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The effect of live yeast inclusion into mixed forage diets on milk yield, locomotion score, lameness and sole bruising in first lactation Holstein Friesian dairy cattle

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ABSTRACT

The aim was to assess the effect of supplementing mixed forage diets with live yeast on milk yield, locomotion score, lameness and sole bruising in first lactation Holstein Friesian dairy cattle. Heifers (n 34) were divided into two groups according to calving date, breeding value (milk fat and protein yield), live weight, body condition and *post-partum* milk yield and offered a mixed forage diet of grass, maize and whole crop silage, 17 were offered the mixed diet with the addition of live yeast (Y), 17 were offered the same mixed forage diet with no additional live yeast (NY). All animals were assessed weekly for milk yield and composition, locomotion score up until 160 days in milk (DIM). Mean milk yield (Y: 29.5, NY: 27.1) and milk solids (Y: 1.98, NY: 1.80 (kg/h/d) were significantly higher with the addition of yeast (P<0.001). Sole lesion score increased significantly at day 160 (50 DIM: 1241 b, 100 DIM: 1295 b, 150 DIM: 1676 a) and of the WL at day 100 pp (50 DIM: 1042 b, 100 DIM: 1448 a, 150 DIM: 1710 a) (P<0.001). The hind outer (HO) claws had significantly higher lesion scores than inner claws (sole outer: 340.2, others 149.4 to 184.2; White line Outer: 267.5, others: 168.4 to 228.9) (P<0.001). Heifers offered forage diets with the addition of yeast had significantly lower sole (Y: 1151.5 b, NY: 1645.3 a)(P<0.05) and WL lesions at 160 DIM. The addition of live yeast increased milk yield and reduced lesion and locomotion score in first lactation heifers.

Keywords: Live yeast; milk yield; mixed forage diets; lameness.

INTRODUCTION

Yeast has been used as a means of manipulating rumen fermentation to improve production performance because of the effect on stimulating cellulolytic micro-organisms in the rumen that increase fibre digestion, alter acetate to propionate ratios and increase microbial protein flow to the duodenum (Wallace & Newbold, 1992). In most studies, where an animal response was observed, yeast culture increased feed intake rather than altering feed conversion efficiency; only occasionally were improved feed efficiency a possible benefit (Günther, 1989). However, Williams *et al*. (1991) found that animals offered high energy diets had decreased rumen lactic acid concentrations, which is associated with higher rumen pH and characteristic of more stable rumen fermentation. Low rumen pH has been associated with poorer hoof quality (Westwood *et al*., 2003). This research aimed to assess the effect of the inclusion of live yeast in total mixed rations on milk yield, lameness, laminitis and hoof characteristics.

MATERIALS AND METHOD

The heifers (n 34) were allocated into one of two groups at parturition between 30 November and the 31 December 2005 and allocated to into matched pairs according to breeding value, body condition score and live weight. The heifers were all offered *ad libitum* access to the same total mixed ration (TMR) for a total of 114 days, which was either with the addition of live yeast at the rate of 10 billion/h/d (Yeast) or with no additional live yeast (No yeast). The weekly milk yield and milk composition was measured using pm and am composite milk samples, which were analysed using an Infrared Analyser (Foss Electric, Hillerod, Denmark). The live weight, body condition and locomotion score were assessed weekly and the scoring systems used had 5 point scales. Locomotion ranged from 0 to 1 which corresponded with a cow that is not lame and does not show tenderness when walking and 4 or 5 was a cow that is severely lame, almost not weight bearing on lame limb/s, in according to Tranter & Morris (1991). Lame heifers were examined to determine the cause of lameness and the development of each lameness case was monitored. The claws of heifers were assessed for sole ulcers, sole haemorrhage and heel erosion at 50, 100, and 150 DIM. Any other alteration present during examination, such as *Digital dermatitis* and heel horn erosion were recorded. The lesions on each foot were scored according to Leach *et al.* (1998). The affected areas of the sole and white line areas of the cow's foot were marked and subsequently photographed with a digital camera

