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Calf Note #259 – Long-term effects of early-life nutrition

Introduction

Amounts of liquids fed to calves – saleable whole milk, waste milk, calf milk replacer (CMR) or combinations thereof – have increased and it's common to feed calves 8 liters or more per day prior to weaning. Increased liquid nutrients delays the time at which calves are ready to be weaned, and the weaning transition needs to be more carefully managed.

Calves are fed >8 L of liquid per day to increase preweaning gain, improve feed conversion (albeit at a higher cost per unit of gain) and potentially improve future milk production. Numerous studies have associated preweaning rates of body weight gain with first-lactation milk production (Raeth-Knight et al., 2009; Davis Moallem et al., 2010; Rincker et al., 2011; Soberon et al., 2012), though there are many other factors associated with first-lactation milk production (Gelsinger et al. 2016).

While some studies have reported improvements in post-weaning calf performance, others have shown little or no difference in body measures, reproductive performance, or milk production after calving. Some of this difference may be associated with the number of animals used in a study (large numbers of animals are needed to detect differences in these types of studies), small differences in total preweaning nutrient intake, or a lack of control of other effects (genetic, nutrition, etc.) in the studies that occur after weaning. In any case, the biological mechanisms underlying the idea that calves that grow faster preweaning are more productive as cows remain elusive.

The research group from Trouw Nutrition in The Netherlands published a manuscript in the Journal of Dairy Science (Leal et al., 2025) that describes results of a study that investigated "what happens" when calves are fed different amounts of milk prior to weaning. The results are interesting and the topic of this Calf Note.

The Research

Holstein calves (n = 86) from a single dairy herd in The Netherlands were fed similar amounts of colostrum at birth and then assigned to receive either 4 L or 8 L/day of a CMR (15% DM; 24% CP; 18% fat; 45% lactose) from d 2 after birth until weaning at 56 d of age. Calves were "stepped down" on d 49 by 50% prior to weaning. Calves had access to calf starter (17% CP; 24% NDF; 18% starch), water, and wheat straw. After weaning, all calves were managed and fed similarly and fed similar diets consistent with NASEM requirements for growing heifers. Breeding began when calves reached 390 kg.

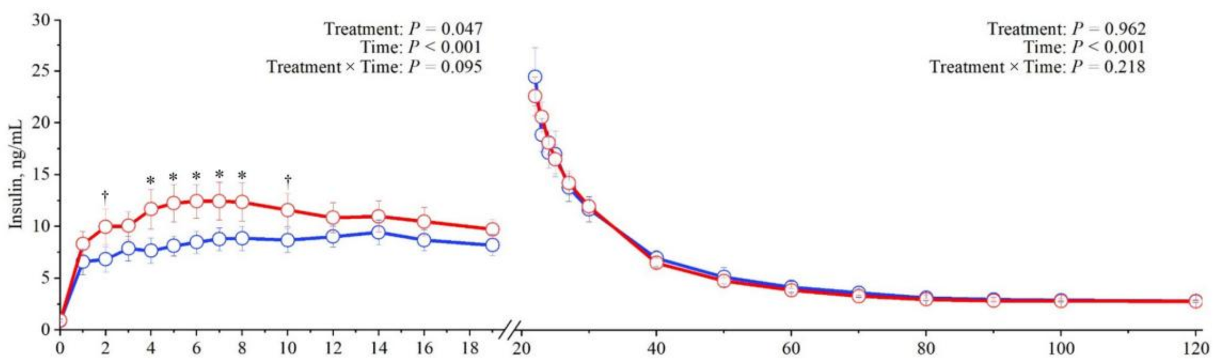
The objective of the study was to compare post-weaning performance and metabolism. Specifically, the researchers were interested in effects of treatment on glucose metabolism and changes in blood metabolites taken after weaning. Specific details of the treatments are available in the manuscript, so they will not be repeated here.

The Results

Performance results are in the Table below. At 70 d of age, calves fed 8 L of CMR were heavier (9 kg), but by 330 d, the difference was no longer significant. Breeding and conception statistics indicated that there was no effect of treatment on reproductive performance or growth from 70 to 330 d of age. The lack of differences were attributed to the quality of the post-weaning diet. The authors hypothesized that the postweaning growth rate (>1 kg/d from 70 to 330 d) allowed both groups to grow rapidly and the reproductive tract of calves fed 4 L of CMR to "catch up".

