Oral drenching of crude glycerol for primiparous dairy cows in the postpartum period

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INTRODUCTION

Glycerol is a sweet-tasting, viscous, hygroscopic liquid that is a by-product of biodiesel production. As world biodiesel production has increased in the last decade, glycerol has become increasingly used as a feed supplement for dairy cows. Glycerol was introduced as a preventive tool to treat ketosis in dairy cows in the 1950's, but was not adopted due its high costs (Johnson, 1954).
The postpartum period is the most challenging stage of lactation because of the high demands of nutrients for milk that is not supported by sufficient intakes of nutrients. Energy balance becomes negative in the last few days before calving, when cows dry matter intake (DMI) is reduced by up to 30% (Bertics, et al., 1992). This leads to mobilization of body reserves (in the form NEFA) to balance the deficit between dietary intake and nutrient requirements. By feeding glucogenic supplements, such as glycerol, we can increase the availability of glucose while at the same time promoting insulin secretion and decreasing NEFA release from adipose tissue (Overton and Waldron, 2004).
Several studies of the oral administration of crude glycerol have shown its potential as a glucogenic substance for dairy cows. Goff and Horst (2001) gave up to 3 L of glycerol via an oesophageal pump, and increased the blood glucose level by 25%. Stokes et al. (2002) found that a large amount of glycerol given orally had no affect on the concentrations of plasma glucose and NEFA. Linke et al. (2004) showed that glycerol feeding or administration increased ruminal butyrate concentration, which can result in an increase of blood ketones, which may be used to produce energy by various tissues. Contrary to these findings, Ogborn (2006) declared that short-term oral drenching of glycerol is not an effective strategy to improve the performance of dairy cows during early lactation as it resulted in a decrease in both DMI and milk yield. Bodarski et al. (2005) reported increased milk production of 14.6 and 12.5%, respectively, for cows fed glycerol at 300 and 500 ml/day over 10 weeks of lactation.
More recent studies are dissimilar in the method of administration, quantity, delivery period and quality of crude glycerol (Stokes et al., 2002; DeFrain et al., 2004; Ogborn, 2006). However, there is a lack of information in the literature regarding oral glycerol administration over the longer period. The aim of the study was to clarify the effect of feeding crude glycerol to early-lactation dairy cows on body weight, body condition score, dry matter intake, milk production and milk composition, and blood metabolites.

MATERIALS AND METHODS

Ten primiparous Holstein dairy cows were involved in the experiment, from days four to 29 of lactation. Two similar groups of cows (5+5) were formed based on similar body weights (BW) and body condition scores (BCS) before calving. The mean BW was 566 ± 14 kg for the control group and 564 ± 12 kg for the treatment group. Ten days before the expected calving date, cows were scored using a five-point scale with quarter-point divisions according to the system proposed by Edmonson et al. (1989).The mean BCS were 3.46 ± 0.04 and 3.54 ± 0.04, respectively.
The cows were housed individually, tethered in stalls, where they were fed twice a day. The cows were fed according to Estonian feeding standards. Both groups were given a basal diet containing concentrate feed (rapeseed cake 27.0%, wheat 24.0%, wheat bran 10.1%, corn 9.0%, corn feed 8.5%, soyabean meal 8.0%, sliced fodder beet 6.0%, barley 5.0%, salt 0.9%, palm oil 0.8%, limestone 0.5%, Premix Ko 0.2%), minerals and forage silage (ad libitum) according to nutritional requirements. Concentrate feed and silage were fed separately. Silage was removed and measured before the subsequent milking. Twice a week a sample of silage was taken for chemical composition analysis (AOAC, 2005). The treatment group was given an oral drench of 500 ml of crude glycerol (82.6% glycerol, 9.3% salts, 7.1% water, 0.6 crude fat and 0.4% methanol) once a day just before the morning feeding. DMI and milk yield were recorded daily.
Milk and blood samples were collected on two consecutive days once a week. **M**ilk samples were combined proportionally according to milk yield, and kept at +4 °C until analysis on the following morning. The milk fat, protein, and lactose contents were measured at the Milk Analysis Laboratory of

the Animal Recording Centre, using an automated infrared milk analyser (System 4000; Foss Electric, Hillerød, Denmark). **Blood samples were taken, before administration of glycerol, from the coccygeal vein and** were kept frozen at –22°C till analysis.
Statistical significance was declared at $P < 0.05$, with trends noted at $P < 0.10$. All statistical analyses were performed with SAS 9.1 (SAS Institute, 2004).

RESULTS AND DISCUSSION

Oral drenching of crude glycerol had no affect on changes in BW (P=0.77) or BCS (P=0.19) over the experimental period. Ogborn (2006) showed in her experiment that glycerol administered during the first five days of lactation significantly decreased BW and BCS. Oral drenching of crude glycerol decreased DMI of concentrate (P=0.04), and increased DM intake of silage (P=0.006), but had no affect on total DM intake (P=0.87). Contrary results were reported by Ogborn (2006) who reported that short-term oral administration of glycerol decreased DMI.
There were no statistically significant differences between the groups regarding milk yield. However, the treatment group cows had 0.9 kg higher milk production. Stokes et al. (2002) had similar results, when large amounts of glycerol were given orally to heifers and multiparous cows. Bodarski et al. (2005), who fed 500 ml of glycerol in TMR, reported a significant effect on milk production in the first two weeks of lactation. Reichel et al. (2006) reported a similar result, where glycerol feeding increased milk yield by a mean of 0.86 to 1.00 L per day. Different results were again reported by Ogborn (2006), where it was found that milk production decreased during early lactation when glycerol was fed.
Neither the milk fat, protein, lactose, urea content nor milk yield (P=0.16) were affected by treatment during the experimental period. Ogborn (2006) indicated a decrease in both milk lactose and protein percentage. DeFrain et al. (2004), who fed glycerol top-dressed onto TMR, also found no significant effect on milk yield or milk components during the post partum period.
Blood serum urea (P=0.43), glucose (P=0.85), insulin (P=0.49) and BHBA (P=0.15) were no different between the groups. Blood NEFA concentration decreased in both groups, but there were no differences between the groups (P=0.78). Our results for glucose may be related to the fact that blood plasma glucose level will return to baseline values within 24 hours (Goff and Horst, 2001), as we collected blood samples **before the administration of glycerol**.
Another cause of the differences in these and reported results may because of the parity of cows used, as primiparous dairy cows recover from the NEB period with more difficulties than multiparous cows (Meikle et al. 2004).

CONCLUSION

Oral administration of 500 ml of crude glycerol per day improved DMI of silage, but did not affect total DM intake. There were no adverse effects on milky yields, milk parameters or animal condition and physiological measures.

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