

The importance of calf nutrition on future dairy cow performance

Rearing calves is all about creating the farm's new dairy herd. A young heifer calf is the milking cow of the future. The impact of calf rearing on the development and performance in later life as a dairy cow is significant.

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Organ and tissue development in most species is not yet completed at birth and continues in the immediate postnatal period. Nutrition during early postnatal life may effect development with lifelong consequences for the animal.

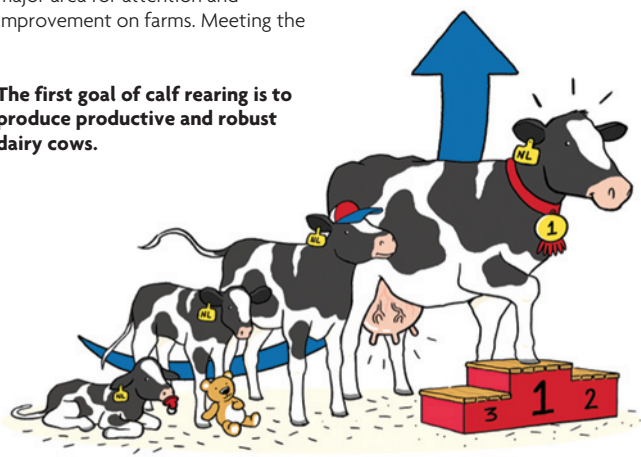
Over the last five years it has become very clear that level of milk fed and growth achieved before weaning are positively correlated with milk production during first and later lactations.

The desired pre-weaning growth can be achieved via two success factors: health and nutrition.

The impact of early life nutrition

Logically, a huge impact in this is the first feeding of colostrum. Even though the dairy industry is highly aware of the importance of colostrum intake, this remains a major area for attention and improvement on farms. Meeting the

The first goal of calf rearing is to produce productive and robust dairy cows.



standards on a daily base and with every calf born, is an ongoing management challenge.

Both science and practice are saying: feed each calf within one hour after birth four litres of good quality colostrum. Faber et al., 2005 fed heifer calves two litres or four litres of colostrum within one hour postnatal. The results were impressive. Just by feeding two litres more colostrum in this very first hour of life, made a change for a lifetime. Average daily growth was higher (1003 vs 800g respectively) for calves fed four litres compared with the ones fed two litres only and those calves produced over 1,000 litres more milk in their first two lactations.

This improved milk production is most likely explained by the effect of colostrum on the calf's overall health, and therewith the ability to grow and develop better in early life. Immediately after the calf has hit the ground, it should be fed four litres of good quality colostrum. This includes both: quantity and quality. As regarding quality, two aspects are most relevant:

- **Immunoglobulin (IgG) concentration.** Many dairy farms manage this by testing the colostrum and only feeding colostrum that meets the standards of at least 50mg/ml. Farms that aim at feeding fresh colostrum straight from the dam to her own calf, face a practical problem here.

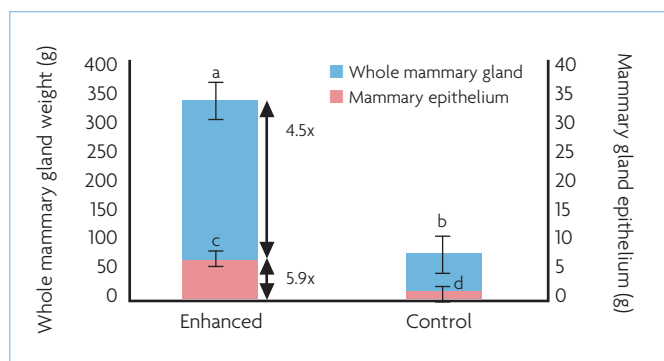


Fig. 1. Weight of the whole mammary gland and weight of isolated parenchymal mass at 54 days of life for calves fed 2.8 Mcal of energy intake per day (610g CMR/d; control) or calves fed 0.3 Mcal of energy intake/kg BW^{0.75} (1300g CMR/day; enhanced) from birth until 54 days (Soberon and Van Amburgh, 2017).

These farms should aim at managing the harvest of good quality colostrum from each dam and heifer: milk her within one hour after calving, minimise stress during the days before calving, assure sufficient intake of protein and energy by the dam during at least the last 14 days before calving, and harvest clean colostrum.

- **Bacterial cleanliness of the colostrum.** Field studies indicate that around one third of all first meals of colostrum contain more than 100,000 bacteria per ml (cfu). A high number of bacteria in the colostrum reduces the effective uptake of antibodies by the calf.

