Effects of substitution of Elephant grass by corn waste and coffee pulp as basal diet on nutrient intake and digestibility in young male Ongole crossbred cattle[1]

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ABSTRACT: The aim of this research is to examine the nutrient intake and digestibility in Ongole crossbred (OC) cattle fed by basal diet of Elephant grass substituted by corn waste (CW) and coffee pulp (CfP). Twelve younh male OC (I_0, 195.0 $\pm$ 1.75 kg of initial weight) were divided into three groups of feeding, i.e. R_0 = Elephant grass (EG) + supplement (60:40) as control, R_1= EG+(CW+CfP)+ Supplement (30:30:40) and R_2 = (CW+CfP) + supplement : (60:40). The experiment was carried out for 10 wk. Parameter measured were: dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF) and total digestible nutrients (TDN) intake and digestibility. Completely randomized design was used to analyze the variance among the parameters. Results showed that total DM intake among treatments was not different which ranged from 97.53 to 101.55 g/kg $W^{0.75}$. Total OM intake of R_0 (72.61 g/kg $W^{0.75}$), R_1 (74.91 g/kg $W^{0.75}$) and R_2 (74.03 g/kg $W^{0.75}$) was also not different. However total CP intake of R_1(7.76 g/kg $W^{0.75}$) showed the lowest ($P<0.05$) compared to R_0 (9.63 g/kg $W^{0.75}$) and R_2 (9.40 g/kg $W^{0.75}$). Total NDF intake of R0 (60,64 g/kg $W^{0.75}$) was the highest ($P<0,05$), followed by R_1 (56.77 g/kg $W^{0.75}$) and R_2 (41.30 g/kg $W^{0.75}$). TDN intake among treatments was not different which vary from 53.45 to 56.10 g/kg $W^{0.75}$. The DM digested of R_0 (70.31 g/kg $W^{0.75}$) was the highest ($P<0,05$), while the OM digested among treatments were not different. However, the CP and NDF digested of R_0 which 7.71 g/kg $W^{0.75}$ and 30.57 g/kg $W^{0.75}$, respectively, were the highest ($P<0.05$). TDN digested among treatments were not different which ranged from 58.44 to 62.97%. It is concluded that CW and CfP were considered to be able to substitute EG as basal diet for young male OC cattle.

Key words: corn waste, coffee pulp, basal diets, Ongole crossbred cattle

INTRODUCTION

The availability of all year round of feed supply in the tropical country as well as in Indonesia varies and depends upon the season. In wet season, the feed is abundant meanwhile in the dry season it is very limited, even no production and it depends on the length of season. Feedstuffs such as crop residues, estate waste, and agroindustry by-product have not yet optimally used as animal feed. Such feedstuffs are used for biofuel, industry raw materials and compost. Although feeds from agricultural by-products varies in nutrient content, some of them have high potency to be used in animal feed, such as: coffee pulp, stem and skin of cassava, corn cobs and corn seed wastes. Some of researcher found that corn waste and can be used as filler in concentrate diets up to 20% without any negative effect on the performance of Ongole cattle (Mariyono *et al*., 2005; Umiyasih *et al*., 2006). Pamungkas et al. (2004) reported that the pregnant cows fed corn waste as basal diet supplemented with prebiotic had calf born within birth weight of 23 kg and produced milk 1 kg/d.

The efficiency of a ruminant feeding system in Indonesia, therefore, relies on how efficiently agricultural by-products are used. In the traditional extensive practice, cattle are fed crop stalks

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supplemented with a little amount of concentrate. Though this feeding system may minimize daily feed cost, it is not a reasonable system to optimize the feed efficiency of agricultural by-products and the profit of beef production.

Based on the total digestible nutrients (TDN) production in Indonesia, agricultural by-products had an opportunity to develop ruminant herds as much as 2.7 million AU (Syamsu et al., 2003). However, the weaknesses of feed from by-products were less preferably by animal and low nutrient content (Soeharto, 2004). There were some efforts to optimise the local biomass mainly from crop residues and agroindustrial by-products through pre-digestion physical, chemical and biological treatments. Therefore the enrichment of nutrient value by substitution and or supplementation could be considered as an alternative choice to run the feeding strategy in proper ways.

The research aimed to examine the substitution of Elephant grass (EG) as one of cultivar forages by corn waste (CW) and coffee pulp (CfP) as basal diets on the nutrient intake and digestibility in young male Ongole crssbred cattle (OC) as the effort to increase the efficiency in fattening.

