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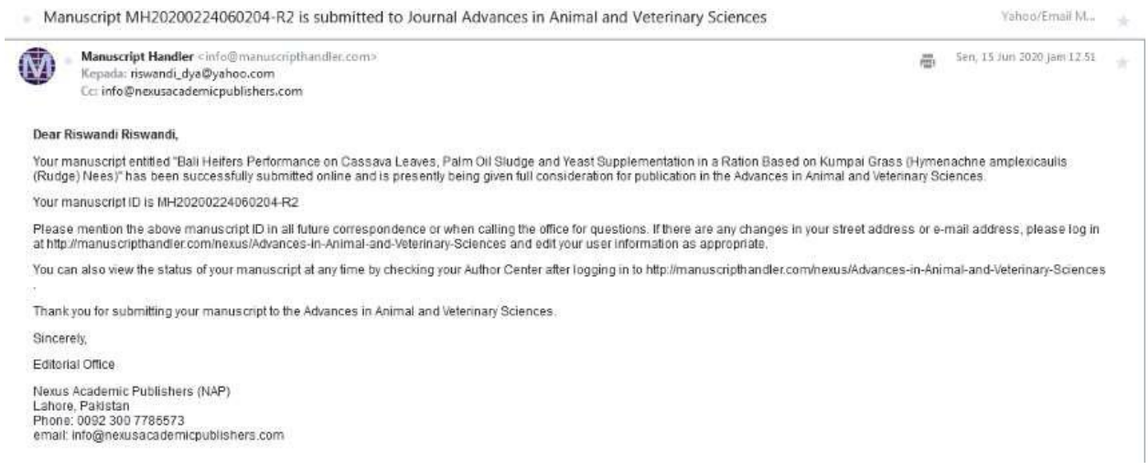

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Research Article

Bali Heifers Performance on Cassava Leaves, Palm Oil Sludge and Yeast Supplementation in a Ration Based on Kumpai Grass (*Hymenachne amplexicaulis (Rudge) Nees*)

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Abstract. Utilization of potential swamp forages, by product of palm oil industry and cassava is a strategy in improvement of cattle feed. The purpose of this study was to evaluate the effect of cassava leaves, palm oil sludge and yeast supplementation on a ration based on Kumpai grass (*Hymenachne amplexicaulis* (Rudge) Nees) on the performance of Bali heifers. Twelve Bali heifers were allocated into two groups. First group was fed with control diet consisting of 70% Kumpai grass + 30% concentrate (R0) while second group (R1) was fed a diet consisting of 55% Kumpai grass + 15% concentrate + 15% palm oil sludge (POS) + 15% cassava leaves + 5 g yeast (*Saccharomyces cereviseae*)/head/d. The variables measured in this study were intake, digestibility of dry matter, organic matter, crude protein, neutral detergent fiber, acid detergent fiber, average daily gain , feed conversion ratio and farmer income. Data were analyzed by independent t-test. The results showed that the supplemented diet had a significant improvement ($P<0.05$) on intake of dry matter, organic matter, and crude protein, digestibility of dry matter, organic matter, crude protein, neutral detergent fiber, and acid detergent fiber, average daily gain, feed conversion ratio and farmer income. Supplementation of palm oil sludge, cassava leaves and yeast in the Kumpai grass based ration significantly increased

performance of Bali heifers. Heifers fed the supplements gave a higher income than those without supplements.

Keywords: Bali heifers, digestibility, daily gain, non-tidal swamp, performance

INTRODUCTION

In non-tidal swamp of South Sumatra, the forage supply is mainly depend on aquatic vegetations, one of them is Kumpai grass (*Hymenachne amplexicauli*s (Rudge) Nees). However, the utilization of Kumpai grass is limited by the high fiber fraction that may reduce intake and digestibility when fed alone in the diet (Ali et al., 2013; Rostini et al., 2014).

