EFFECTS OF LIVE YEAST ON PARTICLE SIZE DISTRIBUTION OF FECES AND PERFORMANCE PARAMETERS IN DAIRY COWS FED ON STARCH-RICH DIETS

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Abstract. Live yeast is known to positively influence rumen fermentation resulting in stabilized performance and reduced risk of metabolic disorders in dairy cows. To investigate the effect of live yeast in dairy cows a field trial was conducted. 160 multiparous cows were assigned into two homogeneous groups. Treatment group received 3 g live yeast per head and day on-top of the energy-concentrated TMR (7.2 MJ NEL/kg, 30% starch in DM). The effects of live yeast supplementation on rumen function were measured by manure-sieving (NASCO Digestion Analyzer). The observed performance parameters were milk yield, energy-corrected milk yield (ECM), milk components per animal and feed intake per group. Live yeast supplementation improved particle size distribution of feces in treatment group compared to control. The smaller particles in treatment group can be interpreted as an indicator for improved digestibility of fiber and/or organic matter. Feed intake increased in treatment group by 4% compared to control. Fat content of milk increased significantly (3.65% vs. 3.82%, P=0.077) resulting in a numerically improved ECM (42.3kg vs. 44.0kg, P=0.208).

Keywords: live yeast, dairy cow, starch-rich diets, feces analysis, Nasco Digestion Analyzer

Introduction

Performance level of dairy cows has increased markedly during the last decades. In order to meet increased production demands, high levels of concentrates are fed. This can lead to increased fermentation rate with a higher accumulation of SCFA and lactate. Consequently, rumen pH drops. Low pH-levels bear the risk of sub-acute rumen acidosis (SARA) resulting in decreased digestion of fiber and organic matter. Further consequences of SARA are reduced performance and increased risk of metabolic disorders (Staufenbiel 2011). Moreover, additional costs due to reduced performance and increased incidence of health problems should be taken into account. Therefore, an optimized rumen function under practical feeding conditions should be achieved. Beside the feeding management, the application of different feed additives can play in important role in this matter.

Live yeast is known to stabilize rumen function by stabilizing rumen pH and improving environmental conditions for cellulolytic and lactate-degrading bacteria in the rumen (Jouany 2001). Strong effects of live yeast supplementation can be expected in rations, which are on the edge of ruminant welfare due to low fiber constituents and high contents of starch and sugar (Scheidemann & Steingass 2004, Ferraretto et al. 2012). A field trial was conducted to investigate the effect of live yeast supplementation on particle size distribution of feces and performance parameters in dairy cows fed on a starch-rich but commonly used diet.

Material and Methods

160 multiparous cows (Holstein-Friesian) in 2nd to 5th lactation were divided into two homogeneous groups (control and treatment group) on the basis of days in milk (DIM), lactation number and milk yield. Animals were loose-housed and fed a total-mixed ration (TMR) offered *ad-libitum*. The TMR was mixed twice a day. The TMR was calculated to be rich in energy (7.2 MJ NEL/kg) and starch (30% in DM, Table 1) following the recommendations of Ferraretto et al. (2012) to create a SARA-inducing ration. In treatment group, live yeast was supplemented on-top. The used product was based on the yeast strain *Saccharomyces cerevisiae* MUCL 39885 and dosed with 3 g per head and day (4.5x10^{10} CFU per h/d). The trial period lasted 13 weeks, whereby a minor feeding change in trial week 7 occurred (partly replacement of wet corn with milled corn). This change in TMR-composition had no effect on analytical parameters (Table 1).

