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Efficacy of live yeast in lactating dairy cattle[1]

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ABSTRACT

A 12-wk continuous lactation trial with 60 primiparous and multiparous Jersey cows was conducted to evaluate the efficacy of Yea-Sacc TS (Alltech Inc., Nicholasville, KY). Cows were given fresh feed in a TMR twice daily, and at each feeding cows were individually provided top-dresses (50 g/animal) of either a ground corn control or ground corn mixed with Yea-Sacc TS (total of 100 g/animal daily). Cows received 1.94 $\times 10^{10}$ to 4.35 $\times 10^{10}$ cfu of Saccharomyces cerevisiae per animal per day for the Yea-Sacc TS treatment. Cows consuming Yea-Sacc TS increased ($P = 0.01$) DMI by 0.7 kg/d, which increased ($P < 0.05$) milk fat, milk protein, and energy-corrected milk yields by 0.067, 0.037, and 1.0 kg/d, respectively. Under our conditions, Yea-Sacc TS demonstrated efficacy for lactating cows fed moderately high starch diets primarily through increased DMI.

Key words: live active yeast, *Saccharomyces cerevisiae*, milk production

INTRODUCTION

Yeast supplementation to dairy rations has been actively researched in the past 20 yr, with various proposed mechanisms of action, but a meta-analysis describes benefits commonly projected through stimulation of the rumen microbial consortium (Desnoyers et al., 2009). Effects of yeast depend on species and strain (Newbold et al., 1995). A widely tested strain is *Saccharomyces cerevisiae* 1026, commercially available as Yea-Sacc TS (Alltech Inc., Nicholasville, KY). Dawson et al. (1990) discussed differences resulting from basal diet composition in which yeast increased cellulolytic bacteria counts in hay-based diets, which is a common finding (Wiedmeier et al., 1987; Dawson et al., 1990; Callaway and Martin, 1997). Callaway and Martin (1997) demonstrated that *S. cerevisiae* stimulated the ability of the bacterium *Selenomonas ruminantium* to convert lactate to VFA, particularly propionate, thus helping to maintain a more stable rumen pH. A stable consortium of microbes is needed to enhance NDF digestibility in dairy cows fed mixed forage and grain, thus helping to maintain a higher DMI (Firkins, 2010). Wohlt et al. (1991) noted that DMI increased after inclusion of live yeast culture into the diet of fresh cows, thus increasing milk production. Williams et al. (1991) predicted that stimulation of cellulolytic bacteria to increase fiber digestion by live yeast culture resulted in the increased DMI. Similarly, yeast increased DMI and 4% FCM of heat-stressed cows (Moallem et al., 2009).

In one of the few studies with Jersey cows, Dann et al. (2000) top-dressed *S. cerevisiae* culture from 21 d prepartum to 140 d postpartum. They noted treatment × day interactions for milk production resulting from similar interactions for DMI, with yeast culture–supplemented cows increasing their DMI more rapidly postpartum compared with the control. Aikman et al. (2008) reported that Jersey cows increased ruminal solid passage rate compared with Holsteins, which they attributed to increased rumination efficiency. Thus, even past the periparturn period, Jerseys might respond to *S. cerevisiae* by improving DMI if diets have enough starch to stimulate production of lactic acid and therefore benefit from increased lactate conversion to VFA. The objective of the current study was to evaluate the efficacy of Yea-Sacc TS in a continuous lactation study with Jersey cows fed a TMR moderately high in starch (24–26%) but adequate in effective fiber.

MATERIALS AND METHODS

Sixty multiparous (n = 38) and primiparous (n = 22) Jersey cows were sourced from The Ohio State University Waterman Dairy Farm,

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Columbus, Ohio. Cows were housed in a climate-controlled (average = 12.4°C, SD = 3.9°C) tie-stall barn with individual stalls and mangers for each cow throughout the 84-d experimental period, including a 7-d adjustment period. Following the adjustment period, cows were paired in this hierarchy: parity, milk production, and DIM during the 7-d pretrial adjustment to stalls. Within a pair, cows were randomly assigned to 1 of 2 treatments: control or Yea-Sacc TS. Mean milk production was verified to be similar (within 0.1 kg/d) among treatments. The experiment period started on January 16, 2013, and ended on April 11, 2013. The protocol for this trial was approved by The Ohio State University Institutional Animal Care and Use Committee.