Item	4 L	8 L	P-value
Growth			
N	**42**	**43**	
BW d 70, kg	**84.9**	**93.9**	**0.01**
BW d 330, kg	**356.7**	**363.7**	**0.30**
ADG 70-330, kg/d	**1.04**	**1.03**	**0.71**
Breeding			
N	**40**	**41**	
BW first service, kg	**412.0**	**416.0**	**0.58**
ADG first service, kg/d	**1.00**	**1.00**	**0.71**
Age first service, d	**399**	**395**	**0.25**
1st service conception, %	**63**	**73**	**0.30**
Conception			
N	**38**	**40**	
Age conception, d	**422**	**412**	**0.19**
Services / conception	**1.46**	**1.35**	**0.48**

Effects of additional liquid feeding on glucose metabolism, there were differences in the way calves responded to a glucose infusion, as indicated in the Figure below. Calves fed 4 L of CMR (red line) produced more insulin in response to the glucose infusion during the initial phase. The authors proposed that preweaning milk supply may slightly affect glucose metabolism well after weaning. The biological and productive significance of this observation is unclear.



Changes in blood metabolites in calves when sampled well after weaning may indicate a long-term shift in metabolism. The authors reported that 14 metabolites were different between the two groups of calves. The metabolites were grouped by metabolic pathway – differences were related to carnitine, glycerolipid, and purine metabolism. When taken together, these data suggest subtle differences in nitrogen and fatty acid metabolism. However, these small changes were not associated with productive changes in growth or reproductive performance.

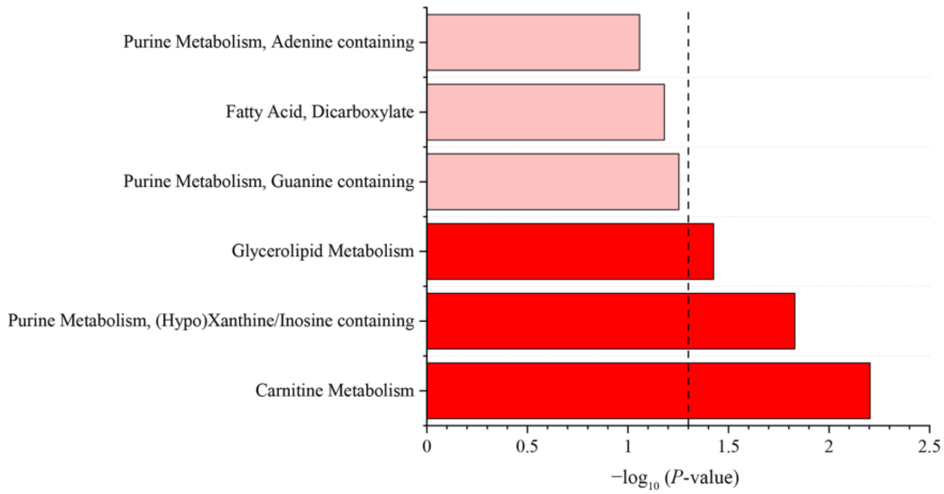


Figure 2. Visualization of meaningful metabolic pathways evidenced by enrichment analysis based on the metabolites detected at d 330 of life in the serum of dairy heifers (n = 50) fed different nutrient intakes preweaning.

Summary

Calves fed 8 vs. 4 L of CMR will grow faster. However, differences in growth may be "washed out" after weaning, particularly when calves are fed excellent dry feed program after weaning to allow calves to "catch up". Though calves fed 8 L of milk preweaning were 7 kg heavier at 330 d of age, the variation in BW did not allow the authors to declare statistical significance. More heifers would be needed to make that declaration. Metabolic differences, though significant, were subtle, and suggested only limited effects of preweaning nutrition on later growth. However, the insights of this research suggest that there are, in fact, long-term effects of preweaning nutrition on calves and subsequent studies (with more animals) can leverage these findings to further identify how these changes affect the cow.

References

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