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Effects of two yeast based direct fed microbials on performance of high producing dairy cows

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ABSTRACT

Our aim was to determine effects of two *S. cerevisiae* yeast based direct fed microbial (DFM) feed additives on the productive response of high producing early lactation dairy cows. The study consisted of three high producing Holstein cow pens (±315 cows/pen) in a 3 × 3 Latin square design experiment with 3 periods of 28 d each. The 3 treatments were: (1) Basal total mixed ration (Control), (2) Control supplemented with 'XPC' yeast culture at 14 g/cow/d and, (3) Control supplemented with 'Yeasture (YST)' DFM at 10 g/cow/d. Milk ($P = 0.01$), milk true protein ($P = 0.01$), lactose ($P = 0.01$) and energy ($P = 0.02$) outputs were higher for YST cows, and there was a tendency for milk fat ($P = 0.07$) to increase compared to Control cows. In contrast, milk and component yields were not impacted by feeding XPC. Total net energy (NE) output was higher for both DFM treatments *vs.* Control (YST ($P < 0.01$) and XPC ($P = 0.01$)), but neither treatment impacted the NE level of the diets. Total tract apparent digestibility of organic matter (OM) and crude protein (CP) tended to be lower ($P = 0.08$ and 0.05) than Control for the XPC treatment, while total tract apparent digestibility of OM and CP for YST cows was lower ($P = 0.02$ and < 0.01 respectively) than Control. Total tract apparent digestibility of ash-free neutral detergent fibre (aNDFom) and starch were not affected by treatment, and there was no effect of either DFM treatment on microbial CP (MCP) flow from the rumen. Total plasma essential amino acid (EAA) concentrations tended to be higher ($P = 0.07$) with YST, which was mainly driven by increases in threonine ($P = 0.03$), tryptophan ($P = 0.02$), valine ($P = 0.08$) and histidine ($P = 0.06$). Although total plasma non-essential amino acids (NEAA) did not differ with YST feeding, there was an increase in concentrations of glycine ($P = 0.04$), asparagine ($P = 0.03$), tyrosine ($P = 0.05$), serine ($P = 0.07$), proline ($P = 0.06$) and taurine ($P = 0.07$). In contrast, XPC had no impact on plasma concentrations of any AA. Overall, MCP flow and whole tract aNDFom data suggest no substantive impact of either yeast additive on rumen fermentation, but whole tract digestibility of OM and plasma AA concentrations suggest a post-ruminal effect of YST wherein gut health improved thereby leading to increased efficiency of nutrient absorption.

Abbreviations: AA, Amino acids; ADF, Acid detergent fibre; ADICP, AD insoluble CP; AL, Allantoin; aNDFom, ash free eutral detergent fibre assayed with alpha amylase; BCS, Body condition score; CP, Crude Protein; DDGS, Dried distillers grains with solubles; DFM, Direct fed microbial; DIM, Days in milk; DM, Dry matter; EAA, Essential AA; EE, Ether extract; GI, Gastrointestinal; MCP, Microbial CP; NEAA, Non-essential AA; NEact, NE activity; NEm, NE maintenance; OM, organic matter; PD, Purine derivative; SCC, Somatic cell count; SG, Specific gravity; TMR, Total mixed ration; YST, Yeasture.

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1. Introduction

Although there are several commercial *Saccharomyces cerevisiae* yeast based products, as well as substantial research completed on supplementing yeast based products to ruminant diets, results are variable (Robinson and Erasmus, 2008). While many claims have been made about the impacts of yeast based products on ruminant animal performance, which include improved feed intake, feed efficiency, rumen fiber fermentation, rumen microbial protein (MCP) synthesis, rumen pH and digestion, all involve ruminal mechanisms. Indeed rumen fermentation processes play a key role in ruminant nutrition (Van Soest, 1994), and the extent of interactions among microbial populations in the rumen is so complex that many pathways remain unknown (Russell, 2002). Thus ruminant nutritionists and microbiologists have the same objective, which is to increase nutrient utilization in the rumen.