Feeding and Animal Care

A basal ration consisting of corn silage, rye grass, and alfalfa mix baleage; concentrate mix; and cottonseed was formulated (Spartan Ration Evaluater/Balancer for Dairy Cattle, v 3.0.3, Michigan State University, East Lansing) to support a lactating Jersey producing 30 L of milk per day with 4.90% fat and 3.90% protein. Ingredient and nutrition composition are in Table 1. The formulated ration was expected to have NE_L of 1.58 Mcal/kg and CP at 17.5% DM according to the 2001 Dairy NRC. Forage NDF and starch were formulated at 17.8 and 27.1% DM, respectively, to simulate conditions in which yeast supplement would be expected to be more efficacious. Cows were fed 105% of ad libitum intake, with refusals being weighed and recorded before the evening feeding. Fresh TMR was mixed once daily and weighed into individual barrels per cow. Half was fed following evening milking, and the remainder was offered the following morning after milking. This strict control of feeding was done to help prevent cross-contamination of feeds among neighboring cows and to equalize distribution of top-dresses (below) into the feed consumed. Feed was pushed up twice daily. Automatic waterers provided ad libitum access to fresh water. Cows were milked twice daily at approximately 0430 and 1600 h. Milk production, health, treatment, and signs of estrus (if applicable) were recorded daily. One control cow was removed from the trial at d 65 because of a case of clinical mastitis, with data included up to wk 6. Cows were weighed every 7 d following morning milking. At the start and end of the trial, cows were weighed on 2 consecutive days following the morning milking. Cows were also evaluated weekly by 2 trained evaluators for BCS (1 to 5 scale; 1 = emaciated and 5 = obese).

Experimental Treatment

Two top-dresses were prepared and provided to cows twice daily at a rate of 50 g per each of the 2 doses. The Yea-Sacc TS top-dress consisted of 5% Yea-Sacc TS and 95% ground corn, thoroughly mixed and resulting in a top-dress that was projected to contain 1×10^8 cfu/g. The target dose was 1×10^{10} cfu/d per animal. The control top-dress was 100% ground corn. Top-dresses were stored away from cows in a separate barn and stored in a cool, dry area that remained at a temperature above 0°C. The Yea-Sacc TS batch was manufactured October 15, 2012, and had an expiration date of October 1, 2013. The feed batch manufacture of both top-dresses was January 14, 2013, and March 6, 2013. Cross contamination was avoided between treatment groups by providing fresh feed and top-dress after cows were tethered in their assigned stalls following each milking and by ensuring that all residual feed was scraped into individual mangers before cows were returned to their stalls after milking.

Table 1. Ingredient composition of the diet

Ingredient	% DM
Corn silage, kernel processed	27.1
Rye grass–alfalfa baleage	13.5
Whole cottonseed	10.0
Soybean hulls	7.2
Corn grain, dry ground	27.3
Soybean meal, solvent, 48% CP	6.2
Rumen-protected soybean meal[1]	6.2
Copper sulfate	0.01
Dicalcium phosphate	0.29
Calcium sulfate	0.18
Limestone	0.94
Selenium 200	0.15
Trace-mineralized salt[2]	0.55
Zinc sulfate	0.01
Biotin 100[3]	0.35
Vitamin A (30,000 IU/g)	0.01
Vitamin D (3000 IU/g)	0.04
Vitamin E (20,000 IU/g)	0.06

[1]Amino Plus, Omaha, NE.

[2]Guaranteed analysis: Na, 36.6%; Cl, 56.4%; Zn, 3,500 mg/kg; Mn, 2,800 mg/kg; Fe, 1,750 mg/kg; Cu 350 mg/kg; I, 70 mg/kg; and Co, 70 mg/kg.

[3]DSM Nutritional Products, Parsippany, NJ.

Sample Collection and Analysis

Weekly samples of the TMR, corn silage, baleage, concentrate mix, and cottonseed were taken and stored at −4°C. Feed was thawed, dried in a forced-draft oven for 48 h at 55°C, ground to pass through a 2-mm screen, and composited by month. The CP, ADF, and crude fat were analyzed according to standard methods (AOAC, 1990). The NDF was determined according to the procedure by Van Soest et al. (1991) with amylase and sulfite but not corrected to an ash-free basis. Starch was analyzed using autoclaving to swell starch, glucoamylase for digestion, and glucose oxidase for quantification by a YSI 2700 Select Biochemistry Analyzer (Application Note 319; YSI Inc., Yellow Springs, OH). Water soluble carbohydrates were analyzed according to methods by Hall et al. (1999). The above analyses were conducted at Dairy One Forage Laboratory (Ithaca, NY). Ash and DM were analyzed according to AOAC (1990). The chemical analyses averaged over