Effects of Level of *Chromolaena odorata* in Complete Feed on Intake and Rumen Fermentation of Cattle: *Pellet Diets*

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ABSTRACT

Chromolaena odorata (CO) is a potential cheap protein source for livestock in dryland areas of Indonesia due to it is abundant availability and high crude protein content (21-36 %). However, it could hampers livestock productivity as it contains various secondary metabolic compounds which possibly act as antinutritional agents. Pelleting is one of the physical treatments aimed at diminishing these anti-nutrition associated effets. The present experiment designed to assess the efficacy of incremental level of CO in pellet diet for fattened cattle. Four growing Bali bulls (aged ±*2* y.o) were allotted into four dietary treatments using Latin Square Experimental Design principles. The treatments were pellet diet containing 10% CO (**COP10**) or 20% CO (**COP20**) or 30% CO (**COP30**) or 40% CO (**COP40**). The pellet was offered at 2% liveweight, while kume grass (*Sorghum plumosum*) were offered *ad libitum*. The treatment diets were iso in crude protein (18%) and metabolisable energy (12 MJ) content. Variables measured were intake, digestibility, rumen fermentation, and rumen microbial crude protein (MCP) supply. The results showed that level of CO in pellet diet significantly reduced feedintake but not nutrient digestion, rumen fermentation and rumen MCP supply. It might be concluded that inclusion of CO as protein source up to 40% in the pellet diet for fattened cattle but care should be taken since there was a tendency toward a decline in feed intake.

Keywords : *Chromolaeana odorata*, Protein, Intake, Digestibility, Cattle.

INTRODUCTION

Dispite its negative effects on pasture production in the dryland areas of the world (McFayden, 2004), *Chromolaena odorata* is a potential feed souce due to its high crude protein content (21%) and biomass production (Mullik, 2002). However, its usage as feed is hampered by the presence of various anti-nutrient compounds in the plant tissues (Aro et al., 2009). Therefore strategies are needed to eliminate these antinutrients compounds. A recent study (Bira*et* et al., 2015) revealed that physical treatments such as grinding can eliminate anti-nutrition associated effects in the plant. The present experiment aimed at assessing the efficacy of *C. odorata*meal inclusion in a complete a diet that given in the form of pellet to cattle at a gradual level on intake, rumen fermentation and rumen microbial crude protein efficiency (*e*MCP).

MATERIALS AND METHODS

Treatments and experimental design

Four young male Bali cattle with an initial liveweight of 195kg(±10,1 kg) were assigned to a 4 x 4 Latin Square experimental design to test four pellet diets. The diets were complete diets

containing 10% (COP10) or 20% (COP20) or 30% (COP30) or 40% (COP40) of *C. odorata,* andprovided at 2% liveweight. Feed allowance was adjusted for each period based on the liveweight recorded at the end of each treatment period. The basal diet (*Sorghum plumosum* hay) and drinking water were given *ad libitum.* The tested diets were designed to be iso-protein (18%) and metabolisable energy (12 MJ). Each treatment period lasted for 15 days consisted of 10 days adaptation and 5 days data collection.

Variables and measurements

Feed intake, digestibility, rumen fermentation and *e*MCP were measured for 5 days in each treatment period. Concentration of $NH_3$and VFAs in the rumen fluid were measured by sampling rumen fluid (using stomach tube aspiration under vaccum) three hours after feeding on the last day of each treatment period. The rumen liquor was strained and acidified with concentrated sulphuric acid to lower the pH below 3. Molar proportion VFAs was quantified using gas liquid chromatography (HP 8530A with an HP 18850A GC terminal and HP 3396A integrator).For MCP production, spot samples of excreted urine were taken daily during the data collection period. Daily spot samples were bulked for each animalin a glass container. The collected urine was acidified using 10% $H_2SO_4$to keep the pH below 3. Bulk urine samples for each cattle in each periuod were processed and analysed following standard protocolsfor spectrophotometry proposed by Chen and Gomez (1995). Calculation of MCP and *e*MCP was performed using the formula for *Bos indicus* cattle proposed by (IAEA, 2003). The *e*MCP was calculated using formula $Y= 0{,}85\ X + 0.147\ W^{0.75}$, where Y total purine derivatives (PDs) excreted in the urine; 0.85 is proportional recovery of absorbed purines in urine; X is total microbial purines absorbed; 0.147 is coefficient for endogenous purine derivatives in the urine for *Bos indicus* cattle, and $W^{0.75}$ is metabolic weight of cattle. Since spot urine samples was used, molar ratio of PDs: creatinine was used to estimate daily excretion of PDs. Daily creatinine excretion was assumed to be constant and a value of 0.91 mmol/kg $W^{0.75}$ (Chen *etal,* 1990) was adopted in the computation.

Statistical analysis

Data were statistically analysed using General Lenear Model principles for Latin Square Experimental Design. Diffenerece between treatments were detected at $P\leq0.05$ using. The analysis was performed by using SAS statistical software.

RESULTS AND DISCUSSION

Intake and digestibility

When the *C. odorata* was raised up to 40% in the complete diet, intakes (DMI, OMI, and CPI) was significantly reduced (Tabel 1). In the contrary, digestibility coefficients were not affected significantly by the level of *C. odorata*in the tested diets.It appears that reduction in intakes was not driven by nutrient density in the diets or physical limitations since all the treatments have the same nutrient density and physical appearance (pellet). Therefore, intake surpression for higher level of chromolaena inclusion in the diet (COP40) is likely to be addressed to bitter taste of chromolaena that effect palatability of the diet as Lorenzini et al., (2007) and Mora and Oddo (2009)also reported that dairy cattle tends to react negatively to bitter taste. The bitter taste in chromolaena is due the presence of secondary metabolic compounds. Heat drying and grinding of chromolaena before pelleting might fail to eliminate anti-nutrient compounds in the meal. A recent study (Mulik et al., 2016) found that total tannine and anti-tripsin concentration in chromolaena increased dramatically to 3 fold when oven dried or sun-dried.

