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Effects of Supplemental Yeast (*Saccharomyces cerevisiae*) Culture on NDF Digestibility and Rumen Fermentation of Forage Sorghum Hay in Nubian Goat's Kids

A.M.A. Fadel Elseed, Rania, M.A. Abusamra

Faculty of Animal Production, University of Khartoum, Postal code 13314, Khartoum North, Sudan.

Abstract: Twelve male Nubian goats' kids fed a basal diet of Forage sorghum hay were used to investigate the effect of *Saccharomyces cerevisiae* culture (Diamond V) supplementation (0, 2.5, 5 g/day) on feed intake, OM and NDF digestibility, rumen fermentation's end products and average daily gain (ADG) in a completely randomized design. Yeast supplementation resulted in a numerical increase in ruminal pH, ammonia-N concentration, and total VFA concentration, however, no effects (P>.05) were observed among treatments. The yeast supplementation increased OMD by 12.1% and 10.1% and NDFD by 13.3% and 10.5% for 2.5 and 5 g/day yeast culture, respectively, compared with the control diet. Moreover, unsupplemented kids had lower (P < 0.01) ADG (5.5 g per day) than those with 2.5 and 5 g/day yeast supplement (20.8 and 16.3 g per day) respectively. This study demonstrated that NDF digestibility, feed intake and therefore, the average daily gain of Forage sorghum hay would be improved by yeast (*Saccharomyces cerevisiae*) supplement. However, no additional benefits gained when adding high level of yeast supplement.

Key words: Nubian goat; yeast culture; forage sorghum; NDF digestibility.

INTRODUCTION

In Sudan ruminants which are estimated to be over 130 million heads of cattle, sheep, goats and camels[12] depends mainly on natural pasture and crop residues in addition to considerable quantities of irrigated forages which are available in irrigated areas. However, during the rainy season grasses provide sufficient feed supplies with a fair amount of essential nutrients which may reflect in good performance of animals. In dry season when grazing offers animals scattered grasses at its least palatable and poor feeding value agricultural residues and irrigated forages emerge as important available feed resources and comprise the entire diet because the energy and protein rich feed sources are expensive and their use in ruminant nutrition competes with monogastric and human nutrition.

Under the feeding of low quality agricultural residues, supply animal's rumen microbes with the necessary nutrients needed allow the animal to maximize the usage of the low quality feed[10]. However, researchers in the field of ruminant nutrition had been interested in manipulating the ruminal ecosystem to increase production efficiency of ruminants. Manipulating rumen digestion system through the addition of direct feed microbial (DFM) and a fibrolytic enzyme to ruminant rations so as to enhance cellulose digestion and improves the performance of the animal is the most interest in recent years[29,23,13,14,15].

Feeding yeast culture to dairy cows on concentrates diet increased dry matter intake[17], dry matter and neutral detergent fiber digestion[6] decreased lactic acid production[9] and milk yield[28]. However, few studies address the effect of yeast (*Saccharomyces cerevisiae*) culture on cell-wall break down of roughages when fed as a sole diet.

Therefore, the objective of this study was to assess the effect of yeast (*Saccharomyces cerevisiae*) culture supplementation on NDF digestibility and rumen fermentation's end products of poor quality hay fed as an only feed.

MATERIAL AND METHODS

Animals, Housing and Diet: Twelve male Nubian goats' kids (about 3 months old; 10 kg average body weight) were used in this experiment. The animals were housed in individual pens (1m × 2 m). In the first day all kids were injected by Ivomic for internal parasite for 3 days, and dipped in Ciber solution for external parasite. Moreover, the pens were cleaned and disinfected by Ciber solution before the onset of the experiment. The animals offered Forage sorghum hay (11.2% CP, 68.9% NDF, and 53.6% NDIP of total CP;

Corresponding Author: A.M.A. Fadel Elseed, Faculty of Animal Production, University of Khartoum, Khartoum North, Postal code 13314, Sudan.
E-mail: abdelnasirm@yahoo.com Tel: +249-09-129-57152

on DM basis) once daily for ad libitium intake, with free access to water and mineral licks.

Treatments and Experimental Design: Animals assigned randomly to one of three different treatments with four animals per treatment following the completely randomized design. The animal on the different treatments received the same basal diet of Forage sorghum hay and supplemented with 0, 2.5, 5 g/day yeast culture (Diamond V). Yeast culture (YC) was added to 5 g of wheat bran as inert material and 5 ml of molasses as appetizer and fed shortly before offering the basal diet.

***In vivo* Study:** Feed intake was recorded daily throughout the 72-day experimental period. The first 15 days were for adaptation. From day 61 the animals were fitted with fecal-collection bags, the first two days for adaptation to bags followed by 8 days for total fecal collection. Orts and feces produced during the 8-day period were recorded every morning and were pooled for each animal with a fixed proportion of the total and then dried prior to analysis. The body weight of the animals was recorded at the beginning and the end of the experimental period.

For determination of ruminal ammonia–N (NH3-N) and volatile fatty acid (VFA) concentration, ruminal fluid samples were delivered through esophageal stomach tube at 2-h interval for 6 hrs after morning meal on the last 2 days of the experimental period. Rumen fluid samples were strained through double layer cheesecloth and pH was immediately measured with a portable pH meter then the samples were acidified using concentrated H_2SO_4 to pH <3.0 and kept frozen prior to analysis.

Chemical Analysis: Feed and feces samples were analyzed for DM, OM, and N according to AOAC[4]. NDF and ADF were determined according to Robertson and Van Soest[27]. Total NH3 -N and VFA were analyzed following Abdulrazak and Fujihara[1].

