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Feeding of Total Mixed Ration on the Productivity of Friesian Holstein Cross-Grade Cattle

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Abstract

An experiment was conducted to evaluate feeding of total mixed ration (TMR) on the productivity of Friesian Holstein (FH) male cross-grade cattle at Semarang Municipality. TMR was a ration formulated with agricultural and agro-industrial by-product (no grass and/or green forage were used) to fulfilled the nutrient requirement of beef cattle. Total mixed ration were formulated on iso-energy of 66% of total digestible nutrients (TDN) and different level of crude protein (CP) content of 11%, 12%, 13%, and 14%. Twenty (20) heads of FH male cross-grade cattle with initial body weight of 292.40±33.06 kg were used in this experiment, and were arranged into 5 treatments T0, T1, T2, T3, and T4), and 4 replications. Data collected were analysed statistically using analyses of variance (Anova) based on the completely randomized design (CRD), then followed by Duncan's Multiple Range Test (DMRT) for different among treatments. Results of the experiment showed significantly different effect ($P<0.05$) on dry matter intake (DMI), CP intake, TDN intake, and average daily gain (ADG). There were no different effect ($P>0.05$) on feed conversion ratio (FCR), and feed efficiency. Others parameter showed that there were no significantly different ($P>0.05$) effect on the dry matter and organic matter digestibility in vitro, rumen ammonia concentration, and volatile fatty acid's rumen concentration. It was concluded that feeding TMR was potentially prospected for fattening of beef cattle, particularly as feeding strategy when there was no grass and/or green forage anymore.

I. Introduction

Poor growth rate has been established as a major disadvantage in beef cattle raising at the farmer, this was due to such factors as low genetic potential of the local cattle, improper management system, and lack of nutrients both in quality and quantity [1]. In the aspect of the availability of grass, the wet season is associated an abundance in grass. But, at the dry season there was no grass anymore or very limited production. Now, Java Island was very density island in Indonesia where many arable land area were already converted for housing and industrial development, this may cause the availability of grass or green forage for ruminant animal very limited. This situation indicates that the utilization of total mixed ration (TMR) by using agricultural waste and agroindustrial by-products ([2]; [3]; [4]; [5]; [6]) is prospective develop in order to increase beef cattle production and productivity in Indonesia particularly in Central Java. TMR [7] was a ration formulated with agricultural and agro-industrial by-product (no grass and/or green forage were used) to fulfil the nutrient requirement of beef cattle. Corbett et al. [8] stated that continuity of feed supplies for animals became reasonably assured and so there could now be continuity in the selection and breeding of improved livestock which, in turn, focused attention on methods of feeding that would enable expression of their production potential. This experiment was conducted to evaluate feeding of TMR on the productivity of Friesian Holstein (FH) male cross-grade cattle at Semarang Municipality.

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2. Materials and Methods

2.1 Experiment 1 - Feeding of total mixed ration to Friesian Holstein (FH) cross grade cattle

Experiment 1 was conducted to evaluate the effect of TMR of iso-energy 66% TDN with different level of crude protein on the performance of FH cross grade cattle. Twenty male of the animals with initial body weight of 292.40±33.06 kg were used in this experiment, and were arranged into 5 treatments T0, T1, T2, T3, and T4, and 4 replications. All of the experimental cattle were fed 100 days, two times a day at 07.00 AM and 03.00 PM. Data collected such as follows: dry matter intake (DMI), crude protein intake (CPI), body weight gain (BWG), and feed conversion ratio (FCR). Completely randomized design (CRD) were used in this experiment, data collected were analysed using analysis of variance (Anova), and Duncan's multiple range test (DMRT) were used to test differences among treatments [9].Table 1 shows the experiment of total mixed ration treatment of iso-energy and different level of crude protein. As a control ration (T0), the experimental cattle was fed with the farmer ration consist of soya curd 51.0%, cassava 2.12%, rice straw 21.25%, rice bran 25.50%, and molasses 0.13% (dry matter basis), with nutrient content of 9.59% crude protein, 25.47% crude fibre, and 57.60% TDN. Feedstuffs and TMR were chemically analysed according of the procedures of [10].

Table 1. Total mixed ration composition (dry matter basis)

Feedstuff	T0	T1	T2	T3	T4
			% DM		
Palm oil meal	-	9.00	9.00	9.00	9.00
Yellow corn	-	10.00	10.00	10.00	10.00
Cassava	2.12	25.00	25.00	25.00	25.00
Rice bran	25.50	11.00	8.00	8.00	8.00
Kapok seed meal	-	13.00	15.00	15.00	14.00
Coffee hull	-	11.00	13.00	13.00	12.50
Palm oil	-	1.10	0.50	0.50	1.00
Copra meal	-	9.00	8.00	8.00	9.00
Urea	-	0.10	0.30	0.60	1.00
Molasses	0.13	10.00	10.00	10.00	10.00
Mineral mix	-	0.50	0.50	0.50	0.40
Salt	-	0.30	0.70	0.40	0.1
Soya Curd	51.00	-	-	-	-
Rice straw	21.25	-	-	-	-
Total	100.0	100.0	100.0	100.0	100.0
Nutrient Composition					
Crude Protein	9.59	11.24	12.12	12.98	13.99
Crude fibre	25.47	30.17	29.97	29.97	29.79
TDN	57.60	65.94	65.76	65.76	65.97

2.2 Experiment 2 - Digestibility and fermentability of TMR

Experiment 2 was aimed to evaluate the digestibility of TMR, and the in vitro fermentability of TMR. Data collected such as follows: dry matter digestibility, organic matter digestibility, rumen NH3 concentration, and total VFA's concentration in the rumen in vitro. Digestibility of DM and OM determination were based on the procedure of [11], and for NH3 and VFA's based on [12]. Data collected were analysed using analysis of variance (Anova), and Duncan's multiple range test (DMRT) were used to test differences among treatments [9].

