LifeStart: The Science Behind the Program

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LifeStart is an innovative calf nutrition program designed to bring science-based and sustainable practices to the dairy industry for the optimization of dairy performance. So, what is the science that initiated the concept and what are the expected outcomes?

In the pursuit of improved milk yield and production efficiencies, the question has long been asked, when can we best influence a cow's milk production? For years, the focus has been during the lactation itself, shifting over time to the importance of the transition period. More recently, the importance of early life development has come to the attention of researchers and producers alike.

A lactation begins at parturition, but before a lactation can begin, development of the mammary gland must occur, and this development begins far before the pregnancy that is the initial cause of the lactation. The development of the mammary gland is not the only factor affecting milk production; rather, feed efficiency and hormonal regulation among other metabolic influences also modulate milk production. Just as mammary gland development begins in early life, feed efficiency and hormonal regulation also are being programmed from as early as within the womb. As dairy producers, we have a window of opportunity to influence this early life development towards positive lifetime performance.

In a retrospective study that evaluated early life events on first lactation performance of over 1200 heifers, ADG pre-weaning revealed a strong positive correlation with milk yield in the order of 888 lb of milk for every additional 1 lb of Average Daily Gain (ADG) (Soberon, et al. 2013). The differences in ADG in this data set were mainly derived from changes in maintenance requirements due to weather changes during the pre-weaning period. Therefore, when analyzed by the correlation of energy intake available for growth, there was a positive significant correlation such that for every additional Mcal of energy intake above maintenance, heifers produced 518 lb more milk during first lactation. Results from this analysis revealed that the effects of early life management and nutrition accounted for 22% of the variation in milk production. This implies that early life nutrition was responsible for 4 to 8 times the effect on milk production that could be expected by genetic selection.

Studying the effects of liquid feed intake during the first 60 days of life revealed an allometric growth of the liver and the mammary gland, but especially of the mammary parenchymal tissue. At the time of weaning, the mammary parenchymal tissue weight of calves fed increased levels of milk replacer was 6 times greater than that of calves that were restricted in milk intake. This indicates a direct effect of nutrient intake with parenchymal proliferation in the first months of life. This additional growth is only relevant if it turns into increased milk production later in life. Thus, a meta-analysis of all the available studies evaluating the effects of early life nutrition on first lactation milk yield was conducted. The meta-analysis resulted in an estimate that calves that received more nutrients pre-weaning produced on average 960 lb more milk during their first lactation. When pre-weaning ADG was included in the analysis, for every additional 1 lb of ADG pre-weaning, heifers produced 1,540.7 lb more milk in first lactation (Soberon and Van Amburgh, 2013).

The effect of early life nutrition on development is not unique to the dairy cow. The implications of early life nutrition have been described in bees, humans, dogs, sheep and swine among other species. In swine, Bartol et al. (2008) described the lactocrine effect, which refers to the transfer of bioactive ingredients from the sow's colostrum to the newborn piglet. The lactocrine hypothesis has been linked to the effects of relaxin from milk on the development of the uterus in the newborn sow (Bartol et al., 2008) as well as improved gastrointestinal development (Thivend et al., 1980), jejunal protein synthesis (Burrin et al., 1992; 1995) and skeletal muscle synthesis (Burrin et al., 1995).

In cattle, colostrum has been traditionally given to the calf for the transfer of IgG in order to aid the immature immune system. However, the benefits of feeding colostrum to young calves surpass that which can be attributed solely to IgG transfer. Positive long-term effects include increased average daily gain to 180 days (Robison et al., 1988), increased milk yield and fat production during first lactation (DeNise et al., 1989; Faber et al., 2005), reduced time to first calving (Waltner-Toews et al.,1986), increased average daily gain pre-weaning (Osorio and Drackley, 2005; Soberon and Van Amburgh, 2011), increased feed efficiency (Jones et al., 2004), and increased DMI post-weaning (Soberon and Van Amburgh, 2011). For example, Faber et al, (2005) used Brown Swiss cattle and offered different levels of colostrum during the first days of life, after which all calves were treated the same. Even though calves that received more colostrum had higher ADG early in life, by the time they calved, calving weights did not differ among treatments. Cows that received more colostrum at birth had a 12% increase in survival to the end of second lactation and they also produced 2,265 lb more milk during 2 lactations. These long-lasting effects are most likely not related to IgG but rather to the array of other growth factors and hormones present in great concentrations in bovine colostrum, such as IGF-I, EGF, lactoferrin, prolactin, insulin, leptin, relaxin, TGF α and TGF β. Current research is now trying to identify the effect of some of these other factors in the development of the calf.