Statistical Analysis: Data were subjected to analysis of variance according to Steel and Torrie[30]. The comparison among means was analyzed by the least significant difference using LSD procedure of the Statisticx[3].

RESULTS AND DISCUSSIONS

All YC supplement was consumed within ten minutes throughout the experimental period.

Rumen Fermentation: YC resulted in a numerical increase in ruminal pH, ammonia-N concentration, and total VFA concentration, however, no significant effects were observed among treatments (Table 1) in agreement with results obtained by Yoon and Stern[34] and Miller-Webster *et al*[21]. Others[16,32,8] have observed a reduction in ammonia concentration.

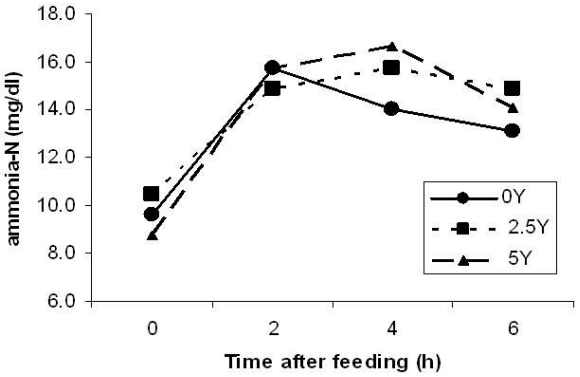

Fig. 1: Diurnal changes in NH3-N concentration of goat offered forage sorghum hay supplemented with 0 (0Y), 2.5 (2.5Y), and 5 (5Y) g/day yeast *(Saccharomyces cerevisiae)*.

The lowest values of the diurnal changes in NH3-N (Figure 1) observed before offering morning feed for all treatments, with the highest value 2 and 4 h after provision for control and YC supplement, respectively, and declined thereafter. Since neutral detergent insoluble protein (NDIP) represent 53.6% of total CP, the enhancement in NDF digestion of YC supplemented diets may improve protein digestibility which could be responsible for the elevation in ruminal NH3-N concentration at 4 and 6 h after yeast supplement.

Intake, Digestibility and Average Daily Gain: Table 2 presents means for digestible organic matter intake (DOMI), organic matter (OMD) and neutral detergent fiber digestibility (NDFD), and average daily gain (ADG). DOMI, OMD, NDFD, and ADG were influenced ($P<0.01$) by adding YC at both concentrations to Forage sorghum hay.

The YC improved OMD by 12.1% and 10.1% and NDFD by 13.3% and 10.5% for 2.5 and 5 g/day YC respectively, compared with the control diet. However, the effects of yeast culture on fiber digestion are highly variable, with some authors recording increases in fiber digestion of low quality forages[24,22,20], while others have recorded no effect[5,15,8]. These inconsistent results might be partially attributed to effects of ration composition, types and amount of yeast culture used[33]. Results from Roa *et al*[26] showed that quality of the forages affects NDF digestion response to yeast culture, with more benefits with good quality forages. Since the pH of all treatments in this study did not drop below 6.2, it appears that the effect on NDFD caused by YC might

Table 1: Rumen pH, VFA and NH_3-N of goat kids offered forage sorghum hay supplemented with yeast culture (0, 2.5 and 5 g/day *Saccharomyces cerevisiae*).

	Yeast supplement (g/day)			SEM	Significance level
	0	2.5	5		
pH[a]	6.22	6.28	6.26	0.03	NS
VFA (mmol/dl)[a]	9.4	11.0	10.6	0.58	NS
NH_3-N (mg/dl)[a]	13.1	14.0	13.8	0.59	NS

NS: P>0.05.
SEM: Standard error of a mean.
[a]Mean of all the 2h samples taken per day.

Table 2: Intake, digestibility and daily weight gain of goat kids offered forage sorghum hay supplemented with yeast culture (0, 2.5 and 5 g/day *Saccharomyces cerevisiae*).

	Yeast supplement (g/day)			SEM	Significance level
	0	2.5	5		
BW gain g/day	5.5[b]	20.8[a]	16.3[a]	0.38	0
OMD (%)	58.1[b]	70.2[a]	68.2[a]	1.24	**
NDFD (%)	52.9[b]	66.2[a]	63.4[a]	1.55	**
DOMI g /kg $BW^{0.75}$	30.8[b]	36.7[a]	36.1[a]	1.28	**

[a-b]: Means with different superscript in the same row differ significantly.
***** P<0.05.
****** P<0.01.
SEM: Standard error of a mean.

be explained by an increment in the number and activity of cellulolytic bacteria rather than via an effect on pH[31,18].

The enhancement of DOMI by addition of yeast culture in the present study is consistent with the finding of Quigley *et al*[25] and Lesmeister *et al*[19] with dairy calves, Kim *et al*[17] and Dann *et al*[7] with dairy cows and Haddad and Goussous[14] with lambs. Because fibrous components ferment and pass from the reticulo-rumen more slowly, they have greater filling effect over time[2] and therefore, the increment of NDF digestion may decreases rumen filling effect that led to enhancement in feed intake in the present study[11].

Unsupplemented kids had lower (P < 0.01) ADG (5.5 g per day) than those with 2.5 and 5 g/day YC supplement (20.8 and 16.3 g per day) respectively. The increase in ADG observed in this study agrees with Lesmeister *et al*[19]. The improved fiber digestion and, therefore, feed intake in response to supplemental YC may have served in stimulating a production response in term of ADG.

The present study concluded that yeast culture supplementation can improve fiber digestion, feed intake and therefore enable animals, at least, to maintain weight during the dry season when low quality forages often comprise practically the whole diet.

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