Optimizing Nutrition and Management of Calves and Heifers for Lifetime Productivity

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Take Home Messages

1. The pre-weaning period is a period of life where the calf is undergoing significant developmental changes and this development is directly linked to future productivity in the first and subsequent lactations.
2. Pre-weaning growth rate and primarily protein accretion appears to be a key factor in signaling/communicating with the tissues that enhances lifetime milk yield.
3. Anything that detracts from feed intake and subsequent pre-weaning growth rate reduces the opportunity for enhanced milk yield as an adult.
4. Nutrient supply, both energy and protein, are important and protein quality and digestibility are essential.
5. There are no substitutes for liquid feed prior to weaning that will enhance the effect on long-term productivity.
6. Factors other than immunoglobulins in colostrum modify feed intake, feed efficiency and growth of calves and can enhance the effect of early life nutrient status.
7. As an industry and as nutritionists we need to talk about metabolizable energy and protein intake and status relative to maintenance and stop talking about cups, quarts, gallons, buckets and bottles of dry matter, milk, milk replacer, etc. The calf has discrete nutrient requirements not related to dry matter and liquid volume measurements.
8. The effect of nurture is many times greater than nature and the pre-weaning period is a phase of development where the productivity of the calf can be modified to enhance the animal's genetic potential.
9. Adhering to specific growth targets throughout the rearing period and calving as early as feasible is essential to ensure optimum economic returns in the first lactation within the management system.

Lactocrine Hypothesis: Colostrum's role

It has been well recognized that the phenotypic expression of an individual is affected by both genetic ability as well as environment. The environment contains multiple external signals that affect the development and expression of the genetic composition of an animal. While in the uterus, the mother controls the environment in which the fetus is developing, influencing in this way the expression of the genetic material and there is good evidence that the environment can play a role in long-term productivity in beef cattle (Summers and Funston, 2012). Similarly, data from an evaluation of the DHIA database published by Hinde et al. (2013) demonstrated that fetal sex had a significant impact on the volume of milk produced by the dam. In this study, a heifer or cow carrying a female fetus instead of a male fetus responded by producing about 500 pounds more milk in the first lactation and did the same in the second lactation if again carrying a heifer in the second pregnancy. The dam receives signals once the sex is determined in utero and is programmed to produce more nutrients for the female during lactation. It is interesting that the dam will provide more nutrients to the heifer calf given the typically smaller body weight and lower maintenance requirements and suggests the heifer should be made more anabolic through maternal nutrition, which follows on the long-term productivity data that has been generated over time.

The effect and extent of maternal influence in the offspring's development does not end at parturition, but continues throughout the first weeks of life through the effect of milk-born factors, including colostrum, which have an impact in the physiological development of tissues and functions in the offspring. A concept termed the "lactocrine hypothesis" has been introduced and describes the effect of milk-borne factors on the epigenetic development of specific tissues or physiological functions in mammals (Bartol et al., 2008). Data relating to this topic has been described in neonatal pigs (Donovan and Odle, 1994; Burrin et al., 1997) and calves (Baumrucker and Blum, 1993; Blum and Hammon, 2000; Hammon et al., 2012). The implication of this hypothesis and the related observations are that the neonate can be programmed maternally and postnatally to alter development of a particular process and potentially modify genetic ability of the animal.