The threshold is set at 100,000cfu per ml, but experts claim that they notice negative effects with bacterial counts higher than 50,000cfu/ml. The bacterial load of colostrum is largely decided by hygiene during harvesting (clean materials, milking hygiene) and during storage. Pasteurisation of colostrum helps to reduce the bacterial load including the number of pathogenic bacteria, such as Johnes disease and salmonella.

At birth, a calf is not yet 'finished'. Udder tissue, for example, undergoes a tremendous development in the first eight weeks. Research over the last 15 years shows a relation between higher calf growth in the

first weeks of life and improved tissue development in organs, but more significantly in the mammary gland (Fig. 1). The latter could indicate an improved milk production.



To ensure enough immunoglobulins and energy, a calf should be fed four litres of quality colostrum (minimum 50g IgG/litre) within one hour after birth.

To maximise this development, optimal calf nutrition is key to assure a high calf growth.

Traditionally, milk intake is restricted for several management and cost-reduction reasons. However, research from several studies show that offering intensified milk feeding in early life has beneficial long-term effects on growth, health and milk production.

Increasing nutrient intake with intensified milk (replacer) feeding

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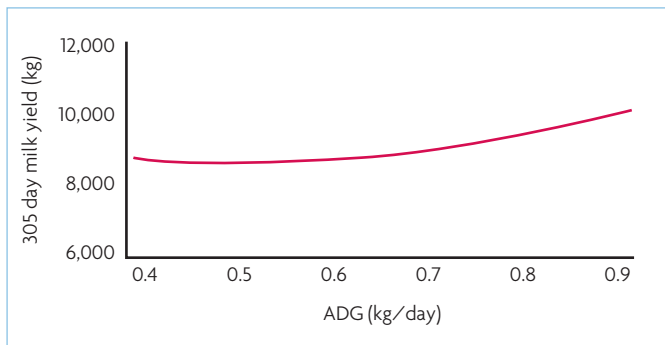


Fig. 2. The relation between ADG and milk yield (Gelsinger et al., 2015).

Continued from page 7 during the first eight weeks of life compared to restricted feeding results in an increasing milk yield (+450 until 1300kg) during first lactation. This increase in calf growth is especially important during the first eight weeks of life.

A higher feeding intensity from 8-14 weeks of life, did not show any effect on mammary gland development. So the first eight weeks of a calf's life seem to be decisive for future milk yield. Also data from nine studies combined in a meta-analysis of Gelsinger et al. (2015) concluded a synergistic relationship between pre-weaning dry matter intake and growth for improving milk yield, but also fat and protein production.

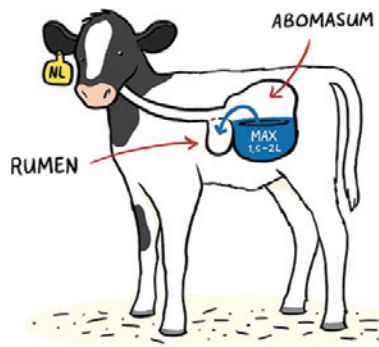
When looking at total dry matter intake (liquid and solid), feeding 100g/d extra projected 138.5kg increase in milk yield. The data also shows an increasing effect of growth rate on 305 days milk yield as daily growth rose from 500-900g per day (Fig. 2). During the maximum milk intake period, Dr J. Hulsen advises feeding at least 1,000g dry matter from milk (replacer) per day, to assure minimal intake of energy and nutrients.

Getting the best calf development

As the calf is nutritionally depending mostly on milk in the first eight weeks of life, in this phase, dry matter intake of milk has to be maximised in order to increase growth and thus optimal (udder) development. Commonly, heifer calves are fed four, up to five litres of milk (replacer) per day. However, when allowing calves to suckle from their mother consumption is 8-12 litres per day in the first weeks of life.

Since they suckle several times per day, the average is around 0.8-1.5 litres per feeding. This is not without a reason. The capacity of the abomasum, and thereby the maximum quantity of milk fed per time, depends on the weight and age of the calves (ranging from 1.5 to 3-4 litres as from one month of

age). When too much milk is consumed at once, the abomasum will overflow and milk will come into the rumen where it causes rumen acidosis. Since the abomasum has a limited capacity, the only option in order to achieve an increased early calf growth, would be to either feed more times per day or to increase dry matter per litre of milk.