Concerns about use of antibiotics in livestock feeding are well known due to the occurrence of antibiotic resistant bacteria that might represent a risk to human health (Barton, 2000). This concern led to use of ionophores as growth stimulants in food animals being banned in the European Union in January 2006 (Regulation 1831/2002/EC; DiLorenzo, 2010). Thus the search for safe, high quality and efficacious feed additives has led research to focus on 'natural' alternative additives such as direct fed microbial's (DFM) and essential oils (Patra, 2011), and how they can be used to improve efficiency of animal production, whether by improving rumen fermentation, decreasing methane production, reducing nutritional stressors such as acidosis and bloat, improving post rumen gastrointestinal (GI) health with the overall objective of increasing the health and productivity of dairy cows. Direct fed microbials are a common dairy feed additive worldwide but, due to variability in animal responses and introduction of new additives, continuing research is needed to demonstrate efficacy.

The objectives were to determine effects of the two *S. cerevisiae* yeast based feed additives on dry matter (DM) intake, whole tract apparent digestibility, rumen fermentation, body condition score (BCS), milk yield and milk composition of lactating Holstein dairy cows in order to determine if it is beneficial to include these additives in their diets

2. Materials and methods

2.1. Study location, duration and experimental design

The study was completed on a commercial dairy farm near Hanford (CA, USA) and encompassed the 12 wks from 23 January 2014–17 April 2014. The experimental period was divided into 3 periods of 4 wks. In every experimental period there was a 3 wk adaption followed by a 4th wk for sample collection. Samples were collected of individual feedstuffs as well as the total mixed ration (TMR), DFM yeasts, urine, blood, milk and feces. The BCS scoring was completed at the start of the study and at the end of each experimental period.

The experimental design was a 3×3 Latin square with 3 pens, 3 dietary treatments and 3 experimental periods. The treatment TMR differed only in that they contained, or did not contain, one of the DFM yeast based feed additives. Each pen received one of the treatments during the experiment: (1) Basal TMR (Control); (2) Control supplemented with the Diamond V XPC yeast culture (XPC; 14 g/cow/d). [Diamond V Mills, Cedar Rapids, IA, USA]; (3) Control supplemented with the Yeasture DFM (YST) (10 g/cow/d). [Cenzone Tech, Inc., San Marcos, CA, USA]. Feeding levels were as specified by the manufacturers.

2.2. Study cows and pens

Three pens containing an average of 315 multiparous high producing Holstein cows/pen not yet confirmed in calf and milked three times daily in a double 35 herringbone parlour were used. Cows were moved out of these 'high' pens to a common 'mid' pen after being confirmed pregnant at about 200 days in milk (DIM), and the cows that moved was removed from the study. Pens were similar with a single feed bunk under a roof structure and 297 free stalls with dried manure solids as bedding which was restored weekly, as well as 295 head gates/pen (used to examine cows in morning 'lock up'). There were rubber mats on the walkway between the free stalls and the milking parlour as well as along the feed bunk in the pen in order to minimize foot and leg injuries. Cows were allowed access to an enclosed dirt lot outside of the roofed area daily, except during morning 'lock up'. Clean drinking water was available at all times.

2.3. Diets

The TMR's were fed twice daily, but the yeast additives were only included in the first load that was fed in the morning when the cows were being milked. The second feeding, to ensure *ad libitum* TMR was available all day, and was fed between 11:30 and 12:30 h and did not contain the DFM. The TMR were 'pushed up' every 2 h during the day to encourage consumption. Diet ingredients are in Table 3.

2.4. The DFM yeast additives

Diamond V XPC (XPC) is a recently introduced yeast culture manufactured by Diamond V Mills containing 15% CP (minimum), 1.5% crude fat (minimum), 25% crude fibre (maximum) and 9% ash (maximum) as defined by the manufacturer.