Colostrum is known to be rich in a variety of nutrients, but also non-nutritive factors, such as hormones, growth factors and other bioactive factors capable of exerting some positive developmental effect on the neonate (Table 1) and this has been extensively researched and reviewed (Odle et al., 1996; Blum and Hammon, 2000; Steinhoff-Wagner et al. 2011; Hammon et al. 2012). For example, colostrum feeding has been shown to positively affect the development of the gastrointestinal tract (GIT) and enhance energy metabolism of the calf. Adequate intake of these non-nutritive factors appears to be important for establishing gastrointestinal development for enhanced nutrient intake and nutrient utilization (Blum and Hammon, 2000; Hammon et al. 2012). The data from Steinhoff-Wagner et al. (2011) clearly demonstrated that colostrum feeding as compared to iso-nutrient levels of a milk-based formula enhanced the glucose uptake of calves fed solely colostrum for up to four days of life. In that experiment, first milking colostrum was fed as the first meal and second, third and fourth milking colostrum was fed over the next three days, respectively, to examine differences in dietary glucose uptake, insulin responsiveness and endogenous glucose production. Calves fed colostrum had higher levels of plasma glucose, similar endogenous glucose production and higher plasma insulin concentrations post feeding, suggesting that colostrum enhanced the absorption of glucose and the insulin in the colostrum was absorbed by the GIT and contributed to the endogenous insulin production. It is also important to note that glycogen reserves were greater in the calves fed colostrum and that serum urea nitrogen was lower and amino acid concentration was greater, implying a more anabolic state with colostrum intake as compared to similar nutrient intake from formula. Thus, it appears that in addition to the Ig's, the other non-nutritive factors in colostrum are important to establish enhanced energy utilization and GIT development in newborn calves and these potential effects should be considered when evaluating and diagnosing differences in calf performance under similar management and nutritional conditions.

Table 1. Nutrients, energy, immunoglobulins, hormones and growth factors in colostrum and milk.

Components	**Units**	**Colostrum**	**Mature Milk**
Gross Energy	MJ/L	6	2.8
Crude protein	%	14.0	3.0
Fat	%	6.7	3.8
Immunoglobulin G	g/L	81	<2
Lactoferrin	g/L	1.84	Undetectable
Insulin	µg/L	65	1
Glucagon	µg/L	0.16	0.001
Prolactin	µg/dL	280	15
Growth hormone	µg/dL	1.4	<1
IGF-1	µg/dL	310	<1
Leptin	µg/dL	30	4.4
TGF-α	µg/dL	210	<1
Cortisol	ng/ml	11.2	1.2
17βEstradiol	µg/dL	3.3-4.7	0.54

Several studies have indicated that the amount or presence of colostrum in the first meal has an impact on growth performance of pre-weaned calves. Jones et al. (2004) examined the differences between maternal colostrum and a serum-derived colostrum replacement. In that study, two sets of calves were fed either maternal colostrum or serum-derived colostrum replacement with nutritional components balanced. The colostrum replacer was developed to provide adequate immunoglobulins to the neonatal calf, however the other non-nutritive factors found in colostrum were not considered. The results demonstrated that in the first 7 days of life, the calves fed maternal colostrum had significantly higher feed efficiency that was still apparent at 29 days, compared to calves fed serum-derived colostrum replacement, however the IgG status of the calves on both treatments were nearly identical suggesting that factors in colostrum other than IgG's were important in contributing to the differences. Further, data from Faber et al. (2005) demonstrated that the amount of colostrum, 2 L (2.1 qt) or 4 L (4.3 qt), provided to calves at birth significantly increased pre-pubertal growth rate under similar nutritional and management conditions.

To extend this data, Soberon and Van Amburgh (2011) examined the effect of colostrum status on pre-weaning ADG and also examined the effects of varying milk replacer intake after colostrum ingestion. Calves were fed either high levels (4 L (4.3 qt)) or low levels (2 L (2.1 qt)) of colostrum, and then calves from these two groups were subdivided into two groups that were fed milk-replacer in limited amounts or ad-libitum. Calves fed 4 L of colostrum had significantly greater average daily gains pre-weaning and post-weaning and greater post-weaning feed intake, consistent with the data from Faber et al. (2005) and Jones et al. (2004). The observations from these experiments reinforce the need to ensure that calves receive as much colostrum as possible over the first 24 hr and possibly over the first 4 days as described by Steinhoff-Wagner et al. (2011) to ensure greater nutrient availability and absorption for the calf. The non-nutritive factors in colostrum, other than Ig's, appear to be important for helping the calf establish a stronger anabolic state and develop a more functional GIT barrier and surface area for absorption.