The high price of concentrate was the main reason for a low frequency of cattle supplementation by smallholder farmers (Hernaman et al., 2018; Mumba et al., 2018). Concerning the price of commercial concentrate, locally-available concentrate may increase cattle performances and farmer income. Palm oil sludge (POS) is one of the agro-industrial by products from palm oil processing with low price and available for small scale farming. The supplementation of POS has a potency for increasing intake and cattle performance due to a higher content of water-soluble carbohydrates and a source of unsaturated fatty acids (Hayyan et al., 2010) that might reduce methane gas production (Machmüller et al., 2000; Vlaeminck et al., 2006). An often used approach for boosting cattle production in tropical humid areas was cassava leaves since a higher crude protein (CP) content especially branched amino acids. The addition of branched amino acids in the ration was able to increase the growth of cellulolytic bacteria as reflected in the increase in the digestibility of dry matter (DM), organic matter (OM) and neutral detergent fiber (NDF) (Puastuti et al., 2017; Tedeschi et al., 2015).

Supplementation of yeast (*Saccharomyces cereviseae*) increased the population of cellulolytic bacteria and reduced the accumulation of lactic acid and oxygen concentration in the rumen and thus increased the use of starch in the ration (Kumar et al., 2013; Pinloche et al., 2013). Other studies proved that yeast supplementation increased the digestibility of DM, OM, CP and fiber fraction and microbial efficiency (Ali et al., 2015; Tang et al., 2008). The purpose of this study was to evaluate the effect of the locally-available supplementations on Bali heifers performances.

MATERIALS AND METHODS

Location and duration

This research was conducted in the village of Tanjung Seteko, Ogan Ilir district, South Sumatra province of Indonesia, Rubber and oil palm plantations are dominantly cultivated in this area and serves a potential sources of feed for beef cattle originating from the plantations by products. The study was conducted for 4 months.

Experimental design and animals

Twelve Bali heifers aged 1 years with an initial body weight of 151±12.3 kg (mean±standard deviation) were randomly allocated into two experimental treatments. The animals were placed in individual pens (1.6 m x 2.5 m).

The trial was conducted during seven weeks and consisted two weeks of preliminary period, four weeks of adaptation period and one week of digestibility measurement when feed intake and fecal excretion were quantified. Live weight was measured weekly before morning feeding.

Feeding

The experimental treatments comprised of two diets. First group was the control diet (R0) consisting of Kumpai grass and concentrate (70:30, DM basis), the second group (R1) consisted of Kumpai grass, cassava leaves, POS and concentrate (55:15:15:15) and 5 g yeast/head/day (Table 2). The ration was prepared according to NRC (2001) for small breed cattle with estimated DM intake of 3% body weight.

Kumpai grass and cassava leaves were collected in the evening and then chaffed to ±10 cm. Palm oil sludge was obtained from a palm oil processing while Yeast (Yea-sacc) was

obtained from Livestock Research Center at Ciawi, Bogor. Feeding start at 8.00 AM. First, the concentrate (yeast) and POS were offered while grass and cassava leaves were offered at 10:00 AM and 4:00 PM. Animals had free access to drinking water and Salt-mineral lick.

Quantification of feed intake and feces excretion

Samples of 100 g of fresh material (FM) consisting of Kumpai grass, cassava leaves, POS and concentrates were daily collected during the week of digestibility measurement. To determine the digestibility of the diet, the feed offered and refusal were weighed and recorded per animal per day. No concentrate refusal was found. The samples were dried at 65 ^{o}C for 72 hours and then pooled at the end of each trial week in order to obtain 100 g of dried sample.

Determination of daily fecal excretion was carried by removing the feces each time the animals defecated from the clean floor throughout the digestion week. For each heifer and every 24 hours (8:00 AM) all fesses was collected into a 10-l bucket and weighed. After that, the fesses were mixed by hand and a sample of 300 g FM was dried in an aluminum foil tray at 65 ° C for 72 hours and re-weighed. At the end of trial, all dry samples were grounded to pass a 1-mm mesh. Sub samples of 100 g of dried feces were stored for analysis.

