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Effect of Different Combinations of Rice Straw, Cassava Powder, and Palm Kernel Cake on Intake and Digestibility by Ongole Crossbred Bulls

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ABSTRACT
The present study investigated the effects of different combinations of cassava powder and palm kernel cake on intake and digestibility of Ongole Crossbred bulls fed a fixed amount of rice straw. Ongole bulls (n=24) were assigned to five dietary treatments (n=5 bulls/treatment for all treatments, except for T3 that had n=4 bulls) and allocated to individual pens in a completely randomized block design. The ration consisted of 5 g rice straw dry matter (DM)/kg liveweight.day with the different concentrate combinations offered *ad libitum*. Concentrates were prepared with different ratios of cassava powder and palm kernel cake respectively: 88:12 (T1), 75:25 (T2), 62:38 (T3), 50:50 (T4), and 38:62 (T5). Bulls were fed twice a day with drinking water available at all times. The experiment consisted of a 14-day adaptation period and a 7-day measurement period. Dry matter and organic matter (OM) intake were not different between treatments, although DM digestibility and OM digestibility were higher in T2 compared to T4 and T5 treatment diets ($P<0.05$). Bulls fed the T2 and T3 nutritional treatments had a higher digestible OM intake than bulls fed the other nutritional treatments ($P<0.05$). It is concluded that including cassava powder at 63 to 75% and PKC at 25 to 38% in a concentrate is the best ratio in a total mixed ration for fattening bulls when fed a small fixed amount of rice straw.

Keywords: *Cassava, Palm kernel cake, Rice straw, Intake, Digestibility, Ongole Crossbred.*

1. INTRODUCTION

Rice straw is abundant across almost all areas of Indonesia and is commonly used by many farmers as the main roughage source in the diets of ruminants due to its low price and availability throughout the year. Cassava powder and palm kernel cake are also readily available in some areas of Indonesia and are high in metabolizable energy and protein respectively. Previous study reported that cassava powder provides 3000 kcal energy per kg dry matter (DM) [1] and contains 29 to 39 g crude fiber (CF) and 19 to 38 g crude protein (CP)/kg DM [2]. Palm kernel cake contains 200 g CP and 130 g CF/kg DM [3].

Rations can be formulated for a high metabolizable energy (ME) and CP content to promote high live weight gain by varying the proportion of cassava powder and PKC although there may be interactive effects on digestibility of a high proportion of cassava powder inclusion due to its high starch content. Therefore, the purpose of the present study was to investigate the effects of varying the proportion of cassava powder and palm kernel cake on intake and digestibility of the diets by Ongole Crossbred bulls.

2. MATERIALS AND METHODS

2.1. Animal and treatment

The experiment was conducted in the facilities of Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta. Ongole Crossbred bulls (n=24, approximately 16 months of age and 200 ± 13.9 kg live weight (mean ± standard deviation) were ranked and blocked on live weight and randomly allocated to individual adjacent pens and one of five nutritional treatments with n=5 bulls/treatment with the exception of the T3 treatment with n=4 bulls. All bulls were offered 5 g rice straw DM/kg live weight.day and 30 g mineral mix/day and the allocated concentrate treatment *ad libitum*. The concentrate treatments were prepared with different proportions (%) of cassava powder and palm kernel cake respectively 88:12 (T1), 75:25 (T2), 62:38 (T3), 50:50 (T4), and 38:62 (T5). Bulls were fed at 08.00 AM and 04.00 PM each day with drinking water available at all times. The experiment consisted of a 14-day adaptation period followed by a 7-day measurement and sample collection period. Feed intake was determined by collecting total rice straw and concentrate residues each day. Digestibility of DM in the diet was determined by the collection of total fecal output from each bull each day.

2.2. Laboratory analysis

Sub-samples (100 g) of ration ingredients (cassava powder, palm kernel cake, rice straw), mixed nutritional treatment offered and feeds refused, and feces were collected for laboratory analysis following AOAC [4]. Samples were ground through a 1 mm screen using a Wiley mill (Model 3, Thomas Scientific, USA). Dry matter content was determined by drying 10 g of sample in a forced-draft oven at 105°C for 24 h (method 934.01). Organic matter was determined by combusting samples in a muffle furnace at 550°C for 5 h (method 942.05). The CP and ether extract (EE) content were determined using a Kjeldahl (method 984.13) and Soxhlet (method 920.39) methods respectively. The CF content was determined in a boiled sample in acid and basal solution (method 987.10).

2.3. Calculations and statistical analysis

Calculations of DM digestibility (DMD) and OM digestibility (OMD) followed the model of Tilman et al. [1]. Digestible OM intake (DOMI) was calculated according to the model described by Utomo [5].

All collected data were analyzed as one-way anova using the procedure of Software Statistical Product and Service Solution (SPSS, version 16). Mean separation was performed by Duncan's multiple range test and the significant differences were declared at $P<0.05$.

