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Supplementation of Yeast Fermented Cassava Chip (YFCC) as a Replacement Concentrate and Ruzi Grass on Rumen Ecology in Native Cattle

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Abstract: Ten, one year old of native cattle with initial body weight of 150 ± 10 kg were randomly divided into two groups and received concentrate at 14% CP (T1) and Yeast Fermented Cassava Chip (YFCC) (T2). The cows were offered the treatment concentrate at 1% BW and ruzi grass was fed *ad libitum*. Means were compared using T-test. All animals were kept in individual pens and received free access to water. The results have revealed that replacement of YFCC on feed intake was non-significantly different, while Average Daily Gain (ADG) was higher ($p<0.05$) in native cattle fed YFCC (T2) treatments than received concentrate at 14% CP (T1) (259 and 205 g/d). In addition, the ruminal pH, ammonia-nitrogen and blood urea nitrogen concentration were significantly different ($p<0.05$). Supplementation of YFCC (T2) could improve population of bacteria and fungal zoospore, but decreased populations of *Holotrich* and *Entodiniomorph* protozoa in rumen ($p<0.05$). The results indicate that supplementation of Yeast Fermented Cassava Chip (YFCC) as a replacement concentrate at 14% CP could improve rumen fermentation efficiency in native cattle.

Key words: Yeast, cassava chip, concentrate, rumen fermentation, native cattle

INTRODUCTION

Cassava (*Manihot esculenta*, Crantz) production in tropical areas has a potential use in ruminant livestock nutrition and feeding. Cassava root contains high levels of energy and has been used as a source of readily fermentable energy in ruminant rations (Wanapat, 2003; Kiyothong and Wanapat, 2004; Promkot and Wanapat, 2005). One strategy for using high degradable carbohydrates is to use in combination with readily available NPN sources such as urea. Urea is commonly used as N source when highly soluble carbohydrates are fed and maintained (Wohlt *et al*., 1978). However, efficient utilization of protein and Non-protein Nitrogen (NPN) in ruminants depends upon knowledge of the basic principles underlying ruminal microbial N metabolism (Fernandez *et al*., 1997). Moreover, ruminal pH has great impact on rumen fermentation efficiency (Wanapat, 2003).

In addition, supplementing diets with yeast *(Saccharomyces cerevisiae)* increases milk production of dairy cows and weight gain of growing cattle (Brossard *et al*., 2006). Production responses attributed to yeast are usually related to stimulation of cellulolytic and lactate-utilizing bacteria in the rumen, increased fiber digestion and increased flow of microbial protein from the rumen which may be beneficial for feedlot cattle fed high-grain diets (Guedes *et al*., 2007).

However, the use of yeast fermenting cassava as a replacement for concentrate not yet been investigated. Therefore, the objective of this experiment was to investigate the supplementation of yeast fermenting cassava chip with ruzi grass as a basal roughage on rumen ecology in native cattle.

MATERIALS AND METHODS

Preparation of Yeast Fermented Cassava Chip (YFCC): This technique is based on the method developed by Oboh (2006) and Boonnop *et al*. (2008), which enriching nutritive value of cassava chip with yeast (*Saccharomyces cerevisiae*) fermentation. The method for synthesis of YFCC is as follows:

- Weigh 20 g of yeast in to a flask and add with sugar 20 g, malate 5 g and distill water 100 ml then mixed and incubated at room temperature for 1 h. (A)
- Preparation of medium by weigh 20 g of molasses directly into a warring blender vessel flushed with O_2, add distill water 100 ml and urea 48 g then pour solution and incubated at room temperature for 10 min. (B)
- Adjusting pH media solution by 70% H_2SO_4 between 3.5-.7 and continue mix with incubated for 1 h.
- Remove yeast-malate media solution in a flask from (A) into a medium (B) and continue flush O_2 for 60 h.
- After 60 h, then transfer yeast-malate media solution 50 ml mix with cassava chip 100 g and then covered by plastic bag for a minimum of 72 h.

- Drying of Yeast Fermented Cassava Chip (YFCC) at 30°C for 24 h before feeding to animals.