MATERIALS AND METHODS

The research was done in Beef Cattle Research Institue (BCRI) at Grati, Pasuruan, East Java, Indonesia, for 10 wk including 2 wk of adaptation period.

Materials

Animals. Twenty young male OC cattle (I_o, 190.05 $\pm$ 2.57 kg W). The grouping of animal was based on initial live weight as follows: flock I within the range from 128 to 160 kg of W (142.40 ± 1.36 kg), flock II from 165 to 173 kg of W (179.69 ± 0.99 kg), flock III from 197 to 213 kg of W (204.40 ± 0.47 kg), and flock IV from 214 to 245 kg of W (233.80 ± 0.83 kg). Each animal within the flock had the same chance to receive the treatments

Feed was given 3%, of live weight., in dry matter (DM) basis. The supplement mixture consisted of pomace (50%) and concentrate (50%). The concentrate consisted of: rice bran (32.5%), cassava meals (10.0%), copra meal (16.0%), soy bean meal (17.0%), fish meal (2.5%), vitamin (1.0%), dicalcium phosphate (0.5 %) and trace mineral (0.5%). Chemical composition of feestuff was shown in Table 1.

Table 1. Chemical composition of feedstuff in experiment[1]

	Chemical composition (% dry matter basis)							
Feedstuff	DM	OM	CP	EE	NDF	ADF	Ca	P
Elephant grass	18.58	81.28	5.36	2.05	81.31	40.60	0.41	0.14
Corn wastes	87.30	78.10	8.70	0.89	60.20	24.80	0.09	0.51
Coffee pulp	89.70	72.90	6.60	0.72	68.10	57.7	0.13	0.31
Cassava pomace	86.83	79.21	3.40	1.30	13.38	9.29	1.15	0.11
Concentrate	93.18	91.07	23.00	1.75	24.89	26.93	1.77	0.71

[1] Proximate analysis, Animal Nutrition and Feed laboratory of BCRI

Methods

Animals were allocated into individual pens along with feeder and water troughs seperately. They received five treatments of feed, as follows: R_0 = EG (60%) + Supplement (40%) (as control), R_1 = EG (30%)+ basal diets (30%)+ supplement (40%), R_2 = basal diet (60%) : supplement (40%), R_3 = basal diet (40%) + supplement, and R_4 = basal diet (30%) + supplement (70%). Basal diet consisted of CW (80%) + CfP (20%). The composition and nutrient content of each treatment are shown in Table 2.

Parameter measured were: feed intake (DM, OM and CP), in-vivo digestibility (Harris,1970). The data were analysed using Randomized Block Design (Steel and Torrie, 1991).

Table 2. Composition and nutrient content of feedstuff

Item	R_0	R_1	R_2	R_3	R_4
	-------------	-------------	%-------------	-------------	-------------
Basal diet :					
Elephant grass	60	30	0	0	0
Corn waste	0	24	48	32	24
Coffee pulp	0	6	12	8	6
Supplement	40	40	40	60	70
Nutrient content:					
DM	46.27	67.90	89.05	87.89	87.78
CP	9.48	9.90	9.58	12.84	12.02
TDN	52.63	57.52	55.29	56.40	55.40

RESULTS AND DISCUSSION

Dry Matter, Organic Matter, and Crude Protein Intake

Substitution of EG had no effect on DM intake. The range of DM total intake was from 6.18 to 6.69 kg/d. The highest DM intake was in R_3 (6.69 kg/head/d) followed by R_4 (6.61 kg/head/d). R_0 (6.18 kg/head/d). R_2 (6.10 kg/head/d) dan R_1 (5.66 kg/head/d). High intake of DM was related with CP content of ration. DM intake in this research was lower than those of Hartati et al. (2005) who reporting that DM intake of OC cattle fed EG and CW supplemented by concentrate was 9.36 kg/head/d. The difference was more caused by different composition of the feedstuf and nutrient content.

In order to compare the effect of treatments with the same basis, the calculation was based on feed intake per metabolic live weight ($W^{0.75}$). The average DM intake of basal diet (CfP and CfP mixture) within the ratio of 80:20 of each treatment were significant different (P<0.01). The highest intake of basal diet was in R_2 (63.18 g/kgBB$^{0.75}$), followed by R_3 (43.29 /kgW$^{0.75}$), R_4 (30.49 g/kgW$^{0.75}$), and R_1 (28.02 g/kg W$^{0.75}$). This different was caused by different proportions of basal diet as treatments.

