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Nutrient Digestibility and Performance of Sheep Fed Bitter Cassava Leaf Meal Based Diet Supplemented with Cyanide-Degrading Bacteria

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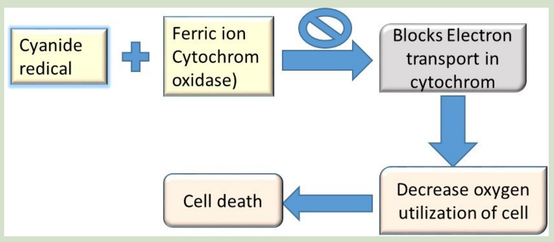
Introduction

- Cassava leaf meal especially bitter cassava contains hydro-cyanic acid (HCN) either free or in the form of cyanogenic glycosides (Soto-Blanco & Go´rniak, 2010) which is toxic for the animal
- Mechanism toxicity of cyanide :



- Cyanide content of bitter cassava leaves up to 1180 ppm and categorized as dangerous. The sun drying treatment during 6 hours reduced cyanide up to 13%.
- One of strategies for detoxifying cyanide is the use of Microbe
- Our previous study had isolated and identified rumen bacteria which can detoxify HCN . Based on morphological and molecular identification, this bacteria had similarities (99%) with *Sharpea azabuensis, Bovine rumen bacterium*, and *Lachnospiraceae bacterium* (Novita *et al*., 2015).

Objective

This research aimed to evaluate the effect of cyanide-degrading bacteria inoculation on sheep performance fed with bitter cassava leaf meal based ration

Materials and Methods

Fig.1. Bitter Cassava Leaf and Indonesian Local Sheep

Highlights

- The addition of bitter cassava leaf meal up to 30% to did not affect feed intake and nutrient digestibility but decreased total VFA, NH_3, feed efficiency and body weight gain of sheep.
- Inoculation of cyanide degrading bacteria to the sheep fed bitter cassava leaf meal increased total VFA, NH_3, body weight gain and feed efficiency compared to those which did not add with cyanide-degrading bacteria.
- Cyanide-degrading bacteria could detoxify cyanide in the bitter cassava leaf meal and enhanced sheep performance that fed bitter cassava leaf meal 30%.

Materials and Methods

Animal : 15 Indonesian local male sheep, 12 months of age,initial body weight of 18.76 ± 1.02 kg

Design : Randomized block design, 5 treatments x 3 block/ replications

Treatments :

T1 : 40% Napier grass : 60% concentrate (Control)

T2 : 40% Napier grass : 45% concentrate : 15% bitter cassava leaf meal (BCL15)

T3 : 40% Napier grass : 45% concentrate : 15% bitter cassava leaf meal + cyanide-degrading bacteria inoculation (BCL15+isolate)

T4 : 40% Napier grass : 30% concentrate : 30% bitter cassava leaf meal (BCL30)

T5 : 40% Napier grass : 30% concentrate : 30% bitter cassava leaf meal + cyanide-degrading bacteria inoculation (BCL30+isolate)

Table 1. Ration formulation (% DM)

Ingredient (%)	Treatment				
	Control (C)	BCL15	BCL15+ Isolate	BCL30	BCL30+ Isolate
Napier Grass	40	40	40	40	40
Bitter Casava leaf meal	0	15	15	30	30
Cassava waste	45	43	43	43.5	43.5
Pollard	15	9	9	9	9
Soybean meal	16	15	15	5	5
Coconut meal	10	4	4	5	5
Molasses	10	10	10	4	4
$CaCO_3$	1	1	1	1	1
Premix	1	1	1	1	1
DCP	1	1	1	1	1
Urea	1	0.5	0.5	0.5	0.5
TOTAL	100	100	100	100	100

Variables measured : feed intake, body weight gain, feed efficiency, microbe population, rumen fermentation characteristics, and nutrient digestibility.

Results

Feed and Nutrient Intake

- The feed intake were similar among treatments

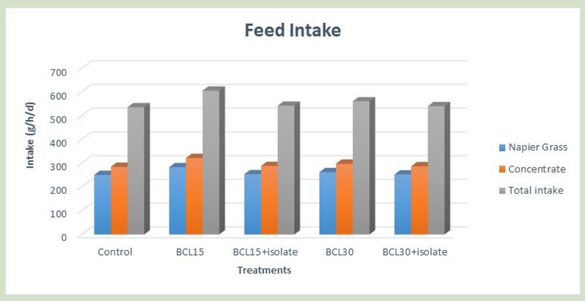


Fig 2. Intake of Napier grass, concentrate and the total ration of sheep fed bitter cassava leaf meal inoculated with cyanide-degrading bacteria

Nutrient Intake and Digestibility

- The used of bitter cassava leaf meal increased nutrient intake (P<0.05) especially ether extract (fat) and crude fiber intake.
- Inoculation of cyanide-degrading bacteria to the sheep fed bitter cassava leaf meal decreased (P<0.05) the intake of fat and crude fiber compared to those without inoculation cyanide-degrading bacteria
- Nutrient digestibility were similar among treatments