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and the images were analysed for the size of claw area, white line and haemorrhage using Image Analysis program (Scion Image Analysis, 2001) and the white line and sole areas of the hoof were scored separately. The hoof growth and wear rates were measured on the right rear inner claw at 50, 100 and 150 DIM. A mark was made on the hoof wall 2 cm below the coronary border. The distance from the coronary border to the mark and from the mark to the distal end of the wall was measured and a new mark was made 2 cm below the coronary border every time the hooves are measured. The monthly growth and wear rates were estimated from these measurements as described by Clark & Rakes (1982) and the hoof angle, length of the front hoof wall and height of the heel were measured at the same time of the hoof growth and wear, according to Boelling & Pollott (1998).

Statistical Analysis

The experiment was a randomised block design, using individual heifers as replicates. The hoof measurements were found to be normally distributed and analysed making comparisons by observation period, using analysis of variance (ANOVA), general linear modelling command (Minitab 14.0). Due to the nature of locomotion scores and the number of low values was high and skewed the distribution towards lower values and a non parametric analysis, Mann-Whiney U test (Minitab 14.0) was used.

RESULTS

The mean milk yield and composition are presented in Table 1 and heifers offered silage with additional live yeast had a significantly higher mean milk yield (P<0.001), fat corrected milk yield (P<0.019), milk protein (%), (P<0.018) total fat and protein yield (P<0.001) and lower milk urea (P<0.001) levels compared with animal offered mixed silage diet with no additional live yeast. There were no significant differences in milk lactose, milk fat (%) or somatic cell count between animals offered diets with or without the addition of live yeast.

The mean locomotion score and hoof measurements are presented in Table 2. The number, percent and total score of sole haemorrhage were significantly higher (P<0.05) for the hooves of animals offered diets with the

Table 1: Mean milk yield, milk composition, SCC, body weight and condition score of animals offered mixed silage diets with (Yeast) or without the addition of live yeast (No Yeast).

	Yeast	No Yeast	SEM	P
Mean feed intake (kg)	23.7	22.5	-	-
Mean milk yield (kg/h/d)	29.5	27.1	0.29	<0.001
Mean corrected yield (kg/h/d)	25.5	24.6	0.28	0.019
Mean milk fat (g/kg)	36.2	37.0	0.53	0.240
Mean milk protein (g/kg)	32.0	32.9	0.19	0.018
Total milk solids (kg/h/d)	1.98	1.80	0.010	<0.001
Mean SCC (,000 cells / ml)	173	189	54	0.930

Milk fat corrected to 40.0 g/kg

Table 2: Mean locomotion score, lesion scores, hoof measurements, growth and wear rates, incidence of digital dermatitis and slurry heal of animals offered mixed silage diets with (Yeast) or without the addition of Yeast (No Yeast).

	Yeast	No Yeast	SEM	P
Locomotion score (1 to 5)	1.25	1.18	-	0.103
Mean number of sole haemorrhages	2.3	3.2	0.28	0.021
Sole haemorrhage (%)	10.1	18.1	2.13	0.009
Total score sole haemorrhage (%)	11.5	23.2	2.96	0.006
White line damage (No.)	0.6	0.7	0.09	0.549
White line damage (%)	18.4	17.2	2.95	0.782
Total score white line damage (%)	25.6	21.6	4.82	0.563
Foot angle (mm)	48.6	49.3	0.34	0.156
Dorsal border (mm)	83.6	84.5	1.78	0.574
Heel depth (mm)	36.9	35.9	1.08	0.524
Diagonal measurement (mm)	116.8	115.8	1.29	0.595
Monthly growth (mm)	6.2	6.3	0.98	0.944
Monthly wear (mm)	4.5	10.7	2.19	0.063
Incidence of digital dermatitis (%)	7.4	7.4	3.021	1.000
Incidence of slurry heel (%)	20.9	9.8	3.26	0.074

addition of live yeast compared with animals not offered live yeast. There were no significant differences in white line measurements or in the incidence of digital dermatitis. The score (percentage and intensity) of sole haemorrhaging was significantly higher in the animals offered mixed silage diets without the addition of live yeast compared with animals offered mixed silage diets with the addition of live yeast. The locomotion score, foot angle, dorsal border, heel depth, diagonal measurement, monthly growth or monthly wear rates were not significant different between animals offered mixed silage diets with or without the addition of live yeast. However, the monthly wear rates were significantly higher for animals offered mixed silage diets without the addition of live yeast compared with animals offered mixed silage diets with the addition of live yeast (P<0.10).