3. Results and Discussion

Performance of experimental cattle after 100 days of feeding was shown in Table 2.

Table 2. Performance of beef cattle fed by experimental total mixed ration

	Treatments				
Item	T0	T1	T2	T3	T4
DMI, kg/h/d	11.07^{a}	6.24^{b}	5.92^{b}	6.37^{b}	6.09^{b}
CP intake, kg	0.98^{a}	0.70^{b}	0.72^{b}	0.83^{b}	0.80^{b}
ADG, kg/h/d	1.21^{a}	0.71^{c}	0.98^{b}	1.11^{a}	0.82^{bc}
FCR	9.24^{a}	8.75^{a}	6.34^{b}	5.76^{b}	7.75^{ab}

T_0: Farmer ration; T_1; T_2; T_3; T_4 (iso TDN ration66%; and 11; 12; 13; 14% CP). Number withdifferent letter at the same row was significantly difference ($P<0.05$)

Table 2 showing that after 100 days of feeding TMR there was different effect ($P<0.05$) on the DMI, CPI, ADG, and FCR of the experimental animal. On the DMI, compare to that farmer ration (T0) all the TMR (T1, T2, T3, and T4) significantly decreased the DMI from 11.07 kg/h/d (T0) vs 6.16kg/h/d, meanwhile, among TMR of 66% TDN there was no different effect on DMI, this may be due that farmer ration had lower energy (57.6% TDN) compare 66% TDN of TMR. The higher the energy content in the ration would be decreased the dry matter intake. The higher DMI of the farmer ration would consequently increase cost of production, and finally decreased their revenue. Although the CP content of T0 was lower than TMR of iso-energy, but, because of their DMI was significantly higher, then the total CPI was also higher compare to TMR. The higher the CPI would also increase the ADG of the experimental animal. Table 2 showing that the farmer cattle had an ADG significantly ($P<0.05$) higher compare to that T1, T2, and T4, and similar with T3, this might be correlated with their CPI was significantly higher. Protein intake was one of the nutrient which responsible to the ADG particularly at the growing animal when it was reflected by additional of meat as a protein biomass in the body. Although, all the TMR (T1, T2, T3, and T4) had ADG lower than farmer ration (T0), in fact, their DMI had lower than T0. So, the average of FCR (as calculated by DMI/ADG) had significantly lower than T0. It means that feeding with TMR more efficient compare to farmer ration, and could be concluded that feeding with TMR had positive and prospective aspect to substitute or to replace farmer ration because feeding T0 had higher cost and lower efficient, and practically would be used during dry season where there was not available grass or green forage, this will ensure the continuous cattle/meat production along year.

Results of Experiment 2 was shown in Table 3. Table 3 showing that there were no different effect of farmer ration (T0) with TMR of iso-energy 66% TDN and different level of CP. The DMD and OMD of all the treatment relatively similar among treatment and practically at the normal condition with generally OMD had higher DMD. In term of total VFA's there were no different effect

among treatment, in fact all of the TMR produced the total VFA's of 128.33-165.00 mM higher than 80-160 mM the concentration needed for maximum microbial protein synthesis in the rumen.

Table 3. Digestibility and fermentability of experimental total mixed ration

Item	Treatments				
	T0	T1	T2	T3	T4
DM Digestibility, %	61.92	62.42	64.94	68.89	63.74
OM Digestibility, %	65.56	67.12	68.98	72.12	67.18
Total VFA's, mM	130.00	153.33	165.00	128.33	143.33
NH_3, mM	3.99	4.34	4.17	3.71	4.52

T_0: Farmer ration; T_1; T_2; T_3; T_4 (Iso TDN ration66%; and 11; 12; 13; 14% CP). Number with different letter at the same row was significantly difference ($P<0.05$)

The concentration of rumen NH3 were no different among treatment. Satteret al. [13] recommended that for maximum microbial protein biosynthesis required ration with ≥10% CP. Since all of the experimental ration content more than 10% CP, so, the concentration of rumen NH3 3.77-4.52 mM were relatively similar with 3.57-7.14 mM [8]or 5 mg% [12] for microbial protein synthesis [14]. Based on the results data from both total VFA's and rumen NH3 it could be concluded that all of the experimental ration had capacity to produce maximum microbial protein synthesis. Means that protein supply (from dietary protein and from microbial protein) for the experimental cattle could fulfilled the protein requirement for their maintenance and growth as reflected by their ADG. Increasing of CP may also cause on their nitrogen retention [3] which than reflected by their gain.

Generally, this experiment imply that feeding with TMR on iso-energy 66% TDN with different level of CP 11%, 12%, 13%, and 14% might be utilized by the farmers to replace their costly ration particularly at the dry season, in order to extend a continuous meat supply and/or for the upkeep of cattle production all year round.

4. Conclusion

Feeding of total mixed ration with iso-energy of 66% TDN, and different level of crude protein 11-14 % significantly affected on the dry matter intake, crude protein intake, energy intake, and average daily gain of the Friesian Holstein cross grade cattle. There were no different effect on feed conversion ratio (FCR), and feed efficiency. No different effect of total mixed ration fermentability *in vitro* on their dry matter digestibility, organic matter digestibility, rumen ammonia concentration, and volatile fatty acids concentration. It was concluded that feeding total mixed ration had no negative effect on the experimental animal, and was potentially prospected for fattening of beef cattle, particularly as feeding strategy when there was no grass and/or green forage anymore.

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