Animals, diets and experimental design: Ten, one-year old of native cattle weighing at 150±10 kg were randomly divided into two groups according to receive two groups of supplemental feeds by receiving concentrate at 14% CP (T1) and Yeast Fermented Cassava Chip (YFCC). The composition of dietary treatments and ruzi grass used are shown in Table 1.

Cows were housed in individual pens and individually fed concentrate at 1% BW. All cows were fed *ad libitum* of rizi grass with water and a mineral-salt block. Feed intake of concentrate and roughage were measured separately and refusals recorded. The experiment was run for 120 days, the first 15 days for treatment adaptation and for feed intake measurements whist the last 7 days were for sample collections of faeces and rumen fluid. Body weights were measured each 30 days during the sampling period prior to feeding.

Data collection and sampling procedures: Yeast fermented cassava chip, concentrate and ruzi grass were sampled each 30 days and were composted by period prior to analyses. Composites samples were dried at 60°C and ground (1 mm screen using Cyclotech Mill, Tecator, Sweden) and then analyzed for DM, ash and CP content (AOAC, 1985), NDF, ADF and ADL (Goering and Van Soest, 1970).

Rumen fluid and blood samples were collected at 0, 2 and 4 h post-feeding on last period. Approximately 200 ml of rumen fluid was taken from the middle part of the rumen by a stomach tube connected with a vacuum pump at each time at the end of each period. Rumen fluid was immediately measured for pH and temperature using (HANNA instruments HI 8424 microcomputer) after withdrawal. Rumen fluid samples were then filtered through four layers of cheesecloth. Samples were divided into two portions. One portion was used for NH_3-N analyses where 5 ml of H_2SO_4 solution (1M) was added to 50 ml of rumen fluid. The mixture was centrifuged at 16,000 g for 15 min and the supernatant stored at -20°C prior to NH_3-N analysis using the micro Kjeldahl methods (AOAC, 1985). Another portion was fixed with 10% formalin solution in normal saline (Galyean, 1989).

The total count of bacteria, protozoa and fungal zoospores were made using the methods of Galyean (1989) based on the use of a haematocytometer (Boeco). A blood sample (about 10 ml) was drawn from the jugular vein at the same time as rumen fluid sampling, separated by centrifugation at 5,000 g for 10 min and stored at -20°C until analysis of Blood Urea Nitrogen (BUN) according to the method of Crocker (1967).

Statistic analysis: The means of each parameter measured in the digestibility studies and internal parasitic egg counts were analyzed by the analysis of variance procedure of SAS (1998) and means were compared using T-test.

RESULTS AND DISCUSSION

Chemical composition of feeds: The chemical compositions of concentrate diets (T1), yeast fermented cassava chip (YFCC) (T2) and ruzi grass fed in native cattle are shown in Table 1. Crude proteins of concentrate, YFCC and ruzi grass were at 14.2, 29.1 and 8.2%, respectively. Diets containing high levels of cassava chip based diets had a slightly higher Non-structural Carbohydrate (NSC) and lower NDF due to increased level of cassava chip in the diets.

Effect on feed intake and digestibility of nutrients: The effects of supplementation of YFCC as replacement concentrate on feed-intake and digestibility of nutrients in cattle are presented in Table 2. Feed intake were non-significantly different among treatments and was higher in native cattle receiving T2 than T1 (2.7 and 2.5% BW). This result was in agreement with earlier work by (Sommart *et al*., 2000 and Khampa *et al*., 2006) which reported that inclusion of cassava chip in diets resulted in satisfactory animal performance and had no negative effects on animal health in finishing beef cattle and lactating dairy cows.

Characteristics of rumen fermentation and blood metabolism: Rumen ecology parameters were measured for pH and NH_3-N (Table 2). In addition, BUN was determined to investigate their relationships with rumen NH_3-N and protein utilization. Rumen pH at 0, 2 and 4 h post-feeding was changed by dietary treatments, however the values were quite stable at 6.7-6.9, but all treatment means were within the normal range which has been reported as optimal for microbial digestion of fiber and also digestion of protein (6.0-7.0) (Hoover, 1986).