Data on Table 3 showed the increase of supplement DM intake (P<0.01). However, within supplement DM intake of R_0, R_1 dan R_2 showed the same response with the range from 39.25 to 40.62 (g/kg W$^{0.75}$). The highest of supplement DM intake was in R_4 (70.53 g/kgBB$^{0.75}$). The increase of supplement DM intake was the consequence of the increase of supplement proportion in ration. The DM intake was also depend on kind of feed. The average of total DM intake (5.66 – 6.69 kg) in this research was lower than those on cattle fed by various type of silages supplemented by concentrates which vary from 9.43 to 9.90 kg (Walsh *et al*., 2008)

EG substitution by basal feed (CW and CfP) was not affect total DM intake until 2.8% of live weight. According to NRC (Anonymous, 1976), DM intake can be reached around 2.8% of W, even more than 3% of live weight (Kearl, 1982). This condition showed that the feeding of basal diet and supplement wasn't able to increase total DM intake of feed given.

Response of the treatments on OM intake was shown on Table 4. The highest of total OM intake was found in R3 (4.77 kg/d) followed by R_4 (4.68 kg/d), R_2 (4.,60 kg/d), R_0 (4.41 kg/d), and R_1 (3.04 kg/d). The low of total OM intake on R_1 was relate in the decrease of total OM intake of basal diet (1.31 kg/d). This condition affected the low total OM intake on R_1 along with the decrease of DM intake both on basal diet and supplement.

The results of CP intake in each treatment were shown in Table 5. The increase of OM and CP intake was caused by the increase of DM intake, mainly on the supplement intake which consisted of higher OM and CP content rather than basal diet (CW and CfP). Liu *et al*. (2005) reported that the increase of concentrate level in the diet was followed by the increase dry matter intake on sheep.

The highest (P<0.01) of total CP intake per metabolic live weight was shown in R_3 (13.18 g/kgW$^{0.75}$) followed by R_4 (12.11 g/kgW$^{0.75}$), R0 (9.63 g/kgW$^{0.75}$) R_2 (9.40 g/kgBB$^{0.75}$), and R_1 (6.76 g/kgBB$^{0.75}$). The increase of CP supplement per metabolic live weight was influenced by the higher proportion of supplement and total CP intake per metabolic W which increase along with CP content in the feed and animal weight.

Table 3. DM intakes, in detail of feed sources

Item	Treatment				
	R_0	R_1	R_2	R_3	R_4
	------------------ kg/d ------------------				
CW and CfP		$1.71^a \pm 0.27$	$3.67^c \pm 0.62$	$2.68^b \pm 0.27$	$1.98^a \pm 0.17$
EG	$3.71^b \pm 0.61$	$1.69^a \pm 0.28$			
Supplement	$2.47^a \pm 0.41$	$2.26^a \pm 0.37$	$2.44^a \pm 0.41$	$4.02^b \pm 0.41$	$4.63^c \pm 0.41$
Total DM	6.18 ± 1.02	5.66 ± 0.92	6.10 ± 1.03	6.69 ± 0.70	6.61 ± 0.59
	------------------ g/kg $W^{0.75}$ ------------------				
CW and CfP		$28.02^a \pm 0.86$	$63.18^c \pm 6.21$	$43.29^b \pm .65$	$30.49^a \pm 1.84$
EG	$60.93^b \pm 1.89$	$29.26^a \pm 1.53$			
Supplement	$40.62^a \pm 1.26$	$38.91^a \pm 2.03$	$39.25^a \pm 2.20$	$61.60^b \pm 1.65$	$70.53^c \pm 2.47$
Total DM	$101.55 \pm .16$	97.53 ± 5.10	98.13 ± 5.51	$102.67 \pm .75$	100.76 ± 3.54
	------------------ % ------------------				
Total DM	2.59 ± 0.04	2.52 ± 0.10	2.49 ± 0.05	2.55 ± 0.04	2.49 ± 0.12

[abc] Within a row, means without a common superscript differ (P<0.01).