3. RESULTS AND DISCUSSION

The chemical compositions of rice straw, cassava powder, and palm kernel cake used in the present study are presented in Table 1. The rice straw presented a low CP (4.85%), high CF (35.9%), and low nitrogen-free extract (NFE; 34.4%) as well as total digestible nutrients (TDN; 36.1%). The cassava powder also had low CP (2.21%) and CF (3.45%), but high in NFE (91.7%) and TDN (81.0%). On the other hand, palm kernel cake showed medium ranges of CP, CF, NFE, and TDN (14.4, 27.2, 46.6, and 55.2%, respectively). The cassava powder and palm kernel cake contents in this study were in an accordance with previous studies [2,3,6].

Table 1. Chemical composition of feedstuffs and diets in the present study (%, DM)

Item[1]	Feedstuff		
	Rice straw	Cassava powder	Palm kernel cake
DM	83.6	78.2	81.8
OM	78.1	96.1	95.7
CP	4.85	2.21	14.4
CF	35.9	3.45	27.2
EE	2.87	2.64	7.94
NFE[2]	34.4	91.7	46.6
TDN[2]	36.1	81.0	55.2

[1]DM = dry matter, OM = organic matter, CP = crude protein, CF = crude fiber, EE = ether extract, NFE = nitrogen-free extract, TDN = total digestible nutrients.
[2]Estimated using formulation of Hartadi et al. [7].

Altering the % of cassava powder and PKC varied the composition of the concentrate mix in accordance with the relative % of cassava powder and PKC and their respective composition (Table 2).

Table 2. Chemical composition of dietary treatments in the present study (%, DM)

Item[1]	Dietary treatment[2]				
	T1	T2	T3	T4	T5
DM	82.1	83.1	82.2	83.7	83.7
OM	97.2	97.0	96.6	95.8	95.9
CP	9.43	9.80	10.1	11.7	12.1
CF	5.45	7.40	10.9	14.7	18.8
EE	2.38	4.26	4.16	3.93	3.50
NFE[3]	80.0	75.5	71.5	65.3	61.5
TDN[3]	75.9	74.3	71.3	67.4	64.9

[1]DM = dry matter, OM = organic matter, CP = crude protein, CF = crude fiber, EE = ether extract, NFE = nitrogen-free extract, TDN = total digestible nutrients.
[2]Ratios of cassava powder:palm kernel cake at T1 = 88:13, T2 = 75:25, T3 = 63:38, T4 = 50:50, T5 = 38:63.
[3]Estimated using formulation of Hartadi et al. [7].

The DMI and OMI were not different between dietary treatments (Table 3). Other reports have indicated that PKC has low palatability [6] and that cassava powder at levels greater than 40% inclusion in a concentrate can depress intake [8]. This was not evident here where a high percentage of either cassava powder or PKC in the ration did not depress intake.

Table 3. Effect of different inclusion rates of cassava powder and palm kernel cake in a concentrate with a fixed amount of rice straw on total ration intake and digestibility of Ongole Crossbred bulls

Item[1]	Dietary treatment[2]				
	T1	T2	T3	T4	T5
DMI (kg/d)	3.15 ±0.48	3.52 ±0.34	3.35 ±0.18	3.32 ±0.14	2.92 ±0.08
OMI (kg/d)	2.86 ±0.46	3.24 ±0.34	3.06 ±.16	3.01 ±.15	2.65 ±0.12
DMD (%)	69.5^{ab} ±1.24	71.3^{a} ±1.75	70.0^{ab} ±2.10	66.1^{b} ±0.63	65.4^{b} ±4.72
OMD (%)	74.8^{ab} ±1.02	76.0^{a} 1.87	73.9^{abc} ± 2.46	70.7^{bc} ±1.23	69.6^{c} ±4.04
DOMI (%)	68.0^{ab} ±1.54	69.8^{a} ±1.70	67.4^{ab} ±2.28	64.1^{b} ±1.59	63.3^{b} ±4.70

[1]DMI = dry matter intake, OMI = organic matter intake, DMD = dry matter digestibility, OMD = organic matter digestibility, DOMI = digested organic matter intake.
[2]Inclusion proportions of cassava powder:palm kernel cake at T1 = 88:12, T2 = 75:25, T3 = 62:38, T4 = 50:50, T5 = 38:62.
[a~c]Means in the same row with different superscripts differ significantly (P<0.05).

The proportion of cassava powder and PKC in the diet had no significant effect on digestibility by bulls fed treatments T1, T2 and T3 but high levels of inclusion of PKC (T4 and T5) depressed DMD and OMD. An increasing percentage of palm kernel in the concentrate diet increased the CF content and reduced the NFE content of the diet, which may have contributed to the decrease in digestibility [1]. The high level of cassava powder with its high NFE, due presumably to its high starch content, accounted for the higher digestibility of the T1, T2 and T3 diets consumed by bulls. There were some biologically small but statistically significant differences between treatments T1, T2 and T3. These results indicated that T2 and T3 treatments resulted in higher DOMI and may be a safer option to feed. The rice straw was included in these rations at a low level to add effective fiber and maintain rumen health.

4. CONCLUSION

It may be concluded that a total mixed ration for fattening bulls based on a small-fixed amount of rice straw and *ad libitum* concentrate is best formulated for the concentrate to have cassava powder (63 to 75%) and PKC (25 to 38%) to result in high DMD and OMD and DOMI.

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