The particle size distribution of feces was measured using wet-sieve analysis by NDA (NASCO Digestion Analyzer, Nasco, USA). The NDA separator is consisting of three sieves arranged in tiers with the following mesh sizes: top 4.76 mm, middle 2.38 mm, and bottom 1.59 mm (Cotanch & Darrah, 2012). Twelve representative cows (2nd/3rd lactation, Ø 47 DIM at trial start) of each group were selected for rectal feces sampling (N=24). Feces analysis was performed every second week after trial start (6 analysis in total) using a standardized protocol. 500g of feces were weight-in und washed through the NDA for 55 seconds. For all analysis the same water nozzle and pressure was used. The feces residual in each sieve were back-weighed and the distribution was compared with each other (total and relatively).

To measure the effects of live yeast supplementation on performance parameters, average weekly feed intake per group and average daily milk yield per animal were documented. Milk components were measured once per month in the official milk performance test. Energy-corrected milk yield (ECM, 3.4% protein, 4.0% fat) was calculated according to Weiß et al. (2013). Results were shown as mean values for the whole trial period.

Statistical analysis was performed by one-factorial ANOVA (SPSS Statistics 22, IBM). The effects of month and treatment (live yeast, control) and interaction (treatment x month) were set as a fix. The animals within the treatments were considered as random effect. Feed intake was described descriptive as a mean value per group and week. P-values below P<0.1 were assumed as significant according to the Regulation (EC) No. 429/2008 (EU, 2008) on additives for use in animal nutrition.

Table 1: **Feed composition and chemical analysis of TMR in trial week 1 – 7 and 8 – 13**

	Trial week 1-7	**Trial week 8-13**
Feed composition in kg fresh matter per head and day		
Corn silage	28.24	28.24
Gras silage	4.2	4.2
Corn gluten	3.0	3.0
Rapeseed meal	5.5	5.5
Soybean meal	1.2	1.2
Wet corn	5.0	1.7
Corn, milled	-	3.7
Seaweed meal	0.08	0.08
Molasses	0.50	0.50
Mineral feed	0.40	0.40
Total	**48.12**	**48.12**
Chemical composition		
Dry matter (%)	45.67	46.06
Crude protein (% in DM)	18.6	18.6
Crude fiber (% in DM)	13.0	13.0
Starch (% in DM)	30.0	30.0
NEL (MJ/ kg DM)	7.23	7.24

Results

Total back-weight of feces did not differ between control and treatment group (295.0 vs. 287.3g). But feces distribution in the different sieves seemed to be influenced by live yeast supplementation. The amount in the bottom sieve was increased significantly (P<0.1, Figure 1).

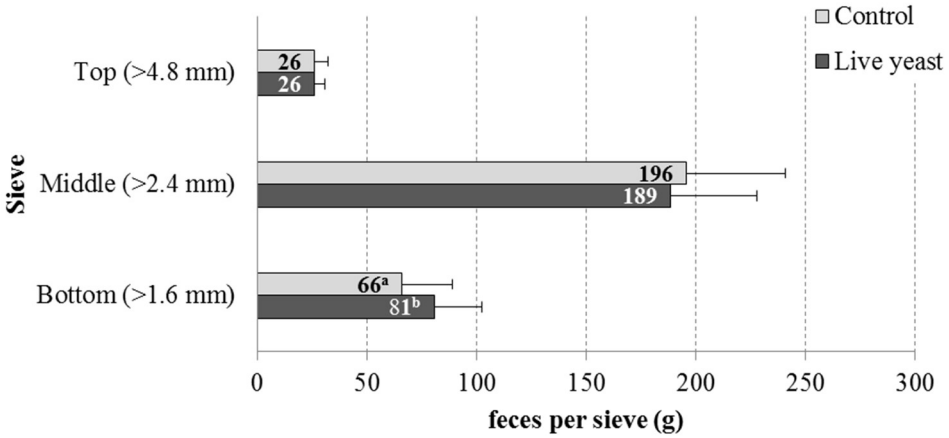

Figure 1: Average residual feces per sieve of control and treatment groups (means±SD, n=12)

Average daily feed intake was increased by 4% in treatment group compared to control (24.7kg vs. 23.8kg). Figure 2 shows the average feed intake of both groups during the trial period.