Also, colostrum is the first meal and accordingly is very important in establishing the nutrient supply needed to maintain the calf over the first day of life. The amount of colostrum is always focused on the idea we are delivering a specific amount of immunoglobulins (Ig's) to the calf, and many times we underestimate the nutrient contribution of colostrum. Further, many times of year, we tend to underestimate the nutrient requirements of the calf, especially for maintenance. For example, a newborn Holstein calf at 85 lbs birth weight has a maintenance requirement of approximately 1.55 Mcals ME at 72 °F. Colostrum contains approximately 2.51 Mcals metabolizable energy (ME)/lb, and a standard feeding rate of 2 quarts of colostrum from a bottle contains about 1.5 Mcals ME. Thus, at thermoneutral conditions, the calf is fed just at or slightly below maintenance requirements at its first feeding. For comparison, if the ambient temperature is 32 °F the ME requirement for maintenance is 2.4 Mcals, which can only be met if the calf is fed approximately 1 lb of DM or about 3.5 quarts of colostrum. This simple example illustrates one of the recurring issues with diagnosing growth and health problems with calves and that is the use of volume measurements to describe nutrient supply instead of discussing energy and nutrient values. Two quarts of colostrum sounds good because that is what the bottle might hold, but it has little to do with the nutrient requirements of the calf.

Managing the calf for greater intake over the first 24 hours of life is important if we want to ensure positive energy balance and provide adequate Ig's and other components from colostrum for proper development. For the first day, at least 3 Mcals ME (approximately 4 quarts of colostrum) would be necessary to meet the maintenance requirements and also provide some nutrients for growth. On many dairies this is done via an esophageal feeder and the amount dictated by the desire to get adequate passive transfer. Those dairies not tube feeding should be encouraging up to 4 quarts by 10 to 12 hours of life to ensure colostrum is fed not only to meet the Ig needs of the calf, but also to ensure that the nutrient requirements are met for the first day of life.

Table 2. Effect of high (4+2 L) or low (2L) colostrum and ad-lib (H) or restricted (L) milk replacer intake on feed efficiency and feed intake in pre and post-weaned calves (Soberon and Van Amburgh, 2011).

Treatment[1]	HH	HL	LH	LL	Std dev
N	34	38	26	27	
Birth wt, lb	97	95.7	92.1	95.4	2.1
Birth hip height, in	31.7	31.6	31.5	31.9	0.2
IgG concentration, mg/dl*	2,746[a]	2,480[b]	1,466[c]	1,417[c]	98
Weaning wt, lb	172.4[a]	140[b]	159.1	137.5[b]	4.2
Weaning hip height, in	36.6[a]	34.9[b]	36[c]	35.3[b]	0.2
ADG pre-weaning, lb	1.7[a]	0.9[b]	1.5[c]	0.9[b]	0.1
Hip height gain, pre-weaning, in/d	0.1[a]	0.06[c]	0.09[b]	0.06[c]	0
ADG birth to 80 d, lb	1.7[a]	1.3[b]	1.5[b]	1.2[c]	0.1
Hip height gain, birth to 80 d, in/d	0.08 [a]	0.06[b]	0.07[c]	0.06[b]	0
Total milk replacer intake, lb DM	97.9[a]	45.2[b]	90.1[c]	44.1[b]	2.6
Grain intake pre-weaning, lb	5.5[a]	26.4 [b]	4.6[a]	21.4[b]	3.3
ADG/DMI, pre-weaning	0.6	0.61	0.67	0.61	0.04
ADG post-weaning, lb	2.4[a]	2.1[b]	1.9[b]	2.0[b]	0.1
DMI post-weaning, lb/d	6.4[a]	6.4[a]	5.7[c]	5.9[b]	0.2
ADG/DMI post-weaning	0.36	0.35	0.34	0.36	0.02

[1]HH = high colostrum, high feeding level, HL = High colostrum, low feeding level, LH = Low colostrum, high feeding level, LL = Low colostrum, low feeding level. Rows with different superscripts differ $P < 0.05$.