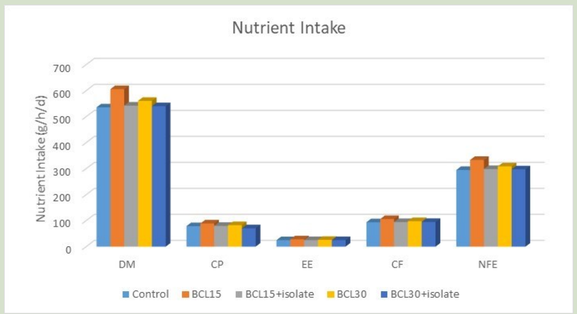


Fig 3. Nutrient intake of sheep fed bitter cassava leaf meal inoculated with cyanide-degrading bacteria

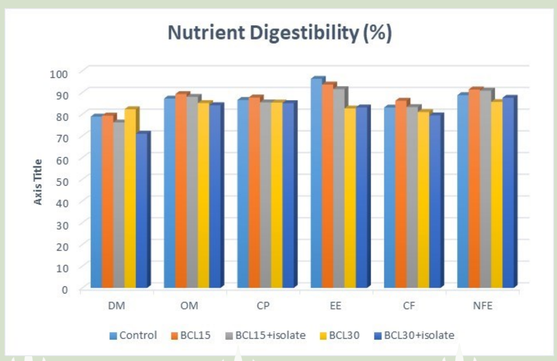


Fig 4. Nutrient digestibility of sheep fed bitter cassava leaf meal inoculated with cyanide-degrading bacteria

Results

Rumen Fermentation Characteristics

- The used of bitter cassava leaf meal at level 15% and 30% generally decreased (P≤0.05) total VFA and NH_3 compared to the control treatment (no bitter cassava leaf meal).
- Inoculation of cyanide-degrading bacteria to the sheep that fed bitter cassava leaf meal 30% could improve total VFA and NH_3 but decreased (P≤0.05) propionate compared to those which did not add with cyanide-degrading bacteria
- The C2/C3 ratio increased (P≤0.05) and methane estimation decreased (P≤0.05) with the used of bitter cassava leaf meal. Inoculation of cyanide-degrading bacteria further reducing methane production.

Table 2. Rumen fermentation characteristics of sheep fed bitter cassava leaf meal with or without HCN degrading bacteria inoculation

Variable	Treatment				
	Control	BCL15	BCL15+isolate	BCL30	BCL30+isolate
NH_3 (mM)	18.29 ± 1.41^{a}	15.05 ± 4.16^{ab}	12.59 ± 1.54^{ab}	10.16 ± 5.80^{b}	13.87 ± 1.74^{ab}
VFA Total (mM)	96.03 ± 3.55^{a}	85.19 ± 19.31^{ab}	65.03 ± 3.28^{bc}	44.78 ± 8.09^{c}	48.99 ± 8.48^{c}
Molar proportion of VFA (mM/100mM					
Acetate	62.93 ± 5.70	67.78 ± 7.42	68.26 ± 2.29	71.66 ± 10.13	73.53 ± 4.13
Propionate	27.05 ± 3.51^{a}	22.62 ± 4.48^{ab}	22.54 ± 1.72^{ab}	20.19 ± 5.28^{ab}	16.68 ± 3.54^{b}
Butyrate	8.61 ± 1.86	8.11 ± 2.52	8.02 ± 0.82	7.13 ± 4.59	9.04 ± 3.04
Valerate	1.40 ± 0.56	1.49 ± 0.46	1.17 ± 0.37	1.01 ± 0.27	0.75 ± 0.19
C2/C3 (mM)	2.37 ± 0.48^{b}	3.11 ± 0.86^{ab}	3.04 ± 0.32^{ab}	3.80 ± 1.46^{ab}	4.56 ± 1.07^{a}
Methane estimation (mM)	23.30 ± 2.00^{a}	23.00 ± 2.03^{a}	18.05 ± 1.60^{b}	13.02 ± 0.99^{bc}	15.61 ± 1.61^{c}

Different superscripts in the same row means significantly (P<0.05)

Body Weight Gain and Feed Efficiency

- The used of cassava leaf meal to substitute concentrate ration at level 15 and 30 % decreased feed efficiency and average daily gain (ADG).
- Inoculation of cyanide-degrading bacteria improved (P<0.05) feed efficiency and ADG compared to the sheep receiving a diet containing bitter cassava leaf meal without bacterial inoculation

Table 2. Rumen fermentation characteristics of sheep fed bitter cassava leaf meal with or without HCN degrading bacteria inoculation

Variable	Treatments				
	Control	BCL15	BCL15+isolate	BCL30	BCL30+isolate
Feed intake (g)	535.57±94.72	605.61±5.0	542.2±31.57	560.64±69.05	540.26±87.11
Initial BW(kg)	17.90±3.61	20.43±0.84	18.97±3.12	17.60±3.21	17.11±1.88
Final BW(kg)	22.03±3.59	24.02±0.18	21.54±2.27	21.21±3.25	22.35±1.07
ADG (g/day)	45.96±14.6^{ab}	39.85±9.66^{ab}	58.19±9.46^{a}	28.59±9.82^{b}	40.11±4.92^{ab}
Feed Efficiency	0.09±0.03^{ab}	0.07±0.02^{ab}	0.11±0.02^{a}	0.05±0.01^{b}	0.07±0.01^{ab}

Different superscripts in the same row means significantly (P<0.05)

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