A non-significant reduction in digestibility coefficients in the present experiment is similar to the results reported by Bira et al., (2015) for cattle given mash diet that had the same nutrient composition. This trend is expected as since all treatments had the same nutrition density (12 MJ ME/kg DM and 18%CP).

Tabel 1. Intake and *in vivo* digestibility of a complete diet contains *Chromolaenaodorata*meal at a rate of 10%(COP10) or 20%(COP20) or 30%(COP30) or 40%(COP40)

Variable	COP10	COP20	COP30	COP40	SEM	P value
Total intake						
Dry matter (kg^{-h})	4.86[a]	5.02[a]	4.78[a]	4.28[b]	0.007	0.002
Dry matter (% liveweigth)	2.51[a]	2.57[a]	2.46[a]	2.19[b]	0.010	0.001
Organic matter (kg^{-d})	4.00[a]	4.14[a]	3.93[a]	3.52[b]	0.061	0.015
Crude protein (g^{-d})	749[a]	771[a]	730[a]	661[b]	13.134	0.005
Digestibale organic matter (kg^{-d})	2.75[a]	2.81[a]	2.60[a]	2.32[b]	0.074	0.013
Protein:digestible organic matter intake	273	275	281	288	8.962	0.582
Digestibility						
Dry matter (%)	63	62	60	59	1.435	0.362
Organic matter (%)	68	67	66	65	1.212	0.341
Crude protein (%)	83	83	82	82	0.640	0.317

The ratio of crude protein intake (CPI) and digestible organic matter intake (DOMI) is a good nitrogen-carbon indicator for rumen function and efficiency of nutrient utilization for MCP production. The CPI: DOMI in the present experiment were in the range of 273 – 288 g protein/kg DOMI and not different significantly across treatments (Table 1). This range values is a good nutrient balance for rumen function. This might be another reason for non significant effect in digestibility coefficients.

Rumen fermentation and microbial crude protein production

The pH of the rumen was in the range of 6.70 – 6.90 and not significant different between treatments. Concentration of NH_3ranged from 109 to 125mg/L. This high rumen NH_3 partly arises from the urea used in the diet to adjust the protein level to 18%. Total and partial VFAs were also not affected by the level of chromolaeat. Nonsignicant effects of incremental level of chromolaena on these three variables was also reported by Bira *et al* (2015). This type of response is expected since all treatments groups received the same composition of diet presented to the rumen.

Table 2. Rumen fermentation and microbial crude protein (MCP) production in cattle given a complete diet contained 10%(COP10) or 20%(COP20) or 30%(COP30) or 40%(COP40) *Chromolaenaodorata* meal and provided in pellet form

Variable	COP10	COP20	COP30	COP40	SEM	P value
Rumen pH	6.90	6.70	6.73	6.71	0.342	0,542
Rumen NH_3-N (mg/L)	116	125	109	119	12.1	0,808
Total VFA (mM)	128.4	132.3	134.7	130.1	2.58	0,725
Acetat (mM)	*88.4*	*86.3*	*88.3*	*85.5*	*4.63*	*0,961*
Butirat (mM)	*12.3*	*12.9*	*16.4*	*10.6*	*1.98*	*0,564*
Propionat (mM)	*27.6*	*30.5*	*30.1*	*34.5*	*2.78*	*0,562*
Rumen MCP:						
Production (g/d)	206	192	186	136	29.9	0,428
Efficiency (g MCP/kg DOMI)	73.4	68.3	71.7	60.4	0.80	0,801

The optimal *e*MCPvalue recommanded in the current feedings standards (SCA, 2007) is around 130 g MCP/kg DOMI. This equal to 130 rumen digestibale protein (RDP) per each kg DOMI. The RDP was not measured in the present study but with the CPI: DOMI ratio of 273 – 288 g protein/kg DOMI and 82% digestibility of crude protein (Table 1), it is estimated that at least 136 g MCP/kg DOMI. The E_{MCP} presented in Table 2 showed a range value of 60.4-73.4 g MCP/kg DOMI. These values were below standard value and the results reported by Bira *et al* (2015). These lower *e*MCPvelues unlikely to be inadequate nutrients in the tested diets for rumen, but more likely to be the effect of chemical and physical aspects of the diets. For chemical aspects, high concentration of secondary metabolic compounds, particularly tannins, in chromolaena (Aro *et al,* 2009; Mulik *et al* 2016) can bind to protein in the diet and makes it indigestible in the rumen, hence reducing quantity to nutrients available for microbial growth. The physical aspect that contribute the low E_{MCP} in this

study was the particels size. Grinding and pelleting of the feed stuff increased outflow rate of feed from the rumen as reported by Poppi *et al,* (1980) hence resulted in low rumen microbial growth.

CONCLUSIONS

It can be concluded that *C.odorata* can potentially be utilized as a cheap protein source for fattened cattle, but when provided up to 40% in the total diet, feed and nutrient intakes were significantly depressed, but no effect was found in nutrient digestibility and rumen fermentation.

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