Chemical analysis of samples

Samples from Kumpai grass, cassava leaves, POS and concentrates as well as fecal samples were analyzed for DM and ash (AOAC, 2005), neutral detergent fiber (NDF), and acid detergent fiber (ADF) (Van Soest et al., 1991) The concentration of N was determined by the Kjeldahl procedure (AOAC, 2005) using the distillation unit Tecator 1028 (Tecator GmbH; Hagen, Germany). All analyzes were carried out in duplicate and the analyzes were repeated when the results differed by more than 5%.

Data analysis

Digestibility value was obtained by reducing the intake of dietary nutrient with nutrient in the feces and then divided by the intake of dietary nutrition. Feed conversion ratio was calculated by dividing the DM intake by live weight gain. Income over feed cost was calculated based on the differences between the selling price of the Bali heifers gain and feed costs in the unit of Indonesian rupiah (IDR). Differences in observed parameters between groups of treatments were analyzed by t-test (SPSS 13.0 program).

RESULTS

The results showed the supplemented of R1 ration increased intake ($P<0.05$) of DM, OM and CP , whereas NDF and ADF were not significantly. increased intake for DM 13.07%, OM 21.34% and CP 102.1%. (Table 3). The supplemented diet improved nutrients digestibility ($P<0.05$), increased digestibility for DM 16.21%, OM 18.66%, CP 24.12%, NDF 8.81% and ADF 13.30% compared without supplement. (table 4). The results showed that the mean of ADG of the heifers on supplemented diet (R1) was higher ($P<0.05$) than that on control diet (R0). As a result, the supplemented diet had a better FCR compared to the control diet (Table 5). Bali heifers fed POS, cassava leaves and yeast supplementation gave 489% higher IOFC values than those fed Kumpai grass and concentrate (Table 6).

DISCUSSION

Nutrients intake

Differences in DM intake caused by the nutrients, especially protein and energy feed (McDonald et al., 2010). The higher intake might relate to the lower content of NDF and higher CP in the supplemented diet which is consistent with Cunningham et al. (2005) that the lower

NDF content, the higher feed intakes. Coleman and Moore (2003) stated that regulation of intake was an interaction between the characteristics of feed and the animal where mainly depend on rumen capacity and passage rate (McDonald et al., 2010). Increased DM, OM and CP in the R1 this is due to feed material cassava leaves have a high CP content and POS is a source of fatty acids, so it will contribute to the preference level (palatability) cattle on feed intake, this is in accordance with Sanh et al. (2002) stated that the palatability and digestibility related to the CP content. According to NRC (2001), generally, the addition calcium salts of fatty acid in dairy cows can reduce the consumption of DM. It is assumed that yeast supplementation modified the condition of the rumen so the effects of unsaturated fatty acids on the DM intake could be suppressed.

Nutrients digestibility

The higher digestibility values might due to the lower fiber fraction of NDF and ADF and the higher CP contents of supplemented ration (Table 4). Besides that, this is due to ration treatment of R1 contains a source of protein (cassava leaves) and energy (POS), both the material has potential as a carbon framework and the source of N for growth of the microbes in the rumen, so that the microbial population will increase, thereby increasing the ration degradation in the rumen. Branched chain amino acids of cassava leaves (Table 1) might contribute to the higher NDF and ADF digestibility since these amino acids are sources of carbon framework for rumen microbial growth (Puastuti et al., 2017; Tedeschi et al., 2015; Zhang et al., 2011). The increase in protein supplementation had a positive effect on the digestibility of CP that in line with the increased digestibility of DM and OM (Figueiras et al., 2016). The supplementation of cassava leaves (for branch chain amino acid (BCAA) source) and organic minerals in palm oil based waste ration can increase the digestibility value of DM, OM, and Average daily gain (ADG) (Adhianto et al., 2018).

Souze et al. (2010) and Larazzarini et al. (2016) reported that nutrient supplementation both energy and protein together for the purpose of optimization of microbial growth in order to use fibrous feed can be optimized so that it will increase the value of intake and digestibility, it will increase nutrients for the formation of body tissues. Badarina et al. (2017) showed that the feeding of POS and some local fermented feed ingredients up to 10 kg/d increased the DM intake by 5.78 kg and digestibility of the ration by 73.14%. This might also relate to the improvement of digestibility by yeast supplementation in the R1 ration (Ali et al., 2015; Tang et al., 2008). Supplementation of yeast increased the population of cellulolytic bacteria and reduced the accumulation of lactic acid and oxygen concentration in the rumen and thus increased the use of starch in the ration (Kumar et al., 2013; Pinloche et al., 2013).

