NSERC Industrial Research Chair in Dairy Nutrition: 5-Year Summary (Part 3)

Michael Steele

University of Guelph, Guelph, ON; email: masteele@uoguelph.ca

Introduction

Dr. Steele was awarded an NSERC Industrial research chair in dairy nutrition in 2015. The purpose of this 5-year appointment is to develop feeding and management practices for calves to promote gut health. Part 3 of this article series focuses on nutritional management strategies for the first weeks and the first months of life.

First Weeks of Life

Plane of Nutrition

A study that we recently conducted at the University of Alberta found that all calves offered large volumes of milk were able to consume over 8 L/day and up to 10 L/day via an automated calf rail during the first week of life. These calves also gained up to 800 g/d, while calves limit fed at 5 L/day only gained 400 g/d (Figure 1). This demonstrates that calves are programmed to consume large volumes of milk to promote their growth and development during early life, especially when starter consumption is negligible.

Unfortunately, many producers assume that it is difficult to implement feeding high planes of nutrition without automation due to the concern of feeding large volumes of milk over 2 or less feedings per day. However, we found that calves fed 8 L of milk per day over 2 meals were able to slow the delivery of milk from the abomasum to the small intestine; thereby, no negative effects were observed on glucose and insulin dynamics compared to calves fed 8 L over 4 meals per day. It is important to note that these calves were fed high levels of milk from the first week of life, and this may be a critical developmental window in which the calf to adapts to higher levels of milk.

Whole Milk vs. Milk Replacer

With the recent shift in calves progressively being fed higher planes of nutrition during the pre-weaning period, there is a renewed interest in how feeding large volumes of MR may affect calf development and metabolism as opposed to whole milk. Traditional milk replacers contain more lactose and less fat compared to whole milk.

There is interest around how feeding high amounts of lactose may influence glucose regulation. A study we conducted at the University of Alberta determined that calves fed a high lactose milk replacer had a greater increase in glucose and insulin concentrations, although insulin sensitivity was unaffected. In terms of how traditional milk replacers may influence gut function, at this point we have found conflicting results. We believe this actually comes down to the quality or types of fat in milk replacers and this is a future area of research we plan to pursue.

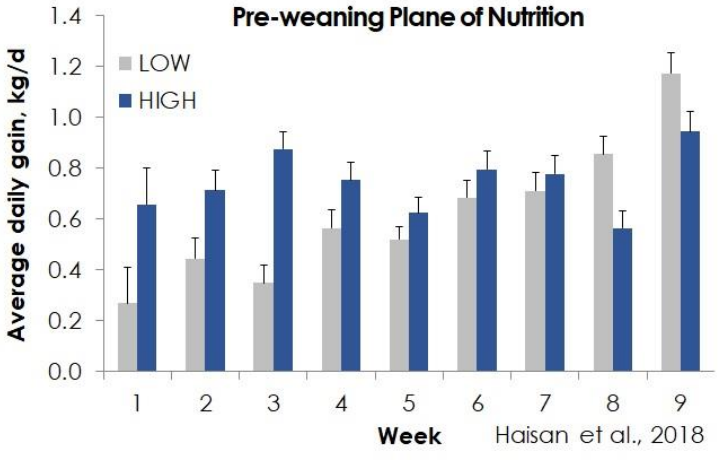

Figure 1. Average daily gain of calves fed either a low (5 L/d) or high (10 L/d) plane of nutrition preweaning.

Weaning

The dairy industry has made great strides in optimizing weaning strategies over the past decades, with more producers weaning gradually and aiming to wean later in life. Our research has shown that weaning later can have beneficial effects from a production standpoint when calves are fed elevated planes of milk preweaning. Specifically, we found that weaning at 8 weeks results in greater starter intake and weight gain and decreased the reduction of weight gain at weaning compared to calves weaned at 6 weeks. We have also demonstrated that when calves are weaned at 5 weeks of life, it can take up to an additional 5 weeks after weaning for the rumen environment of calves fed elevated planes of milk to be in a state that is not considered ruminal acidosis. This suggests that calves weaned early have not undergone the necessary adaptations to digest high amounts of starch at this time.

The weaning transition is a period in which the calf undergoes drastic physical and developmental changes. Previous work has largely characterized how weaning affects the rumen; however, there is little research regarding how weaning can affect the lower gut. We have found high levels of fecal starch in calves fed elevated planes of nutrition and weaned abruptly, suggesting that calves may be experiencing hindgut

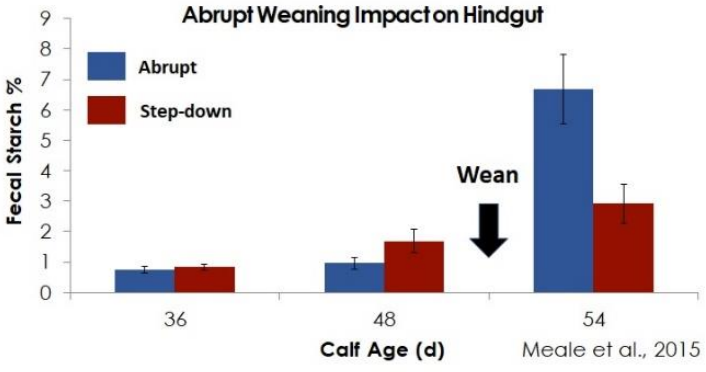

Figure 4. Amount of fecal starch found in calves weaned abruptly or using a step-down method.

Beyond Weaning

Currently, the initial weeks and months after weaning are essentially a black box for heifer nutrition and management. This period is critical in heifer development and we need strong evidence to support post-weaning diets that maximize growth without over-conditioning yearling heifers. We have found that feeding heifers a high plane of nutrition after weaning results in a higher body condition score, as well as increases energy intake and hormones that have a positive effect on gut development, for up to 6 months after weaning (Figure 5).

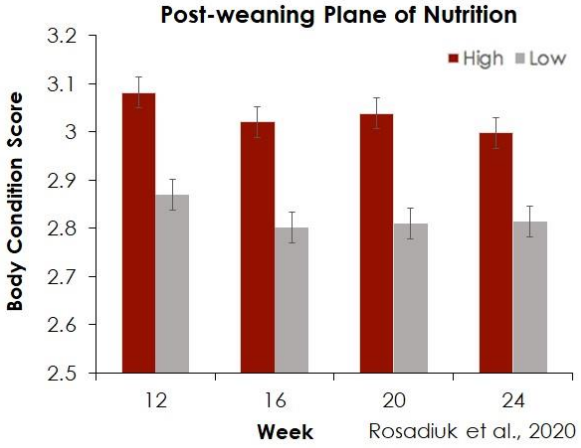

Figure 5. Body condition score of heifers fed a high or low plane of nutrition post-weaning.

Furthermore, compared to heifers fed a low plane of nutrition post-weaning, heifers fed a high plane of nutrition had:

- Enhanced reproductive tract development
- Higher chances of achieving puberty by 30 weeks of age
- Higher number of ovarian follicles during the first estrous cycle

The industry tends to under-feed heifers after weaning, and this research suggests that there may be evidence to support changes in these traditional diets to maximize both heifer growth and reproductive efficiency.