Given the data on effects of colostrum on metabolism, a management suggestion to make best use of the factors the dam is trying to supply the calf would be to feed first milking colostrum to the calf immediately, then feed colostrum from milkings 2 through 4 (day one and two of lactation) to the calves over the first 4 days. This would ensure the non-nutritive factors are supplied to the calf during the period the calf is responsive to them in an effort to enhance intestinal development and function along with enhancing glucose absorption during a period when energy status is extremely important to the calf.

Nutrient status and long-term productivity

There are many studies in various animal species that demonstrate early life nutrient status has long-term developmental effects. Aside from the improvement in potential immune competency, there appear to be other factors that are impacted by early life nutrient status. There are many published studies and studies in progress that have both directly and indirectly allowed for an evaluation of first lactation milk yield from cattle that were allowed more nutrients up to eight weeks of age. In the majority of these studies, increased nutrient intake prior to 56 days of life resulted in increased milk yield during the first lactation that ranged from 0 to 3,000 additional pounds compared to more restricted fed calves during the same period (Table 3).

Table 3. Milk production differences among treatments where calves were allowed to consume more nutrients than the standard feeding rate prior to weaning from milk or milk replacer. The milk yield values are the difference between the control and treatment animals.

Study	Milk yield, lb
Foldager and Krohn, 1991	3,092[s]
Bar-Peled et al., 1998	998[ns]
Foldager et al., 1997	1,143[t]
Ballard et al., 2005 (@ 200 DIM)	1,543[s]
Shamay et al., 2005 (post-weaning protein)	2,162[ns]
Rincker et al., 2006 (proj. 305@ 150 DIM)	1,100[ns]
Drackley et al., 2007	1,841[s]
Raith-Knight et al., 2009	1,582[t]
Terre et al., 2009	1,375[t]
Morrison et al., 2009 (no diff. calf growth)	0
Moallem et al., 2010	1,600[s]
Soberon et al., 2012	1,217[s]
Margerison et al., 2013	1,311[s]
Kiezebrink et al. 2015 (little diff. calf growth through entire phase)	0

The papers and data described in Table 3 were analyzed in a meta-analyses to further investigate the impact of nutrient intake and growth rate prior to weaning (Soberon and Van Amburgh, 2013). The analysis excluded Foldager and Krohn, (1991) due to inadequate data to fully describe the treatments and Davis-Rincker et al. (2011) because they did not measure full lactations. The Morrison et al. (2009) study was included in the analysis and the data of Margerison and Kiezebrink were not available at the time of the analysis. The software used was Comprehensive Meta Analyses software (www.Meta-Analysis.com) (Borenstein et al. 2005) and the data included were study, treatment size (number of calves), mean milk yield, standard error or deviation, P value and effect direction. The data of Soberon et al. (2012) was initially excluded and then included to test for weighting effects since Soberon et al. contains many hundreds of animals. Inclusion of Soberon et al. did not change the outcome and the data were included in the analyses. The analysis indicated that feeding higher levels of nutrients from milk or milk replacer prior to weaning significantly increased milk yield by 959 ± 258 lb, $P < 0.001$, with a confidence range of 452 to 1,463 lb of milk. Further, when ADG was included as a continuous variable among the data set, the outcome was similar to that of Soberon et al. (2012) where for every pound of pre-weaning ADG, milk yield in the mature animal increased by 1,540 lb ($P = 0.001$). This is a significant amount of milk and demonstrates the sensitivity of the calf to pre-weaning nutrition, health and growth. Maintaining health to ensure high levels of feed intake reinforces the objectives of the dam to provide more nutrients to the heifer as described in the study by Hinde et al. (2013).

An analysis of all the lactation data and the pre-weaning growth rates, when controlled for study, suggests that to achieve these milk yield responses from early life nutrition, calves must at least double their birth weight or grow at a rate that would allow them to double their birth weight by weaning (56 days). This further suggests that milk or milk replacer intake must be greater than traditional programs for the first 3 to 5 weeks of life in order to achieve this response.

