Effects of *Saccharomyces cerevisiae* on Nutrient Digestibility in Mature Horses Fed Diets with High and Low Concentrate to Hay Ratios

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Story in Brief

The objective of this study was to evaluate the effects of a yeast culture preparation containing *Saccharomyces cerevisiae* (Diamond V "XP" Cedar Rapids, IA) on digestion coefficients in horses fed varying concentrate to forage ratios. Eight mature, sedentary geldings with a mean weight of 506.2 kg and a mean age of 9 were paired by weight and age and utilized in two simultaneous 4x4 Latin squares. Treatments were: 1) a high concentrate diet (70:30) with no supplemental yeast culture (HC); 2) a high concentrate diet with yeast culture (HCY); 3) a high forage diet (30:70) with no supplemental yeast culture (HF); and 4) a high forage diet with yeast culture (HFY). Yeast culture was added to the concentrate as a top-dressing at each feeding at the recommended feeding level of 37.5 g/hd/d (assuming a 500 kg horse consuming 1.5% of BW/d). The trial consisted of four 21-d acclimation periods followed by a 72 h total fecal collection to determine DM, ADF, and NDF digestibilities. No difference in DM, ADF, and NDF digestibility was detected due to yeast culture supplementation. There was, however, a significant difference between the high concentrate and high forage diet across all measured parameters.

Key Words: Horses, Yeast Culture, *Saccharomyces cerevisiae,* High Concentrate, High Forage

Introduction

Adding direct-fed microbials, such as yeast culture, to diets has been a practice in ruminants for many years with growing popularity in equine nutrition. Supplementing two of the more common yeast cultures, *Saccharomyces cerevisiae* and *Aspergillus oryzae,* has been shown to increase nutrient digestion and significantly alter cecal and ruminal fermentation parameters. Due to the vast differences in nutrient requirements across classes of horses, it has become a common practice to replace 30 to 60 percent of the fibrous feeds in an equine diet with concentrate. For example, working horses require higher levels of energy in the diet which is often met by increasing the amount of soluble carbohydrate levels. Increasing these levels while decreasing forage intake predisposes the horse to experience starch overload in the hindgut, and therefore increases the chance for colic or laminitis. Numerous theories have proposed that these direct-fed microbials may increase the lactic acid utilizing bacteria (Koul, et al.1998; Kumar, et al.,1994; Medina et al., 2002), thereby resulting in a higher pH. Furthermore, the higher pH provides a more desirable environment for cellulolytic bacteria, thus enhancing fiber digestion. Therefore, the objective of this study was to determine if supplementing yeast culture to a high concentrate or high forage diet would result in significant differences in the digestion coefficients of mature horses.

Materials and Methods

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ratios. Eight mature, sedentary geldings were paired by weight and age and utilized in two simultaneous 4x4 Latin squares. Treatments were: 1) a high concentrate diet (70:30) with no supplemental yeast culture (HC); 2) a high concentrate diet with yeast culture (HCY); 3) a high forage diet (30:70) with no supplemental yeast culture (HF); and 4) a high forage diet with yeast culture (HFY). Yeast culture was added to the concentrate as a top-dressing at each feeding at the recommended feeding level of 37.5 g/hd/d (assuming a 500 kg horse consuming 1.5% of BW/d). Diets were formulated to meet or exceed NRC (1989) recommended requirements for DE, CP, Ca, and P for mature horses at maintenance and were fed at levels to be isonitrogenous and isocaloric. The concentrate ration was composed primarily of rolled corn, whole oats, and molasses while the forage component was Bermuda grass hay (Table 1). Prior to feeding treatment diets, all horses were allowed a 30 d acclimation period and fed the concentrate and forage in a 50:50 ratio. Horses receiving the high concentrate diet were fed at 1.3% of their body weight, while those on the high forage were fed at 1.5% in order to equalize gross energy intakes.

The experiment consisted of four 21-d acclimation periods followed by 72 hours of collections. During collection periods, all feed refusals were recorded along with water intake. Total fecal collections were performed and fecal samples were weighed after every 24 hours, mixed and grab samples were taken and frozen for subsequent analysis. All feed, hay, and fecal samples were placed into a drying oven at 50° ℃ for 96 hours. Dried samples were weighed and ground. Dry matter was then calculated. All feed, hay, and fecal samples were then sent to Dairy One (Ithaca, NY) for analysis of NDF and ADF.

Data were analyzed using the MIXED procedure of SAS (2001) with sequence, period, and treatment as fixed effects and horse(sequence) as a random effect. Least squares means were calculated for each parameter and the p-diff procedure was used to test for differences between treatment means.

Table 1. Diet composition for treatment diets, % as fed

Ingredient	**HC**	**HF**
Bermuda Grass Hay	30.00	70.00
Shelled Corn, Cracked	44.41	19.03
Oat Grain	21.00	9.00
Liquid Cane Molasses	3.50	1.50
Trace Mineralized Salt	.35	.15
Limestone	.53	.23
Dicalcium Phosphate	.21	.09
Nutrient		
DE (Mcal/kg)	2.90	2.32

CP, %	8.50	8.33
NDF, %	29.90	49.72
ADF, %	14.19	24.84
Ca, %	.25	.32
P, %	.26	.20

HC-high concentrate diet of 70% concentrate, 30% hay

HF-high forage diet of 30% hay, 70% concentrate

Results and Discussion

There was no significant effect of yeast culture supplementation on DM, ADF or NDF digestibility between treatments (Table 2). These findings coincide with Hall et al. (1990), who observed no significant differences in DM, NDF, or ADF digestibilities when horses were fed a basal ration with four different levels of Yea-Sacc (Alltech, Nicholasville, KY), a commercially prepared yeast culture. Digestibilities for DM and NDF were higher ($P<.05$) and ADF was lower ($P<.05$) in the HC diet compared to the HF. The enhanced DM and NDF digestibility values for the HC diet was most likely due to the greater concentration of soluble carbohydrates in the diet.

Table 2. Mean Daily Intake, Fecal Output, and Digestibilities for Dry Matter, NDF, and ADF across experimental diets[a]

	HC	HCY	HF	HFY	SEM[d]
DMI, g/d	6195[b]	6233[b]	7168[c]	7125[c]	245
DMFO, g/d	2285[b]	2334[b]	3312[c]	3234[c]	177
DMD, %	62.8[b]	62.3[b]	54.1[c]	54.7[c]	1.9
NDFI, g/d	2107[b]	2115[b]	3853[c]	3824[c]	114
NDF FO, g/d	1447[b]	1471[b]	2813[c]	2775[c]	95
NDFD, %	31.2[b]	30.3[b]	27.1[c]	27.3[c]	1.1
ADFI, g/d	997[b]	999[b]	1920[c]	1905[c]	56
ADF FO, g/d	952[b]	970[b]	1375[c]	1341[c]	78
ADFD, %	2.9[b]	1.2[b]	28.9[c]	29.7[c]	6.2

a Values are least squares means

bc Means within a row with different superscripts differ (P,.05)

d Values are average standard errors

Implications

When supplementing mature, sedentary geldings with a yeast culture supplementation containing *Saccharomyces cerevisiae*, there is no significant differences in digestion coefficients. However, feeding a high concentrate or high forage diet results in significant differences across all digestive parameters.

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