Average daily gain (ADG) and feed conversion ratio (FCR)

A body weight gain of cattle is strongly associated with nutrition in the feed and the feed digestibility level. Rations have a high nutrient content and palatability good level can quickly increase body weight gain of cattle for fattening (Purwanti et al., 2014). According to NRC (2001), body weight gain is influenced by several factors such as total protein obtained each day, type of animal, age, state of genetic, environmental conditions, the condition of each individual and the treatment of management.

The increase of ADG is caused by an increase in the consumption and nutrient digestibility of the treatment ration. The result of the present study is in line with Riswandi et al. (2015) that the supplementation of Lamtoro leaves (*Leucaena leucocephala* (Lam.) de Wit) in the fermented Kumpai grass-based diet resulted a higher ADG of Bali bulls than those on fermented Kumpai grass alone. The addition of yeast as a feed supplement in the diet has the potential to improve rumen ecosystem thus contributing to improved rumen microbial

population. The increase of the digestibility and feed intake will increase nutrients to the body's tissue (Tripathi and Karim, 2010).

Conversion rate is the ratio between the amount of DM intake and animal body weight gain (Katongole et al., 2009). The value of feed conversion is highly dependent on the digestibility and nutrient metabolism in the body. Feed consumed will be used for basic living and production. Feed conversion value depend on the quality of feed, the higher nutrient contained, the better the resulting feed conversion (Nusi et al., 2011).

Income over feed costs (IOFC)

The IOFC of this study is IDR 12,264. - /animal/d with palm oil by-products beef ration (Zakiatulyaqin et al., 2017) while Jefri et al. (2013) stated that livestock business using palm oil by-products was profitable with an R-C ratio more than 1.00.

CONCLUSIONS

Supplementation of palm oil sludge, cassava leaves and yeast in the Kumpai grass based ration significantly increased production of Bali heifers as shown by higher nutrients intake and digestibility and average daily gain. Heifers fed the supplements gave a higher income than those without supplements.

CONFLICT OF INTEREST

We declare that in this research there is no conflict of interests.

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363
364 Table 1. The chemical composition of diets (% dry matter)

Nutrient	Kumpai grass	Cassava leaves	Palm oil sludge	Concentrate
Dry matter	91.86	88.75	90.76	80.59
Organic matter	88.52	78.96	83.23	63.21
Crude protein	8.43	20.34	18.85	15.62
Crude fiber	32.85	23.64	13.54	11.24
Ether extract	4.64	7.92	18.93	6.99

Neutral detergent fiber	58.43	30.58	46.37	37.71
Acid detergent fiber	46.35	22,34	35.32	21.66
Hemicellulose	12.08	8.24	11.14	16.05
Cellulose	26,64	16.72	27.21	15.86
Lignin	13,51	4.62	7.25	3.52
Oleate	0.05	0.13	42.18	1.42
Linoleic	0.22	0.38	11.24	1.58
Valine	0.03	0.63	0.39	0.43
Leucine	0.07	0.75	0.48	0.37
Isoleucine	0.12	0.67	0.43	0.28

Note : Data were analyzed by Laboratory of Nutrition and Feed Science, Faculty of Agriculture, University of Sriwijaya

Table 2. Ingredients and chemical compositions of the experimental diets (% dry matter).

