratio the ammoniated palm frond : concentrates supplemented with *Saccharomyces sp* and mineral P and S. This is due to the size of the ration DM intake balanced with the average daily gain. This is in line with the opinion of Tillman *et al.* (1998) which states that the value of the ration efficiency depends on the amount of dry matter intake, which could produce weight gain. Beckman *et al.* (1977) and Jenny *et al.* (1991) reported that there was no difference in body weight gain in control and lactic acid bacteria fed animals. In contrast to this Aldrovandi *et al.* (1984) and Abu Tarboush *et al*. (1996) reported a higher body weight gain due to *Lactobacillus* supplementation. These differences might be due to types of animals and feeds used and other unidentified factors which affect the changes in body weight on probiotic feeding.

## CONCLUSION

The result of this research showed that increasing level oil palm frond ammoniated from 30 % to 60% in Bali beef cattle diets gave the positive influence of digestibility nutrient and growth performance. Moreover, our study provided evidence that oil

palm frond ammoniated could use until 60% in beef cattle diet if supplemented with concentrate and rumen microbial growth.

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### Conflict of Interest

The authors declare that in this study there are no conflicts of interest

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### Author's Contributions

Jepri Juliantoni : Execution of the experiment, sampling and records, and writing of the manuscript.

Mardiati Zain : Experimental, design, statistical analysis and writing of the manuscript.

Irsan Ryanto :Experimental design and statistical analysis.

Elihasridas: Experimental design.

Khasrad: Experimental design and statistical analysis

Ethics

The authors declare there are no ethical issues related to this observational study

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