Cornell University Cooperative Extension

Pre-Weaned Calf Management

NNY Dairy Programs

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Meeting the nutrient requirements of the calf

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5 Factors of a Calf Management program

1. Minimize stress at birth
2. Maximize passive immunity
3. **Meet nutrient requirements of calf**
4. Optimize rumen development
5. Maintain animal health

Now that your calf has received high quality colostrum and has achieved passive transfer she (or he) is well on it's way to a healthy start. Now we need to think about the nutrient requirement of the calf.

The goal of many calf rearing programs is to have maximum retention of nutrients & high growth rates at the lowest cost possible!

Meeting the this goal can become a nutritionist's nightmare. This is due to the fact that during the first 2 to 3 weeks of life the calf's digestive tract is rapidly developing in regards to digestive enzyme secretions as well as physiological and metabolic changes. Additionally, the proportions of nutrients provided by liquid and solid feed are in constant flux, the physical capacity of the digestive system is increasing, the fermentative capacity increases, all leading to changes in digestibility of solid feeds.

There are three phases of development related to digestive function in the young calf.

1. **Liquid feeding phase** - all or essentially all of the nutrient requirements are met by colostrum, milk or milk replacer.
2. **Transition phase** - liquid diet and starter both contribute to meeting the nutrient requirements of the calf.
3. **Ruminant phase** - the calf derives all of its nutrients from solid feeds.

This article will focus primarily on nutrient requirements during the first two phases of digestive tract development.

Energy Requirements

Energy in the diet is first used for basal metabolism, thermogenesis, immune function and lastly growth. The first functions are grouped into what is called maintenance requirements of the animal. If there is not enough energy in the diet to meet the maintenance requirements, growth will be stunted. Net Energy for maintenance (NE_m) in calves and heifers increases based on age, current body weight and the desired amount of gain. Feeding above the amount energy and protein needed for maintenance allows for growth (Table 1).

It is important to know where major losses of energy occur as the energy yielding components of the diet undergo digestion and metabolism. This allows for you to account for them in the diet, or be pro-active and hopefully reduce them (ex: use calf jackets in the winter months).

Energy Requirements for pre-weaned calves are impacted by:

- Increasing lean tissue deposition - protein synthesis is energetically expensive!
- Cold weather - Calves under three weeks of age begin experiencing cold stress at 60^{0}F.
- Illness—the immune system requires energy and burns more energy when fighting disease.

Protein Requirements

Proteins in milk/milk replacer are broken down by digestive enzymes into peptides and amino acids. The amino acids are then absorbed by the small intestine and used as the building blocks for synthesis of proteins within the calf. The proteolytic digestive system of the calf is immature at birth and until the age of ~3 weeks the calf is less able to digest most non-milk proteins.

Milk is digested/broken down at a greater efficiency then milk replacer. Milk replacer derived from milk

Table 1. Daily energy and protein requirements of dairy calves fed milk or milk replacer and starter

	Calves gaining 1.0 lb/day				Calves gaining 1.5 lb/day			
Body Weight lb	NE_m[1] Mcal	NE_g[2] Mcal	ME[3] Mcal	CP lb	NE_m[1] Mcal	NE_g[2] Mcal	ME[3] Mcal	CP lb
55	0.96	0.70	2.24	0.34	0.96	1.14	2.92	0.48
65	1.09	0.75	2.46	0.34	1.09	1.21	3.18	0.49
75	1.21	0.79	2.67	0.35	1.21	1.28	3.43	0.49
85	1.33	0.82	2.87	0.36	1.33	1.34	3.66	0.50
95	1.45	0.85	3.06	0.36	1.45	1.39	3.88	0.51
105	1.56	0.88	3.25	0.37	1.56	1.44	4.10	0.51
115	1.67	0.91	3.42	0.37	1.67	1.49	4.30	0.52
125	1.78	0.94	3.60	0.38	1.78	1.53	4.50	0.53
150	2.04	1.00	4.01	0.39	2.04	1.63	4.97	0.54
200	2.53	1.11	4.77	0.42	2.53	1.81	5.84	0.57

Source: Adapted from *Nutrient Requirements of Dairy Cattle*, 2001.
[1]NE_m = net energy for maintenance.
[2]NE_g = net energy for gain.
[3]ME = metabolizable energy.

proteins is often broken down at a greater efficiency (92—98%) then milk replacer that contains non-milk proteins (85—94%). Additionally, plant proteins can lead to allergic reactions, poor digestion and scours in calves. Due to the potential lower digestibility's, adjustments should be made to the diet to ensure adequate supply of amino acids if you are using a non-milk based milk replacer.
Once the calf begins to eat starter and the rumen begins to develop, some of the protein requirement is met by microbial protein.