An analysis of 1,244 heifers with completed lactations from the Cornell herd was conducted and used a statistical approach similar to a sire evaluation to determine the effect of pre-weaning nutrition on lifetime productivity (Soberon et al., 2012). These data demonstrated there are programming or developmental events being affected in early life that have a lifetime impact on productivity (Table 4). Two aspects of the data that are worth noting were the effect on milk yield over multiple lactations and some effects of immune stress during the pre-weaning period. Within the data set, we were able to evaluate a portion of the cattle that completed up to 3 lactations. When we evaluated the 450 animals that had completed a third lactation, we found a lifetime milk effect of pre-weaning average daily gain of over 6,000 lb of milk depending on pre-weaning growth rates.

Table 4. Predicted differences by TDM residual milk (lb) for 1st, 2nd, and 3rd lactation as well as cumulative milk from 1st through 3rd lactation as a function of pre-weaning average daily gain and energy intake over predicted maintenance for the Cornell herd. (Soberon et al. 2012)

Lactation	*n*	*Predicted difference in milk per lb of pre-weaning ADG*	*P value*	*Predicted difference in milk (lb) for each additional Mcal intake energy above maintenance*	*P value*
1st	1244	850	< 0.01	519	< 0.01
2nd	826	888	< 0.01	239	0.26
3rd	450	48	0.91	775	< 0.01
1st – 3rd	450	2,280	0.01	1,991	< 0.01

The other observation worth noting was the effect of diarrhea or antibiotic treatment on growth and productivity. For calves with either diarrhea or antibiotic treatment, ADG was not significant and ADG differed by approximately 30 g/d for calves that had either event in their records ($P > 0.1$). However, for calves that had both events recorded, ADG was lower by approximately 50 g/d ($P < 0.01$). Over the eight year period, approximately 59% of all of the calves had at least one of the recorded events. First lactation milk yield was not significantly affected by reported cases of diarrhea. However, antibiotic treatment along with diarrhea had a significant effect on TDM residual milk and calves that were treated with antibiotics produced 1,086 lb less milk in the first lactation ($P > 0.01$) than calves with no record of being treated. Regardless of antibiotic treatment, the effect of ADG on first lactation milk yield was significant in all calves ($P < 0.05$). Calves that were treated with antibiotics produced 1,373 lb more milk per kg of pre-weaning ADG while calves that did not receive antibiotics produced 3,101 lb more milk per kg of pre-weaning ADG. The effect of increased nutrient intake from milk replacer was still apparent in the calves that were treated, but the lactation milk response was most likely attenuated due to factors associated with sickness responses and nutrient partitioning away from growth functions (Johnson, 1998; Dantzer, 2006).

Practical considerations to ensure adequate pre-weaning growth

To meet the requirements, there are several options and each option requires an economic and management process for each farm. For example, standard calf feeding programs over the last 30 years took the approach of feeding modest amounts of milk or milk replacer, generally at a level that would meet the maintenance energy requirements, and the overall objective was to encourage dry feed intake (Kertz et al. 1979; Otterby and Linn, 1980). This practice was developed to overcome certain health issues in addition to being low cost. Weaning as early as possible does offer the benefits of lower feed costs and reduced labor, however, the approach only works effectively when the calf is always in a thermo-neutral situation. For example, using the calf model within the 2001 Dairy NRC (NRC, 2001) a 110 lb calf consuming 1.25 lb of a 20:20 milk replacer has a metabolizable energy (ME) allowable gain of 0.68 lb/d at 68°F, which is within the thermo-neutral zone for this calf. However if the temperature is 32°F, the ME allowable gain is 0 lb/d and energy balance is actually negative, thus the calf must rely solely on dry grain to meet its nutrient requirements and a 110 lb calf is generally less than 2 weeks of age, so this is somewhat unrealistic for adequate nutrient intake above maintenance and acceptable growth and health performance.