Ingredients	Treatment	
	R0	R1
Kumpai grass (%)	70	55
Cassava leaves (%)	0	15
Palm oil sludge (%)	0	15
Concentrate (%)	30	15
Yeast (g/head/d)	0	5
TOTAL	100	100
Dry matter	88.48	89.54
Organic matter	80.87	82.47

Crude protein (%)	11.29	13.41
Crude fiber (%)	28.37	25.33
Ether extract (%)	5.79	7.93
Neutral detergent fiber (%)	52.21	49.35
Acid detergent fiber (%)	39.94	36.65
Hemicellulose (%)	13.27	12.05
Cellulose (%)	23.41	23.62
Lignin (%)	10.51	9.23
Oleate (%)	0.46	6.59
Linoleic (%)	0.63	2.10
Valine (%)	0.15	0.23
Leucine (%)	0.16	0.28
Isoleucine (%)	0.08	0.27

Note : Data were analyzed by Laboratory of Nutrition and Feed Science, Faculty of Agriculture, University of Sriwijaya

365

Table 3. Intake (kg/d) of dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF) by Bali heifers at control (R0) and supplemented diet (R1).

Parameter	R0	R1	SEM	P
DM	6.12 [a]	6.92 [b]	0.23	0.043
OM	5.06 [a]	6.14 [b]	0.26	0.007
CP	0.47 [a]	0.95 [b]	0.12	0.010
NDF	3.14	2.84	0.15	0.380
ADF	2.26	2.13	0.11	0.600

Different superscripts in the same row show significant different ($P < 0.05$).

R0 = 85% Kumpai grass + 15% concentrate (control); R1 = 55% Kumpai grass + 15% concentrate + 15% cassava leaves + 15% palm oil sludge + 5 g yeast/head/d; SEM: standard error of the mean

366
367

Table 4. Apparent digestibility (%) of dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF) by Bali heifers at control (R0) and supplemented diet (R1).

Parameter	R0	R1	SEM	P
DM	55.5 [a]	64.5 [b]	0.33	0.004
OM	58.4 [a]	69.3 [b]	0.12	0.001
CP	59.7 [a]	74.1 [b]	0.11	0.004
NDF	61.3 [a]	66.7 [b]	0.15	0.008
ADF	57.9 [a]	65.6 [b]	0.11	0.012

Different superscripts in the same row show significant different (P <0.05).

R0 = 85% Kumpai grass + 15% concentrate (control); R1 = 55% Kumpai grass + 15% concentrate + 15% cassava leaves + 15% palm oil sludge + 5 g yeast/head/d; SEM: standard error of the mean

368

Table 5. Average daily gain (ADG, kg/d) and feed conversion ratio (FCR) by Bali heifers at control (R0) and supplemented diet (R1)

Variable	R0	R1	SEM	P
ADG	0.32 [a]	0.56 [b]	0.07	0.04
FCR	23.2 [a]	13.3 [b]	1.20	0.035

Different superscripts in the same row show significant different (P <0.05).

R0 = 85% Kumpai grass + 15% concentrate (control); R1 = 55% Kumpai grass + 15% concentrate + 15% cassava leaves + 15% palm oil sludge + 5 g yeast/head/d; SEM: standard error of the mean

Table 6. Income Over Feed Cost (IOFC) (IDR/animal/d) and Revenue Cost (R-C) ratio in the Bali heifers at control (R0) and supplemented diet (R1).

Variabel	R0	R1	SEM	P
Price of ADG *	14,250.- [a]	25,250.- [b]	2,935.-	0.04
Feed costs **	12,142.- [a]	12,827.- [a]	559.6.-	0.6
IOFC	2,108.- [a]	12,423.- [b]	2,741.-	0.032
R-C ratio	1.16 [a]	1.98 [b]	0.15	0.046

Note: Different superscripts in the same row show a significant difference (P <0.05).

R0 = 70% Kumpai grass + 30% concentrate (control); R1 = 55% Kumpai grass + 15% concentrate + 15% cassava leaves + 15% palm oil sludge + 5 g yeast/head/d; SEM: standard error of the mean.

*) The price of animal = IDR 45, 000.-/kg of live weight)

**) The price of Kumpai grass= IDR 1,000. - /kg; cassava leaves IDR 1,500. - /kg; Palm oil sludge IDR 1,500. - /kg; concentrate of IDR 3,500. - /kg, Yeast IDR 300,000. - /kg.

369

370

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