No effect of yeast supplementation on uncorrected milk yield could be analyzed. The average in both groups amounted to 44 kg per head and day. Milk components (fat percent) were significantly improved in treatment group compared to control (P<0.1). As a result, ECM was numerically increased in treatment group (Table 2). In the last trial month ECM differed significantly between control and treatment group (41.5 vs. 45.0 kg, P=0.018).

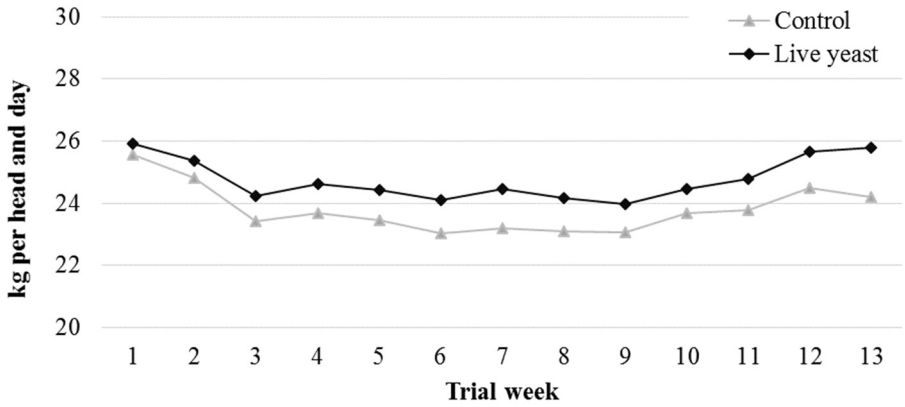

Figure 2: Mean feed intake of control and treatment group during trial period

Table 2: Selected performance parameters (ECM, milk components) of control and treatment group

	Control	Treatment	SEM	P-value
ECM (kg per head/day)	42.3	44.0	0.93	0.208
Fat (%)	3.65	3.82	0.07	0.077
Protein (%)	3.45	3.45	0.03	0.965

Discussion

Feces analysis showed significantly higher amounts of small particles (bottom sieve) in treatment group. These results may indicate an improved fermentation rate in the rumen resulting in a modified particle size distribution of feces. In the present trial it was not investigated if this modified particle size distribution results from an improved digestibility of OM. Desnoyers et al. (2009) observed an improved digestibility of OM (+0.98%) and a higher feed intake (+1.16%) due to live yeast supplementation. The authors concluded that the improved feed intake resulted from the improved digestibility of OM. Improved feed intake was also observed in the present trial.

Positive effects of live yeast on cellulolytic bacteria has been described by Chaucheyras-Durand et al. (2008). More cellulolytic bacteria lead to an improved fiber digestibility and accumulation of acetate. Acetate can be used for fat synthesis by the dairy cow (Kirchgeßner et al. 2014).

In the present trial, milk fat content significantly improved due to live yeast supplementation (3.65% vs. 3.82%; $P<0.1$). In contrast to findings of Desnoyers et al. (2009) this effect was not proven for pure (uncorrected) milk yield. But it is important to notice that the milk performance of cows in the present trial was already on a very high level. A further improvement of this parameter could not be expected.

Conclusion

The wet-sieve analysis system used in the trial (NASCO Digestion Analyzer) seems to be a suitable and handy method for documenting changes in feed digestibility. But for reliable and comparable results, it is essential to follow a standardized protocol for feces collecting and sieving. Also the number of reference animals has to be high enough (10% of the herd, minimum n =12). Further practical experience and corresponding digestibility analysis are necessary to evaluate the method properly.

The trial data obtained from the Digestion Analyzer show, that the addition of live yeast to a TMR rich in starch positively influences the substrate degradation inside the rumen. The already high performing cows further improved their performance due to an increased milk fat content leading to a higher ECM. Effects of diet composition and behavior of feed intake on particle size distribution of the feces were not taken into account.

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