Ruminal NH_3-N and BUN concentrations were altered by YFCC (T2) supplement which containing high cassava-based diets. As NH_3-N is regarded as the most important nitrogen source for microbial protein synthesis in the rumen. In addition, the result obtained was closer to optimal ruminal NH_3-N between at 15-30 mg% (Wanapat and Pimpa, 1999; Chanjula *et al*., 2003, 2004) for increasing microbial protein synthesis, feed digestibility and voluntary feed intake in ruminant fed on low-quality roughages.

Rumen microorganisms populations: Table 3 presents rumen microorganism populations. The populations of fungal zoospores, protozoa and total bacteria direct counts were significantly different and populations of bacteria had higher numbers in native cattle receiving diets YFCC (T2) than T1. In contrast, the present number

Table 1: Chemical composition of concentrate, yeast fermented cassava chip (YFCC) and ruzi grass

Analyzed composition (%)	Concentrate[1]	YFCC	Ruzi grass
DM	91.5	89.1	29.8
OM	90.3	89.5	87.6
CP	14.2	19.2	8.2
TDN	78.3	78.9	57.3
NDF	25.7	17.5	35.6
ADF	14.6	6.1	27.8
ME (Mcal/kg)	3.1	3.3	2.0
Price (US$/kg)	0.28	0.23	0.06

DM = dry matter, CP = crude protein, OM = organic matter, NDF = neutral detergent fiber, ADF = acid detergent fiber, TDN = total digestible of nutrients, ME = metabolizable energy. ([1]Ingredients = concentrate compost of cassava chips 65, fine rice bran 6, brewer's gain 10, palm meal 10, urea 2, molasses 5, sulfur 0.5, salt 0.5 and mineral mix 1%) as dry weight.

Table 2: Effects of supplementation of cattle fed yeast fermented cassava chip (YFCC) as a replacement concentrate on feed intake, blood metabolites (BUN) and ruminal fermentation in native cattle

Item	T1	T2	P-value
DM feed intake (%BW)			
Concentrate	1.0	-	-
YFCC	-	1.0	-
Ruzi grass	1.5	1.7	0.084^{NS}
Total	2.5	2.7	0.147^{NS}
ADG (g/day)	205	259	0.034*
Ruminal fermention			
Temperature (^{0}C)	40.1	39.8	0.423^{NS}
Ruminal pH	6.7	6.9	0.048*
NH_3-N (mg%)	17.6	20.8	0.0341*
BUN (mg%)	9.4	12.1	0.0475*

T1 = Supplementation of concentrate at 14% CP.
T2 = Supplementation of yeast fermented cassava chip (YFCC).
* = $p<0.05$, NS = $p>0.05$

Table 3: Influences of supplementation of yeast fermented cassava chip (YFCC) as a replacement concentrate on rumen microorganisms in cattle

Item	T1	T2	P-value
Total direct counts (cell/ml)			
Bacteria ($x10^{12}$) Protozoa	5.3	9.6	0.0361*
Holotric ($x10^4$)	6.8	4.1	0.0391*
Entodiniomorph ($x10^5$)	8.9	5.2	0.0457*
Fungal zoospores ($x10^6$)	6.3	8.6	0.0414*

T1 = Supplementation of concentrate at 14% CP.
T2 = Supplementation of yeast fermented cassava chip (YFCC).
* = $p<0.05$, NS = $p>0.05$

of protozoa in the rumen was decreased by YFCC supplementation in high cassava-based diets. In the experiment by Guedes *et al.* (2007) reported that yeast are usually related to stimulation of cellulolytic and lactate-utilizing bacteria in the rumen, increased fiber digestion and increased flow of microbial protein from the rumen which may be beneficial for feedlot cattle fed high-grain diets.

Conclusions: Based on this experiment, it could be concluded that supplementation of Yeast Fermented Cassava Chip (YFCC) as a replacement concentrate at 14% CP could improved ruminal fermentation efficiency by increasing populations of bacteria and fungi, but decreased protozoal populations in native cattle.

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