Factors affecting protein requirements:

- Rate of gain –the genetics of the animal, facilities and management can either encourage or hinder rate of gain.
- Size of animal—More protein is required to support lean growth in larger animals.
- Imbalanced Protein:Energy Ratios - excess protein must be de-aminated and ammonia detoxified and excreted.

WATER

Often the most overlooked, water is the most important nutrient. Fresh water, in addition to water consumed with milk replacer is essential for optimal growth and consumption of dry feed. Water acts as a solvent for nutrients, a thermoregulator and as an osmoregulator. During incidences of scours, 10 - 12% of a calf's body weight can be lost as water; as the water is lost in the feces, so are vital electrolytes which can lead to dehydration and death.

Milk or Milk Replacer?

During the liquid feeding phase you need to determine if you want to feed whole milk or if you want to feed milk replacer. Both of these then come with more options - pasteurization, acidified, free-choice… While the topic of how you chose to feed your calves is out of the scope of this paper, the nutrient value is not! Milk and milk replacer nutrient value varies and you need to do your homework on both.

If you are feeding whole milk (hopefully pasteurized or acidified) - purchase a refractometer that measures the total protein and/or total solids of waste milk. This will allow you to **estimate** the nutrient value of the milk you are feeding your calves. Knowing what the nutrient value of your milk is, allows you to make feeding adjustments and meet the needs of your calves based on age, size and weather conditions.

As a simple comparison to milk replacer - whole milk testing at 3.5% fat and 3.0% protein would contain 27% fat and 24% protein on a dry matter basis.

There are many milk replacer options, with varying nutrient levels. It's important to find a formulation that meets your needs and keeps your calves healthy and reaches your target gains and intakes. Look at the fat and protein levels - is it adequate to meet the maintenance and growth goals? If a calf consumes more energy then require the "extra" energy can be used to convert dietary protein into body tissue. However, if energy is limited, growth does not occur. You may want to look into a different milk replacer formulation for summer and winter. Does the milk replacer contain adequate & bioavailable vitamins and minerals?

What is the value in spending the money on calves?

Milk replacer can be expensive, feeding more milk can be expensive. So what is the over all gain to the farmer? Why should you spend the money on your calves?

Calves that receive a higher plane of nutrition pre-weaning can have increased milk production in the first lactation = $$$$increased profitability $$$$

Calves should receive adequate energy and protein to encourage growth rates of 500—700 g/day during the pre-weaning period. Feeding for higher growth rates during the first 6 - 8 weeks of life can have benefits beyond growth. During this timeframe specialized tissue (parenchyma tissue) is being developed in the mammary gland. It has been demonstrated that calves fed a higher plane of nutrition have greater mammary gland development & future milk production. For every 1 kg of pre-weaning ADG, heifers on average produced 970 kg more milk during their first lactation and 235 kg more milk for every mcal of metabolizable energy intake above maintenance.

Other benefits of feeding a higher plane of nutrition during the pre-weaning period include: Increased feed efficiency, increased growth rates, earlier age at first breeding, earlier age at calving.

Take Home Messages

- Nutrient requirements **increase** during times of stress.
- Clean, fresh **water** is required by all calves!
- The greater the ADG (lean muscle/skeletal growth) of the calf before weaning, the greater their potential first lactation milk response.
- Take time to **evaluate** your pre-weaned calf feeding program to make sure you are reaching the nutrient needs of your calves!

These fact sheets are made possible through the collaborative efforts of the CCE County Associations of NNY (Clinton, Essex, Franklin, Jefferson, Lewis & St. Lawrence) To contact any of the NNY CCE offices directly: Clinton: 518-561-7450; Essex: 518-962-4810, Franklin: 518-483-7403; Jefferson: 315-788-8450; Lewis: 315-376-5270; St. Lawrence: 315-379-9192.