DISCUSSION

In this study, there was a significant higher mean milk (P<0.001) 9%, total fat and protein yield (P<0.001) and urea (P<0.001) content of milk from animals offered mixed silage diets with the addition of live yeast. Similarly, Wohlt *et al*. (1998) found that dietary yeast supplementation during early lactation improved dry matter intake (DMI), milk yield, and the digestibility of crude protein (CP) and acid detergent fibre (ADF). Robinson & Garrett (1999) observed trends for increased DMI and milk production during early lactation for cows offered yeast supplementation *pre-* and *post-partum.* While, Erasmus *et al.* (2005) also found mean milk CP yield progressively increased in those offered yeast as the level of milk CP production of the cows increased and mean DMI progressively increased with yeast supplementation, as the DMI level of the cows increased. While a review of 22 studies, involving more than 9039 dairy animals and a range of types of yeast cultures, found that using yeast cultures supplementation resulted in a mean increase in milk production of 7.3%, while responses varied within a range from a 2% to 30% increase in milk production (Dawson, 2000).

While the mean locomotion score was not affected by diet, heifers offered a TMR with yeast had a significantly lower percentage and intensity of sole haemorrhaging compared with heifers not offered yeast. This could be due to this group having lower rumen lactic acid leading to acidosis and laminitis, which has been attributed to vasoactive substances including histamine, lactic acid, serotonin or endotoxins are produced during systemic illness, including ruminal acidosis (Westwood *et al*., 2003). This may affect vascular perfusion of the digit and at 4 to 8 weeks after the systemic insult, ischaemia and anoxia of the corium become evident clinically as haemorrhages of the sole, change of horn colour from white to light yellow, and a softening of the horn texture, most likely as a result of perturbed keratin metabolism (Westwood *et al*., 2003) which may well affect the wear rate of the hoof horn. There have been a number of diet components that have been associated with lameness and these include; grass silage of low in dry matter (Offer et al., 2001), high concentrations of dietary starch (Manson & Leaver 1988; Greenough & Vermunt, 1991; Nocek 1997), low concentrations of effective fibre (Nocek, 1997) and high concentrations of ruminal degradable protein (Bazeley & Pinsent 1984; Ossent *et al.,* 1997) and finally housing of animals (Livesey *et al*., 1998). Yeast (*Saccharomyces cerevisiae*) is known to act as a rumen environment modifier/ buffer and has the potential to reduce the severity of acidosis and thus laminitis and this suggests why these animals had significantly less sole haemorrhaging as less lactic acid was produced in rumen. Newbold *et al*. (1996) and Marden & Bayourthe (2005) suggest that the ability of the live yeast to scavenge oxygen in the rumen, during the daily feed cycle both in the feed and saliva, increasing the anaerobic state of the ruminal milieu and stimulates the activity of cellulolytic bacteria producing propionate thus reducing the accumulation of lactate. In this research the addition of live yeast significantly reduced the level of sole haemorrhage numbers (P 0.021), percentage (P 0.009) and total score (%) (P 0.006), which may indicate that yeast may have the potential to reduce the risk factors affecting sole damage and hoof wear associated with lameness (Chesterton, 1989) possibly via its effect on rumen pH (Gibb, pers. comm.).

CONCLUSIONS

The addition of live yeast at 10 billion/h/d to total mixed rations significant increased mean yield (kg) (P<0.001), total milk fat and protein (P<0.001) and urea (P<0.001) levels and significantly reduced the level of sole haemorrhage numbers (P 0.021), percentage (P 0.009) and total score (%) (P 0.006).

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