LifeStart sets life performance, through colostrum administration and liquid feed supply during the first two months of life, so that the milk production potential of a calf can be increased by 2,000 to 3,000 lb of milk per lactation. However, to properly harvest these benefits, calves most be properly cared for during the rest of the rearing period. When a calf is receiving 8 to 12 liters of milk or milk replacer per day, the weaning process requires more attention. It is possible to properly develop the rumen of these young animals and ensure a proper transition but it is highly recommended to use a step-down method for 2 weeks (Khan et al., 2007; Miller-Cushon et al., 2013). Once the calves are weaned, it is important to provide a proper nutrition that would allow the calf to maintain protein synthesis. In a study designed to evaluate the interaction between pre-weaning nutrition and post-weaning dietary protein levels, Moallem et al. (2010) observed that the gains achieved through proper nutrition pre-weaning could be lost if proper levels of protein were not offered pre-breeding. In his study, calves offered whole milk pre-weaning produced more fat corrected milk than calves fed a low protein milk replacer; however, the calves that were supplemented with an additional 2% of protein from 150 to 350 days produced 4.4 lb/d more fat corrected milk than the calves that had been fed the same whole milk but were not supplemented with protein pre-puberty. This study supports the theory that gains can only be achieved at certain developmental stages, but these gains can be lost later in life through improper environmental conditions including nutrition.

Calves raised under this management model will achieve proper breeding weights and heights earlier. It is important to recognize that the proper time to breed a dairy heifer for the first time is when she reaches 55% of her mature body weight and it is not directly correlated to her age. The optimum age at first calving for Fresian-Holsteins when grown under this program is between 21 and 23 months; smaller breeds can successfully calve by 19 months. This was confirmed by analyzing first lactation production of over 10,500 heifers in New York State. Age at first calving ranged from 19 months to 33 months. The analysis revealed that for every month that heifers calved after 23 months, they produced 604 lb. less milk during their first lactation.

Biology and epigenetics are not the only factors that have to be considered when determining the best rearing system for dairy calves. Economics and welfare are another two important considerations in the decision. Dr. Michael Overton from the University of Georgia made an economic comparison of a traditional rearing system to a LifeStart approved system. Dr. Overton used USA values including interest rates, milk price, veterinary costs, and cull values but his equations can be extrapolated to dairies in any country. In his analysis, calves reared under an intensive rearing system cost more per day to feed than traditional calves. However, given that these calves calved 3 months earlier, the total cost of raising calves under a full potential program was the same as the cost of raising heifers under a traditional system. This was before accounting for the additional milk produced by the intensified calves. When the additional milk is considered, the cost of raising calves under an intensified or full potential program is 10% less than the cost of raising them under a traditional system.

In conclusion, the first hours and weeks of a calf's life are a prime time to influence life-time performance. Colostrum is an important source of IgG that provides the calf with much-needed passive immunity, but beyond that, colostrum contains many growth factors that are beneficial for the life performance of calves. Nutrient intake from milk or milk replacer have a positive influence on milk yield later in life. There is no compensatory mechanisms for these effects; if the window of opportunity is missed, the chances to optimize her performance are gone.

Remember: The most effective way to properly influence the future performance of a calf is to: **1. – Colostrum**, 3 L at birth, 2 L 6 hours later and an additional 2 L 12 h from birth. **2. – Calories**, provide sufficient, good quality milk or milk replacer so calves can at minimum double their birth weight by 56 days. After weaning, properly balanced diets should allowed breeding calves at 13 to 14 months of age once they have reached 55% of their mature body weight to achieve an age at first calving between 21 and 23 months.**3. – Consistency,** deliver milk or milk replacer that is completely mix at the same percentage of solids every time, at the right temperature, 3 times a day. **4. – Comfort**, provide the calves with sufficient space and bedding so she grows in a well ventilated, dry environment, during winter she needs to be able to nest in the bedding to keep warm. **5. – Cleanliness**, the best colostrum and facilities would be compromised if the calf, the feeding equipment, the facilities are not properly and consistently cleaned to reduce the calves' exposure to pathogens. Cleanliness begins with the calving pen and the mothers' udder before collecting colostrum but it is required throughout her life.