Other considerations for nutrient source relates to the feeds available. For example, nonsaleable milk is an excellent source of nutrients for the calf assuming the solids and bacteria content are managed appropriately to provide a consistent and healthy diet. The energy content of milk is greater than most milk replacers due to the higher fat content of milk so meeting the nutrient requirements of calves fed nonsaleable milk is easier, especially in regions where the temperatures drop far below the critical temperature. It is important when feeding nonsaleable milk that the solids content be measured and standardized. Variability in nonsaleable milk solids content can be significant and affect the delivery of nutrients to the calf as described by Moore et al (2009) where the measured range over 12 samples from individual dairies was 5.1 to 13.4%. A Brix refractometer can be used to monitor the solids level to provide consistent delivery of nutrients to calves, and aid in developing management protocols using milk extenders, milk replacer or other sources of digestible nutrients (Bielmann et al., 2010).

Similarly, ensuring the reconstituted solids level of milk replacers is in an acceptable range is also important for a consistent and digestible nutrient supply. The directions supplied by the manufacturer should be followed for temperature of the mixing water to ensure appropriate mixing and stability within the water and also that the powder be weighed and not measured volumetrically to ensure proper weight to volume relationships. Due to manufacturing differences among milk replacers, the weight to volume relationship can vary greatly, and if similar vessels are used to measure the volume, then error in the solids content of the total solution can occur and this can cause osmotic issues in the calf, which in turn can lead to scours and reduced nutrient absorption. Acceptable ranges in the solids content of reconstituted milk replacers are 12.3% to about 18%, however at concentrations greater than 13.5%, free-choice water availability, times fed per day (>2x feeding) and water quality all become critical factors to ensure successful implementation of such a diet.

Water quality is also important for adequate mixing and feeding of milk replacers and general calf health. The total dissolved solids (TDS) content of water, along with the mineral content and concentration can greatly affect the osmolarity and osmolality of the final solution and can be a source of frustration when diagnosing scours, inconsistent feed intakes and abnormal feeding behavior. Kertz et al. (1984) demonstrated the need and effect of supplying adequate water for ensuring feeding intake and overall animal performance, however, quality of water is important in facilitating that outcome. Calves fed milk replacer are potentially more sensitive to poor water conditions because if water is high in TDS and other elements or compounds that affect water holding capacity, then when combined with milk replacers the high osmolarity can cause scours and this is not the fault of the milk replacer, but the combination of the two factors. Beede (2006) has summarized much of the literature on water and provided guidelines for evaluating water quality for dairy cattle. Recommendations for TDS for calves is less than 2,000 ppm (mg/L) however, for calves fed milk replacer the TDS in water should be less than 1,000 ppm to ensure salt toxicity and other osmotic problems do not occur. Sodium concentration in milk is typically in the range of 20-35 mmol/L and total solids are 11.2% to 13.7% depending on the nonsaleable milk source, handling and management. Thus, any concentration above those levels can have an effect on the osmolality of the solution and potentially cause digestive upsets and diarrhea. Recommended levels of sodium for water are <100 ppm and for chloride are <250 ppm (NRC, 2001). Other concerns with water would be pH and high levels of iron, magnesium, manganese and sulfur that can cause high osmotic pressure in the gut or a laxative effect and lead to diarrhea or other undesired outcomes.

Post-weaning Growth Benchmarks to Optimize Milk Yield

The other management objective is to encourage dry feed intake to develop the rumen and supply nutrients. It is essential that the calf learn to consume starter and develop a functional rumen by the time the weaning process is completed. Basic requirements for starter intake prior to complete weaning are that calves be consuming at least 2-2.5 lb of starter by the time liquid feed is removed. However, the amount of starter intake prior to weaning is confounded by the level of milk fed, so an absolute value is not really appropriate. It is most important that the calf consume enough to develop the rumen and establish a robust microbial population to ensure good digestion and rumen function. Under most of the conditions that dairy calves are managed, there are barriers to learning that affect how the calf views and accepts starter grain as a food source. Our way of managing that learning has been to limit the nutrients from milk or milk replacer in an effort to enhance hunger so they are encouraged to consume nutrients from other sources. Having calves of somewhat varying ages in housing conditions that allow for interaction or at least visual observation helps with the learning process because the older calves provide lessons in eating behavior for the calves not yet experienced enough to understand where and what the starter grain might be. Creating an environment that allows calves to teach each other about starter grain intake is essential to enhance nutrient delivery and weaning efficiency in dairy calves and help avoid post-weaning nutrient balance problems (de Paula Viera et al., 2012).

