# Gastro-intestinal development and health in young dairy calves

Intestinal problems are common in calves, taking place between birth and weaning, predominantly until three weeks of age (Table 1).

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Scours are the result of an interaction of different factors: pathogenic bacteria (ETEC, Clostridium perfringens), viruses (rota and corona), parasites (cryptosporidium spp.), the immune status of the calf, the environmental conditions and the nutritional strategy (for example incorrect milk replacer concentrations and overfeeding).

Intensive rearing and associated feeding schedules with certain nutritional compositions are predisposing calves to be susceptible for enteric bacteria.

Calf diets are, for example, often protein rich and offer a perfect source of essential amino acids needed for the growth of Clostridium perfringens.

In addition, reducing feed costs is essential in calf rearing, therefore alternative protein sources are often incorporated in milk replacers, having a negative impact on gut health.

## Diarrhoea in calves

Diarrhoea in calves causes loss of fluids and electrolytes (dehydration) and insufficient digestion of feed.

This leads to protein catabolism to compensate for the losses in feed digestion with subsequent muscle breakdown and poor performance or death.

These diarrhoea problems have a huge financial impact on the farm:

- Growth delay in calves could have an impact on milk production during first lactation periods.
- Losses due to high mortality of neonatal calves (scours account for ±75% of all deaths under three weeks of age).
- Diarrhoea associated medication costs.

Therefore it is important to pay some attention to preventive measures against diarrhoea problems in newborn calves and to support their gut health.

## GIT development

In the newborn calf, the rumen is still inactive and rudimental (with a volume of 1-2 litres) compared to a three month old calf (volume of 25-30 litres). All four stomachs are present in this young calf, but the rumen is rudimental, while the fourth stomach, the abomasum, takes 70% of the total volume.

Dairy calves are held in a pre-ruminant state for one month in most European countries and then they are weaned during a two week period. The rumen is only stimulated once fermentative substrate is provided to the calf, taking place at weaning. In contrast, the colon is already active at a young age and that makes a pre-weaned dairy calf a hindgut fermenter and not yet a fore gut fermenter, stressing the fact that the establishment of a healthy intestinal beneficial microflora and a good epithelial barrier is important for the survival of the newborn calf.

If we take a closer look at short chain fatty acid (SCFA) production by the beneficial microbiota in the colon of pre-ruminant calves between two and four weeks of age, high concentrations of butyrate and lactate are observed.

Obviously, these SCFA provide beneficial effects for intestinal health during the first weeks of life. Lactate is used by the beneficial microflora as a substrate to produce butyrate.

Among these beneficial effects of SCFA, butyrate is known to be a key molecule in maintaining intestinal health. It induces epithelial cell proliferation leading to longer villi, it promotes tight junction protein expression leading to an optimal intestinal barrier, and it reduces inflammation, but stimulates the specific immunity targeting pathogens. It is no secret that in feed supplementation of butyrate based product could be beneficial in the battle against calf scours and for gut health management in general of these pre-ruminant calves.

## Rumen development

During the transition period of the dairy calf, from pre-ruminant to ruminant, rumen development needs to be supported.

As the calf ages, the rumen becomes more important (up to 80% of the total stomach volume considering all stomachs), while the abomasum loses importance and volume and is only meant to comprise 8% of the total stomach volume.

Because of low grain intake and an active oesophageal groove during the first three weeks of age, rumen development is not stimulated. However, studies have reported a heterogenic ruminal microflora to be present from one day of age. Only from 4-6 weeks of age will rumen fermentation

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**Table 1. Infectious agents causing calf scours.**

| Infectious agent | Susceptible ages | Main symptoms |
|---|---|---|
| E. coli (ETEC) | 3-5 days | Grey to creamy-white diarrhoea, death |
| Rotavirus | 3-14 days | Yellow diarrhoea with blood and mucus |
| Coronavirus | 7-21 days | Watery or haemorrhagic diarrhoea |
| Cryptosporidia | 5-35 days | Lethargy, loose to watery stools with blood, mucus or bile, death |
| C. perfringens | First 2 months | Sudden death, colic or nervous system signs |
| Coccidiosis | From 2 weeks | Bloody diarrhoea with mucus |
| Salmonella | >5 days | Bloody smelly diarrhoea with mucus |

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become important, as fermentative substrate is stimulating the already existing but non-active rumen microflora, and the calf starts to be more of a fore gut fermenter. The physical presence of feed in the rumen is thus stimulating the ruminal microflora, but will not promote the development of the ruminal papillae.

There is an absolute requirement for SCFA presence in the rumen, such as butyric acid, for normal papillae development.

As these SCFA are fermentation products, an adequate ruminal microflora and dry matter uptake is needed to guarantee this production. In addition, an in feed supplementation of butyrate based products could increase rumen development.

## Calf performance

In intensive rearing, feed cost reduction is a key issue and is obtained by incorporation of alternative sources of protein in milk diets, such as soy or whey protein. Feeding milk replacer containing soy protein has a huge impact on calf performance, for several reasons:

- First of all, the shift from cow's milk to milk replacers based on whey protein or soy protein leads to an enhanced gastric emptying rate, as clotting does not occur. Clotting is essential to reduce abomasal emptying and subsequently increases the efficiency of the digestive process.
- Second, soy proteins contain antinutritional factors, like immunogenic proteins, causing hypersensitivity reactions in the intestinal tract of the newborn calf leading to intestinal damage.

A decrease of villi height associated with villus atrophy in the duodenum, ileum or jejunum are reported by several authors, as well as a huge dilation of the lacteals and inflammatory responses.

One author even described a negative impact on the physiology of the exocrine pancreas, likely leading to impaired secretion of digestive enzymes.

Obviously these damaging factors in the gut are leading to malnutrition and diarrhoea. Butyrate is known to overcome these intestinal epithelial damages by stimulating villi growth and thus restoring growth performance, while still being cost effective.

From the above examples, butyrate seems to be the key nutrient in stimulating intestinal health as well as ruminal health in the growing young calf going from a hindgut to a foregut fermenter during the first part of their life. In addition, butyrate could prevent intestinal damage caused by the incorporation of alternative protein sources. Luckily, butyrate based products are commercially available to be mixed into milk replacer, to solid feeds or to be supplied per head per day.

## Butyrate based products in calves

As Impextraco is aware of intestinal health related problems in newborn calves, a new product, Butifour NF has been designed. Through their trial facilities located in Brazil, Impextraco are able to test new products thoroughly.

This particular new product is based on a synergism between calcium butyrate, stimulating gut/rumen development and maturity, calcium lactate, stimulating the butyrate producing beneficial microflora, and natural ingredients, supporting the gut's digestive activity.

As nature still harbours a lot of interesting ingredients, it is not a coincidence that Impextraco is focusing on these natural plant derived solutions. Unlike pancreatic enzymes, plant derived molecules work in the mouth and the stomach where they are able to digest the feed. These plant derived substances also operate in the small intestine, aiding pancreatic enzymes in continuing the digestive process.

With Butifour NF, ruminal and intestinal development, as well as the digestive process, is guaranteed in young calves, supporting them in their growth to become an efficiently producing dairy cow. ■