

# Effects of Free-Access Feeding and Milk Replacer Acidification on Calf Performance and Development of Digestive Anatomy

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## Introduction

Conventional milk feeding strategies have traditionally provided milk or milk replacer to calves at a rate of 8 to 10% of body weight, usually distributed over two meals per day. There is, however, a growing body of research indicating that calves are motivated to consume much higher volumes of milk, as much as 20% of body weight, without negatively affecting health (Appleby et al., 2001; Jasper and Weary, 2002; Khan et al., 2007; Borderas et al., 2009). Furthermore, feeding higher or ad libitum volumes of milk supports significantly greater body weight gain (Appleby et al., 2001; Jasper and Weary, 2002; Khan et al., 2007) and is associated with reduced behavioural signs of hunger, including fewer calf contacts and displacements, and increased lying time (De Paula, Vieira et al., 2008; Borderas et al., 2009). A system of implementing free-access acidified milk feeding for calves has recently been proposed, and gained widespread adoption in Ontario (Anderson, 2008). Nevertheless, there has been little controlled research conducted to evaluate the effects of this novel milk feeding program. The aim of this research was to examine the effects of free-access feeding and milk replacer acidification on calf performance and development of digestive anatomy.

## Materials and Methods

Holstein male calves (n=16) were randomly assigned at birth to 1 of 4 feeding programs: 1) free-access (ad libitum) feeding of milk replacer (22% CP and 17% fat), 2) free-access feeding of acidified milk replacer, 3) restricted (6 L/d) feeding of milk replacer and 4) restricted feeding of acidified milk replacer. Formic acid was used to acidify the milk replacer to a target pH between 4.0 and 4.5. Calves were weaned from milk at 42 days of age. Milk replacer, starter ration and water intakes were measured daily, while body weight gain was determined weekly for each calf. One calf from each feeding program was euthanized at 28, 42, 56 and 70 d of age. Rumen tissue samples were collected and wall thickness, papillae length, width and density were measured. Multivariable regression models were constructed to examine the effects of free-access feeding and acidification on important outcome variables.

## Results and Discussion

Calves assigned to the 4 treatment groups did not differ for body weight or serum total protein concentration at the time of enrolment. Free-access feeding resulted in higher milk consumption

(9.2 vs 5.3 L/d,  $p < 0.01$ ); acidification did not affect milk intake ( $p > 0.05$ ). Restricted-fed calves began consuming starter ration significantly earlier (hazard ratio=12.3,  $p < 0.01$ ) and had greater starter intake (3.8 vs 1.0 kg,  $p < 0.01$ ) over the free-access calves. Milk replacer acidification was

associated with reduced time to onset of starter consumption (HR=3.7,  $p<0.05$ ). Free-access calves gained significantly more body weight than the restricted-fed calves (26.0 vs 14.3 kg,  $p<0.05$ );

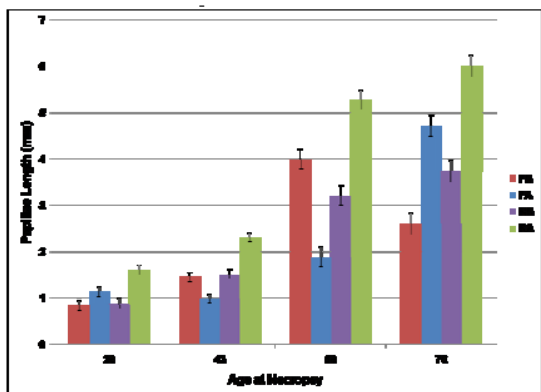


Figure 1: Mean papillae length (mm) in the cranial part of the ventral ruminal sac of calves fed different milk feeding treatments

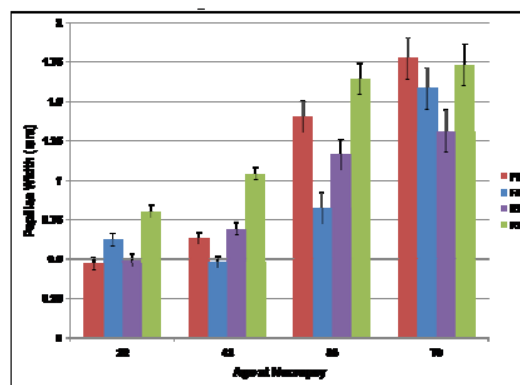


Figure 2: Mean papillae width (mm) in the cranial part of the ventral ruminal sac of calves fed different milk feeding treatments

acidification did not affect weight gain ( $p>0.05$ ). Restricted milk feeding was associated with increased papillae length ( $p<0.05$ ; Figure 1) and width ( $p<0.05$ ; Figure 2).

## Conclusions

These data demonstrate that calves will consume higher volumes of milk than what is offered with conventional feeding methods. Calves reared on free-access milk feeding programs also show improved body weight gain. Thus, free-access acidified milk feeding may mimic calves' natural feeding patterns, negate feelings of hunger and improve calf welfare. In addition, these results indicate that free-access feeding delays the onset to starter ration consumption and is associated with reduced ruminal papillae growth, which could negatively impact the welfare of calves during the weaning period. As such, it is recommended that further research be conducted to determine the optimum weaning protocol for calves on free-access milk feeding programs.

## References

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