This all implies there are some benchmarks for growth post-weaning and those benchmarks are a function of the desired age at first calving (AFC) and the mature size of the herd you are working with (Table 5). These benchmarks have been described in the 2001 Dairy NRC but are difficult to implement due to the lack of data on BW and ADG that exists on most herds. This lack of data puts the nutritionist and heifer manager in a situation where they are attempting to make change in the absence of any real quantifiable data. The most important input in any ration balancing software is body weight and this also happens to be the most important information for managing heifer growth and AFC. It is important that if we are going to invest so much effort into the pre-weaned calf, that post-weaning, a similar amount of effort be applied to ensure that the benchmarks are met in order to achieve a BW at calving that allows the potential increase in milk yield to be realized.

Table 5. Example target weights for breeding weight, first, second and third calving weights based percent of mature body weight. Percent of mature body weight for breeding is based on physiologic maturity and the percent mature weight at first calf is a post-calving weight where milk yield is optimized in the first lactation (Hoffman, 1997; Van Amburgh et al., 1998; NRC, 2001).

		Mature weight, lb		
	Percent of mature weight	900	1,300	1,760
Pregnancy wt., lb	55%	494	716	967
1st Post calving wt., lb	85%	765	1,106	1,494
2nd Post calving wt., lb	92%	828	1,197	1,617
3rd Post calving wt., lb	96%	864	1,248	1,688

Farm data from the Northeast U.S. suggests that the benchmarks for first calving BW are not being met and milk yield is significantly lower due to the partitioning of nutrients to growth during that lactation. This can have a negative impact on income over feed costs in many herds, especially when heifer inventories are high and heifers make up a larger percent of the lactating herd. A typical scenario in the Northeast revolves around milk price and cull cow prices over the last 3 to 5 years and a lack of monitoring of heifer growth post-weaning or once pregnant. Milk price was high for most of 2014 and 2015 and cull cow prices were also high for same period. In many cases, cull value was almost equal to heifer rearing costs and this lead to higher than average culling in many herds especially if the herd had a strong heifer inventory. Accordingly, many herds now have more than 35-38% first lactation animals – upwards of 50% first lactation cattle in some herds; however there was little to no monitoring for adequate growth of the heifers after they were confirmed pregnant. The benchmark of weight at pregnancy (55-60% mature BW) was successfully achieved, however, heifers were calving at weights below the benchmark of 82% mature BW.

The value of calving at a BW less than the benchmark involves unrealized milk income due to the partitioning of nutrients to growth by the heifer during the first lactation. The heifer is always going to prioritize growth and attempt to achieve 90-92% of mature size by the second lactation, so this happens at the expense of milk yield. In one herd scenario, the heifers were calving at 72% of the mature BW of the herd (10 units or 13% below the target (82%) for optimizing milk yield) and the heifers were peaking at 80 lb, whereas they should have been peaking at 90-92 lb (heifers should be approximately 80-82% of mature cow milk when calving at the proper weight). Assuming 225 pounds milk per pound of peak, which means the unrealized milk for this group of heifers was approximately 2,500 lb due to not meeting the mature size benchmark. If the net milk price was $16.80/CWT and the income over feed cost (IOFC) margin was $8.33, then the reduced IOFC was ($8.33*25 CWT) $208.25 per heifer and for an 800 cow herd with 40% first lactation heifers, the value was $66,640 IOFC. At a milk price of $20/CWT the value is closer to $100,000 IOFC for the same herd and scenario.

Thus, it is important to make sure that the benchmarks for growth are achieved, especially if the objective is to realize not only the milk due to the growth objective, but also due to the management and investment that was made during the pre-weaning period.

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Notes: