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Use of a live yeast strain of *Saccharomyces cerevisiae* in a high-concentrate diet fed to finishing Charolais bulls: effects on growth, slaughter performance, behavior, and rumen environment

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ABSTRACT

Aim of this study was to evaluate effects on growth, slaughter performance, behavior, and rumen environment parameters of dietary supplementation with a live yeast strain of *Saccharomyces cerevisiae* in a high-concentrate finishing diet fed to young Charolais bulls. A total 171 bulls (initial body weight (BW) = 442 ± 22.8 kg) were stratified by BW and assigned to one of two experimental groups: Control (85 bulls) and Yeast (86 bulls). Each group was allotted to 6 contiguous pens. All bulls were fed the same finishing diet *ad libitum* as a total mixed ration (TMR) at 0900 h. The live yeast strain of *Saccharomyces cerevisiae* CNCM I-1077 was added to the Yeast bull premix to target a daily dose of 5 g/bull. Bull final BW (743 ± 18.7 kg) and average daily gain (1.64 ± 0.12 kg) did not differ between groups. However, yeast increased dry matter (DM) intake (11.0 *versus* 10.4 kg/d; $P = 0.04$) and tended to reduce ($P = 0.08$) the number of days required for finishing. The effect of yeast on DM intake was particularly relevant in the first weeks of fattening, possibly as a sign of better adaptation by bulls to the high-energy concentration of the finishing diet. Carcass weights and dressing did not differ between treatments, but the likelihood of producing a carcass graded as excellent by conformation score was 2.15 times higher for Yeast than Control bulls (Chi-Square = 14.7 and 95% confidence interval = 1.42–3.27; $P < 0.001$). Observation of bull behavior assessed during the 8 h after TMR delivery at the end of the 2nd and 4th mo of fattening showed a similar eating and ruminating pattern between treatments. However, yeast provision prevented from the drop in rumination rate (min/kg DM) recorded in Control bulls from the 2nd to the 4th mo of fattening. Physical and chemical analysis of TMR samples collected from the mangers at determined intervals after TMR delivery indicated that bulls of both treatments preferentially selected towards long fibrous particles. Rumen pH, lactic acid and total volatile fatty acid concentrations in samples collected before TMR feeding after the 3rd month of fattening were not affected by treatment but yeast increased acetate and butyrate concentrations as well as acetate:propionate ratio. *Post mortem* inspection of rumen wall showed that the occurrence of rumen papillae hyperkeratinization was

Abbreviations: ADF, acid detergent fibre expressed with residual ash; ADG, average daily gain; aNDF, neutral detergent fibre assayed with a heat stable amylase and expressed with residual ash; AOAC, association of official analytical chemists; BW, body weight; BYS, before yeast supplementation; C, control; CI, confidence interval; DM, dry matter; EE, ether extract; FCR, feed conversion ratio; ME, metabolizable energy; NRC, national research council; RR, relative risk; TMR, total mixed ration; VFA, volatile fatty acids; Y, yeast; Y3, after 3 months of fattening

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lower for Yeast than Control bulls (relative risk = 0.51 and 95% confidence interval = 0.27–0.95; $P = 0.02$).

1. Introduction

Intensive beef production systems are designed to maximize animal growth and profitability, generally by providing high-concentrate diets with small amounts of forage (Campbell et al., 1992), often as TMR in order to promote synchronized intake of concentrates and forages (Cozzi and Gottardo, 2005; Nagaraja and Lechtenberg, 2007). However, ingestion of high quantities of readily fermentable substrates can lead to digestive disorders, such as ruminal acidosis (Calsamiglia et al., 2012). This pathological condition develops in the early stage of fattening as a result of overly rapid transition from high-forage to high-concentrate diets (Bevans et al., 2005), or in the later stage of fattening due to excessive intake of non-structural carbohydrates (Nagaraja and Titgemeyer, 2007). Negative effects of ruminal acidosis on growth and health of beef cattle reared in intensive systems have been reported (Gonzàlez et al. 2012) and a high incidence of mortality has been diagnosed in cattle with acute acidosis (Nagaraja and Lechtenberg, 2007). Preventive strategies have been developed to avoid acidosis, often by changing feeding management and/or including additives in the TMR (Castillo et al., 2004, 2013). Among additives, live or dried yeast has been widely used to prevent digestive disorders and improve feed intake and efficiency in young growing cattle (Lesmeister et al., 2004; Galvao et al., 2005). Yeasts are known to act positively on ruminal microbial activity by stabilizing pH, especially in cattle with high dietary intake of non-structural carbohydrates which could alter the microbial ecosystem (McAllister et al., 2011). High-concentrate diets have also been shown to negatively affect cattle intake and sorting activity (Ingrand, 2000; Cozzi and Gottardo, 2005), but effects of yeasts on these behaviors are unknown.

The aim of this study was to evaluate the effects of adding a live yeast strain of *Saccharomyces cerevisiae* to a high-concentrate diet on the growth, behavior and rumen environment of Charolais bulls during their finishing period.

2. Material and methods

2.1. Animals and farm management

The study was completed on a beef farm located in the Veneto region in the eastern part of the Po Valley (Italy) using a total 171 young Charolais bulls imported from France in two batches within a 2 wks period. At arrival, bulls were acclimatized to the new rearing environment in deep litter pens allocated outside the fattening barns where they were fed a high forage diet for a 15 d adaptation period (Table 1). Following adaptation, bulls were assigned to one of two experimental groups (Control (C) *versus* Yeast

Table 1
Feed ingredients (g/kg DM) and chemical composition (means ± standard deviation; g/kg) of the diets provided during the adaptation and the finishing periods.

	Adaptation diet	Finishing diets	
		Control	Yeast
Ingredient composition, g/kg DM			
Corn silage, whole crop	353	297	297
Corn, high-moisture shelled	166	131	131
Corn, meal	90	242	242
Corn, gluten feed	90	76	76
Sugar beet pulp, dried	90	45	45
Wheat, straw	91	76	76
Premix[a]	120	133	133[b]
Chemical composition, g/kg			
Dry matter	600	604 ± 7.45	597 ± 14.0
Organic Matter	951	953 ± 2.28	952 ± 1.81
Crude protein	124	129 ± 2.72	129 ± 2.15
Ether extract	34	33.2 ± 1.98	32.9 ± 1.70
Starch	306	355 ± 15.1	359 ± 10.1
aNDFom	342	289 ± 14.0	288 ± 13.9
ADFom	203	146 ± 7.59	145 ± 6.23
ME, MJ/kg DM[c]	10.3	11.0	11.0

[a] Composition: Each one kg consisting of 380 g corn distillers grain, 190 g wheat middlings, 105 g soybean meal, 105 g corn gluten feed, 55 g calcium carbonate, 55 g roasted soybeans, 38 g urea, 25 g sunflower meal, 20 molasses, 20 g sodium chloride, 2.5 g magnesium oxide, 32,400 IU Vit. A, 4500 IU Vit. D, 493 mg zinc sulfate monohydrate, 225 mg choline, 43 mg niacin, 373 mg ferrous carbonate, 277 mg manganese sulfate monohydrate, 141 mg cupric sulfate pentahydrate, 5.5 mg calcium iodate, 0.99 mg sodium selenite. The carrier is sodium chloride to complete 1 kg, Consorzio Agrario del Nordest, Verona, Italy.

[b] Yeast premix contained 3.1 g/kg of Levucell SC2ME Titan as fed basis.

[c] Calculated according to NRC (2000).