Table 4. OM intakes, in detail of feed sources

Item	Treatment				
	R_0	R_1	R_2	R_3	R_4
	------------------ kg/d ------------------				
CW and CfP		$1.31^a \pm 0.21$	$2.76^c \pm 0.46$	$1.91^b \pm 0.20$	$1.87^b \pm 1.17$
EG	$2.65^b \pm 0.44$	$1.30^a \pm 0.21$			
Supplement	$1.77^a \pm 0.29$	$1.73^a \pm 0.28$	$1.84^a \pm 0.31$	$2.86^b \pm 0.29$	$3.27^b \pm 0.29$
Total OM	$4.41^b \pm 0.73$	$3.04^a \pm 0.49$	$4.60^b \pm 0.80$	$4.77^b \pm 0.49$	$4.68^b \pm 0.42$
	------------------ g/kg $W^{0.75}$ ------------------				
CW and CfP		22.60 ± 1.18	44.62 ± 2.49	29.29 ± 0.78	21.37 ± 1.0
EG	$43.58^b \pm 1.35$	$22.45^a \pm 17$			
Supplement	$29.04^a \pm 0.90$	$29.86^a \pm .56$	$29.6^a \pm 1.66$	$43.87^b \pm 1.18$	$49.89^b \pm .75$
Total OM	$72.61^b \pm 2.26$	$52.38^a \pm .74$	$74.03^b \pm 4.15$	$73.13^b \pm 1.95$	$71.26^b \pm .50$

[abc] Within a row, means without a common superscript differ (P<0.01).

Nutrient Digestibility

The determination of feed digestibility was based on dry matter (DM), organic matter (OM), crude protein (CP), total digestible nutrient (TDN), crude fiber (CF), neutral detergent fiber (NDF) and acid detergent (ADF) of each treatment was shown in Table 6.

Result showed that substituting EG with CW and CfP as basal diet was significant increase digested DM. Digested DM of R_3 was the highest (P<0.05) as of 75.27 g/kg $W^{0.75}$ followed by R_0 (70.31 g/kg $W^{0.75}$), R_4 (69.82 g/kg $W^{0.75}$), R_1 (63.32 g/kg $W^{0.75}$) and R_2 (60.46 g/kg $W^{0.75}$). However, within treatments there was no significant different of OM digestibility and digested OM. The OM digestibility ranged 61.77 – 73.25%, meanwhile, digested OM varied from 49.49 to 57.15 g/kg $W^{0.75}$.

The digested CP of each treatment showed significant effect (P<0.01). The highest of digested CP was in R_3 (11.41 g/kg $W^{0.75}$) followed by R_4 (9.70 g/kg $W^{0.75}$), R_0 (7.71 g/kg $W^{0.75}$), R_1 (6.22 g/kg $W^{0.75}$) dan R_2 (6.21 g/kg $W^{.75}$). The digested CP in this experiment was similar to those on the report of Utomo (2001) that Ongole cattle crossbred fed rice straw and the level supplementation of rice bran and leucaena leaves resulting on digested CP at range of 4.42-8.06 g/kg DM. The digested CP was go along with CP content in respective feedstuff of treatments.

Table 5. CP intakes, in detail of feed sources

Item	Perlakuan				
	R_0	R_1	R_2	R_3	R_4
	kg				
CW and CfP	0	$0.17^{a} \pm 0.03$	$0.35^{c} \pm 0.06$	$0.34^{c} \pm 0.03$	$0.24^{b} \pm 0.02$
EG	$0.35^{b} \pm 0.05$	$0.17^{a} \pm 0.03$			
Supplement	$0.23^{a} \pm 0.04$	$0.22^{a} \pm 0.04$	$0.23^{a} \pm 0.04$	$0.51^{b} \pm 0.05$	$0.56^{b} \pm 0.05$
Total OM	$0.58^{b} \pm 0.09$	$0.56^{a} \pm 0.07$	$0.58^{b} \pm 0.10$	$0.86^{c} \pm 0.09$	$0.80^{c} \pm 0.07$
	g/kg $W^{0.75}$				
CW and CfP	0	$2.90^{a} \pm 0.15$	$5.64^{c} \pm 0.31$	$5.28^{d} \pm 0.14$	$3.63^{b} \pm 0.13$
EG	$5.77^{b} \pm 1.18$	$2.91^{a} \pm 1.15$	0	0	0
Supplement	$3.85^{a} \pm 0.11$	$3.85^{a} \pm 0.20$	$3.76^{a} \pm 0.21$	$7.91^{b} \pm 0.21$	$8.47^{c} \pm 0.30$
Total CP	$9.63^{b} \pm 0.30$	$6.76^{a} \pm 0.35$	$9.40^{b} \pm 0.53$	$13.18^{d} \pm 0.35$	$12.11^{c} \pm 0.42$

abc Within a row, means without a common superscript differ (*P*<0.01).

