

Optimal rumen development for improved heifer performance

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In order for them to enjoy a long productive life, dairy cows should receive the best possible treatment from the day they are born. Successful dairy cows generally develop from heifers that grow well and reach their age-based target weights. In this regard, a proper nutritional programme is essential.

Besides the essential intake of colostrum as soon as possible after birth, nutrition should be focused on the early and complete development of the rumen, before the age of twelve weeks. Rumen development is of the utmost importance for successful weaning and early growth, both of which lay the foundation for the matured lactating cow.

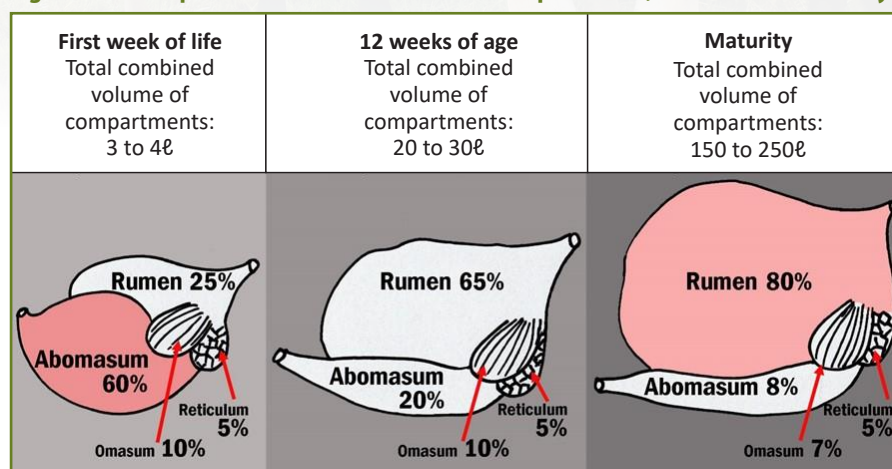
Digestive system of a calf

Although underdeveloped, the newborn calf possesses all the digestive organs of an adult ruminant. The calf's rumen is non-functional, small and sterile, and lacks papillae (finger-like projections) on the rumen wall. In the initial stages, its digestion and absorption are similar to that of a monogastric animal.

The first three compartments of the calf's stomach, namely the rumen, reticulum and omasum, are relatively small compared to the abomasum. The abomasum is physiologically well developed and has a capacity of approximately two to four litres. Colostrum and milk or milk replacer will provide in all the calf's nutritional needs. The oesophageal groove diverts milk from the oesophagus past the rumen, straight to the abomasum.

In the young calf, the abomasum comprises some 60% of the total stomach capacity, compared to only 8% in the adult ruminant. The calf's rumen accounts

Figure 1: Development of the bovine stomach compartments, from birth to maturity.



for about 25% of the overall stomach capacity and can develop to almost 80% in the matured cow. The relative size of the stomach compartments, from birth to maturity, is summarised in Table 1.

As soon as a calf starts eating dry feed, especially grains that contain fermentable carbohydrates such as starch, the rumen will start to develop and play an increasingly important role in the digestive process. The stomach compartments will grow in proportion to the calf's body size and the animal will develop into a fully functional ruminant (Figure 1). The duration of this process depends largely on the diet.

Requirements for rumen development

The following five important requirements apply to rumen development.

Bacteria establishment in the rumen

Upon birth, the calf's rumen is sterile with no bacteria present. Within a few hours after

birth, the calf ingests a large concentration of bacteria from the environment. These are mainly aerobic (oxygen deficient) bacteria. The anaerobic (active without oxygen) rumen bacteria are systematically established and will dominate within two weeks of the calf starting to consume dry feed.

Liquid in the rumen

Water is an essential ingredient for rumen fermentation and must be provided from the age of two to three days. Without sufficient water, bacteria cannot grow and multiply, and rumen development is inhibited. Milk or milk replacer does not form part of 'normal drinking water'. Due to the action of the oesophageal groove, it bypasses the rumen and reticulum into the abomasum. Milk or milk replacer can therefore not be regarded as 'sufficient water'.

Outflow of material from the rumen

Proper rumen development requires an actively functioning rumen, which includes that material entering the rumen, must be able to flow out again. Signs of an active rumen include rumen contractions and the rumination action. At birth there is virtually no rumen activity present, but this tends to increase along with the increased intake

Table 1: Relative size of the bovine's stomach compartments, from birth to maturity.

Age	Rumen	Reticulum	Omasum	Abomasum
Newborn calf	25%	5%	10%	60%
3 to 4 months	65%	5%	10%	20%
Mature cow	80%	5%	7-8%	7-8%

of dry feed, so that rumen contractions are observed as early as the age of three weeks. If calves are given only milk, it will take longer for contractions to be observed.

Absorptive ability of rumen tissue

An important criterion of ruminal development is the absorption of end-products from the fermentation process, especially the volatile fatty acids butyric, propionic and acetic acid. The rumen wall consists of a muscular and epithelial layer. The muscle layer forms the outer wall and is responsible for contractions to move and mix the rumen contents. It also supports the epithelial layer of the inner wall.

The epithelial layer consists of an absorptive layer of tissue with numerous finger-like projections, or papillae, which form the absorptive surface of the rumen wall. Research shows that volatile fatty acids are the primary stimulus for the development of the epithelial tissue, particularly butyric and propionic acid.

Availability of a substrate

Dry feed intake is the main driver of rumen development. Early development

is promoted by a diet that promotes the growth and development of the rumen wall.

Managing rumen development

In addition to milk or milk replacer, calves should have unlimited access to a high-quality calf starter meal from the age of two days. The starter meal must have a high energy content and contain high-quality natural protein (at least 18% crude protein on an air dry base). Feed must be fresh and palatable to encourage intake, so that it will stimulate the development of rumen papillae.

The sooner a calf starts eating dry feed, the sooner the rumen will start to develop. The calf should consume approximately 200 to 250g of starter meal per day at the age of two weeks. Provide fresh, clean drinking water on an ongoing basis, as it encourages the intake of starter meal and thus promotes rumen development.

High-quality hay should be fed in addition to starter meal from the age of approximately six weeks. Low-quality roughages such as mature hay,

maize stover and wheat straw are not recommended for young calves, as their rumens have not yet developed sufficiently to utilise these low-grade feeds.

Calves can be weaned as soon as they consume at least 1kg of starter meal for three consecutive days. This can be as early as six weeks old. If raw materials are available locally, a dairy farmer can use the opportunity to mix his own high-quality calf meal or feed, which usually means a cost saving.

The successful transition from milk to a grain-based diet requires proper rumen development. This process takes time and starts with the consumption of quality calf feed. Regardless of the onset of the process, it takes about three weeks before the bacterial population has increased sufficiently for grain to be digested. Timing is a key factor here.

Regardless of how much milk calves are fed or at what age they are weaned – if the rumen isn't ready, calves will experience a difficult transition to a grain- and hay-based diet after weaning. **SF**



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