For optimal digestion, in the first 14 days of age, provide a maximum of 1.5-2.0 litres per feeding, as the capacity of the abomasum (where milk digestion takes place) is limited.

Feeding multiple times per day would be the preference. Sockett et al., 2011 showed that even when feeding same amount of powder (dry matter) per day, feeding three times per day increased calf growth. Nutrients were used more efficiently, and milk production was

increased with 500kg extra milk in later life. Logically, feeding three times per day also allows feeding more total litres per day to maximise daily growth.

When feeding three times a day is not an option or even more growth is desired, the only option left is to increase dry matter per litre (to about 175g/l) by enriching cow milk or by using a calf milk replacer. Applying these practises, daily dry matter intake of 1kg and even up to 1.5kg is possible.

Respect the calf's (nutritional) needs

Since young calf's growth and development is directly correlated with future milk production, calf nutrition is well-worth investing in. Cow milk as calf nutrition is an option, however breeding goals in dairy cows target high lactation levels with high levels of protein and fat. As a result, the levels of vitamins, minerals and trace elements are suppressed and cow milk no longer fulfils the nutritional requirements of the young calf (Fig. 3).

Adequate levels of these elements are necessary to ensure that all metabolic systems are functioning properly and are essential for immunity development.

There is another important nutritional reason why rearing calves with fresh cow milk suppresses the development becoming a high-performing dairy cow. As known, a cow eats large quantities of vegetable material and for this having a well-developed rumen is essential.

At birth, the rumen makes up only 25% of total stomach capacity. In maturity, however, the rumen should be 80% of the stomach capacity, and contain trillions of microbes to supply the majority of the daily energy and microbial protein a cow needs. In other words; the rumen is the engine of the cow.

At weaning the rumen should be capable to be this engine. When, at weaning time, the rumen malfunctions, nutrition is definitely subopti-

mal which depresses growth and further calf development. In order to achieve a functioning rumen, feeding solid feeds is essential.

Functionally, starter feed enhances papillae development for nutrient absorption in the rumen, whereas hay (or other chopped roughages) stimulates the rumen muscular layer needed for rumination. So high solid feed intake pre-weaning is essential for rumen development and smooth weaning and also, therefore, has a positive effect on lifetime production.

However, the high fat level in cow milk causes a rapid saturation, resulting in an undesired solid feed intake reduction, giving problems at weaning and a reduced calf development. For this reason, many dairy farmers use milk replacers to ensure high solid feed intake and easy weaning.

Conclusion

In order to maximise calf growth and development, it is important to supply nutrition formulated to meet the calf's requirements.

According to Dr J. Hulsen, increasing the life-time production of dairy cows is an important goal for the dairy industry worldwide, to reduce costs and environmental impact. This starts with excellent health and nutrition of the newborn dairy cow.

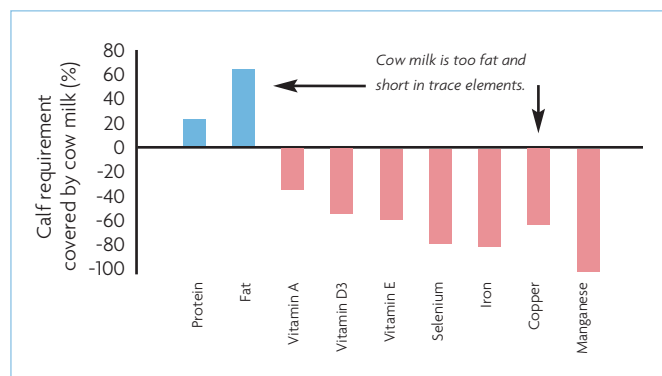
The ultimate goal is milk production. Although the initial pre-weaning costs associated with intensive milk feeding are higher, it has a long term effect on milk production as well as calf growth, health, and development.

Intensified milk feeding in early life – mainly focusing on the first eight weeks – has been proven to improve calf development and future milk yield.

For this, early life nutrition is considered as one of the best investments in dairy farming. ■

References are available from the author on request

Fig. 3. Percentage of calf's nutrient requirements covered by feeding fresh cow milk.



Joosten – young animal nutrition is implementing this knowledge in their calf rearing offering. Joosten is specialised in production and export of high quality calf milk replacers to over more than 45 countries worldwide. Based on 145 years of experience and trials done worldwide, Joosten develops premium young animal nutrition for a lifetime performance. Keeping track on the latest developments and improvements in application is done at Joosten Dairy Application Farm van Iersel, a Dutch 630 Holstein dairy farm.