Table 6. Nutrient digestibility of Ongole crosbred cattle in each treatment

Item	Perlakuan				
	R_0	R_1	R_2	R_3	R_4
DM digestibility, %	64.06 ±2.91	59.97±7.62	58.59 ±.29	68.72 ± .06	65.21± 2.32
Digested DM, g/kg $W^{0.75}$*	$70.31^{ab} \pm 5.04$	$63.39^{a} \pm 11.04$	$60.46^{a} \pm 5.55$	$75.27^{b} \pm 02$	$69.82^{ab} \pm 2.99$
OM digestibility, %	67.74 ± 2.44	61.77 ± 11.73	63.52 ± 3.13	73.25 ±3.25	68.80 ± 1.60
Digested OM, g/kg $W^{0.75}$	53.15 ± 3.39	50.07 ±12.41	49.49 ± 4.21	57.15 ±2.61	52.15 ± 1.65
CP digestibility, %	75.00 ± 3.44	65.77± 13.05	62.67± 4.04	81.00 ± .41	75.23 ± 1.74
Digested CP, g/kg $W^{0.75}$	$7.71^{q} \pm 0.53$	$6.22^{p} \pm 1.48$	$6.21^{p} \pm 0.57$	$11.41^{s} \pm 0.53$	$9.70^{r} \pm 0.40$
TDN digestibility, %	58.44 ± 2.44	62.59 ± 11.73	60.12 ± 3.13	62.08 ±3.02	62.97 ± 3.02
Digested TDN, g/kg $W^{0.75}$	33.09 ± 1.38	37.01 ± 5.20	34.10 ± 1.97	37.51 ±1.41	37.16 ± 0.92
CF Digestibility, %**	$60.02^{p} \pm 0.86$	$77.61^{q} \pm 3.54$	$79.75^{q} \pm 1.22$	$77.43^{q} \pm 2.25$	$79.05^{q} \pm 3.16$
Digested CF , g/kg $W^{0.75}$**	$17.89^{q} \pm 0.60$	$22.20^{s} \pm 1.58$	$20.29^{r} \pm 1.34$	$16.43^{q} \pm 0.35$	$14.88^{r} \pm 0.68$
NDF digest-ibility, %**	$50.28^{q} \pm 2.57$	$65.44^{s} \pm 3.50$	$37.58^{p} \pm 5.11$	$54.70^{qr} \pm 6.44$	$60.11^{rs} \pm 4.99$
Digested NDF, g/kg $W^{0.75}$**	$30.57^{q} \pm 1.21$	$37.19^{r} \pm 3.36$	$15.50^{p} \pm 2.05$	$28.01^{q} \pm 2.69$	$35.09^{r} \pm 3.43$
ADF digestibility, %	81.46 ± 0.02	72.24 ± 0.11	72.70 ± 0.02	82.73 ± 0.02	73.90 ± 0.02
Digested ADF, g/kg $W^{0.75}$	25.74 ± 1.33	20.86 ± 3.96	18.10 ± 1.40	20.55 ± 0.78	16.59 ± 0.90

ab Within a row, means without a common superscript differ (*P<0.05).

pqrs Within a row, means without a common superscript differ (**P<0.01).

Among the treatments, the highest CF digestibility was in R_2 (79.75%), followed by R_4 (79.05%), R_1 (77.61%), R_3 (77.43%) and R_0 (60,02%). However the highest digested CF was in R_1 (22.20 g/kg $W^{0.75}$), followed by R_2 (20.29 g/kg $W^{0.75}$), R_0 (17.89 g/kg $W^{0.75}$), R_3 (16.43 (g/kg $W^{0.75}$), and R_4 (14.88 (g/kg $W^{0.75}$). The average results in CF digestibility of the experiment were higher than those on OC cattle fed fermented rice straw and supplemented by *Lerak* meals (*Sapindus rarak*) (as anti protozoa agent) resulting in CF digestibility of 18.39- 31.03% (Suharti *et al*., 2009).

Result on CF digestibility was similarly to NDF digestibility which had significant different among the treatments. The highest ($P<0,01$) of NDF digestibility was in R_1 (65.44%), R_4 (60.11%), R_3 (54.70%), R_0 (50.28) and R_2 (37.58%). However, the ADF digestibility and digested ADF were not different. This condition reflected the same ability of rumen microbes to digest ADF. The range of ADF digestibility was 72.24 – 82.73%, meanwhile the digested ADF varied from 18.10 to 25.74 (g/kg $W^{0.75}$).

CONCLUSIONS

Substitution EG by CW and CfP did not influence the total dry matter intake, however, it increased organic matter, crude protein intake of metabolic weight of young male OC cattle. The highest increase of nutrient (especially digested CP) was obtained at 100% substitution EG by CW and CfP as basal diet in the ratio of basal diet: supplement 40:60. CW and CfP were considered to be able to substitute EG as basal diet of young male OC cattle.

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