Section 4

Concentrate
Feeding and Feed Additives

Introduction

The intake of calf starter concentrates is the single most important factor in the development of the rumen, which is very small and undeveloped at birth. Starter intake is important in ensuring a smooth transition from milk feeding to an adult diet at weaning without setbacks to growth. In general, calves are fed a 'calf starter' ration up to 12-16 weeks of age. From there they are switched to a 'calf grower' ration.

1. **What are the important qualities of a calf starter?**
2. **Coarse ration v pellets - which is better for calf performance?**
3. **What ingredients do coarse rations usually contain?**
4. **When should you start feeding concentrates to calves?**
5. **What allocation of concentrates is recommended?**
6. **What are the factors affecting calf starter intake?**
7. **Calf starter nutrient specification.**
8. **Vitamins and minerals.**
9. **Feed additives.**

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1 What are the important qualities of a calf starter?

It is essential that any calf ration is:

Palatable - the calf should be willing to eat the ration, starting as early as possible.

High quality - the ration should be highly digestible in energy and protein and contain the necessary amount of other nutrients.

Competitively priced - the cost per kg gain must be favourable.

2 Coarse ration v pellets - which is better for calf performance?

A coarse calf ration has ingredients of similar size (e.g. rolled barley, flaked maize), with no dust or fine meal present.

The young calf will accept a coarse ration more readily than pellets. A course ration encourages more chewing and saliva secretion. In addition, calves fed coarse starter mix eat more and have been shown to have higher weight gains than those fed pellets. The coarseness also benefits growth of the muscle layers in the rumen wall.

Therefore, calf concentrate feeding should begin as a coarse ration (approximately 2,000μm). After a few weeks, pelleted starters can be gradually introduced. Pellets that are either too hard or too soft will adversely affect the calf's concentrate intake.

Dusty meals can pose a problem, leading to increased incidence of respiratory disease. Finely ground ingredients increase the incidence of digestive disorders. Adding molasses (approximately 5%) helps to control the dustiness of rations and can also improve ration palatability.

Calves prefer a prefer a high quality coarse ration of uniform size (left). A dusty ration (right) will reduce feed intake.

3 What ingredients do coarse rations usually contain?

Most coarse rations contain ingredients such as flaked maize, rolled barley, peas, processed soya, beet pulp, linseed flakes, molasses and a pelleted protein balancer. Each ingredient must be palatable in its own right to prevent the calf from selecting out individual components of the ration. Because flaked/toasted cereals are more expensive than the same cereal in ground form, coarse rations tend to be more expensive than pelleted rations.


Flaked maize


Toasted flaked peas


Toasted full fat soya


Pelleted protein balancer


Toasted barley


Hipro soyabean meal


Pelleted sugar beet pulp


Calf starter concentrate

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4 When should you start feeding concentrates to calves?

Calves should have access to clean, palatable starter concentrates from **three days of age.**

From three weeks of age calves will begin to eat considerable amounts of starter concentrates. From then on, the higher the quantity of milk fed, the lower the amount of concentrates they will consume.

5 What allocation of concentrates is recommended?

When it comes to stimulating calf starter consumption in young calves, always remember *"less is more."* At first, a small handful of concentrate should be offered after milk is fed. The ration should be placed in front of the calves in shallow troughs/buckets to encourage the calf to 'nose around' in it. By two weeks, the allocation should be increased to two handfuls. The idea is to encourage consumption while not overwhelming the calves or wasting feed.

The ration offered should be changed daily, keeping it fresh and encouraging the calf to eat. Use a measure for meal dispensing as it helps to prevent overfeeding which can lead to digestive upsets and scouring.

Concentrate should be increased gradually, with calves consuming at least 1kg of concentrate daily by weaning. It is vital to check that the calves' dung does not loosen too much as the ration allocation is increased.

Farmers should use a measure for meal dispensing to prevent overfeeding and waste.

6 What are the factors affecting calf starter intake?

There are a number of variables that contribute to differences in calf starter intake. These include:

- Milk feeding programs; the amount being fed, protein and fat percentage of MR.
- Water intake/availability.
- Calf starter formulation and its physical form.
- Calf genetics, gender, birth weight.
- Calf housing, management and environmental conditions.
- Starter quality - dusty, mouldy, off-flavours will reduce palatability.

7 Calf starter nutrient specification.

A ration that meets the calf's nutrient specifications, as well as their preference for texture, taste and smell, will encourage early intake.

To promote growth and maintain health, calf rations must contain:

- **Energy** for growth and functions like breathing, walking and grazing.
- **Protein** for all basic metabolic processes and growth.
- **Fibre** for rumen function and to ensure cud chewing.
- **Vitamins** for metabolic processes, bone formation and disease resistance.
- **Minerals** for carbohydrate metabolism, cartilage and muscle function.

Protein content	Calf rations should contain **18% crude protein** (CP) on an as-fed basis.
Energy content	Calf starter should have adequate energy supplied from a grain base. Energy values of 13-14 MJ ME/ kg dry matter are acceptable (12MJ/kg DM minimum). A target energy density of 0.95 UFL is recommended.
Oil content	The oil content of a starter can be up to 4%. The ration should not contain added fat.
Fibre content	A fibre content of 8-10% is sufficient to prevent digestive upsets.

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8 Vitamins and minerals.

Calves are born with very low reserves of vitamins A, D and E and are very dependent on colostrum to supply these vitamins. Most milk replacers and concentrates have enhanced levels of these vitamins because of their importance to calf health.

The milk-fed calf is also unable to synthesise its requirements for the complex of B vitamins and these are normally added to milk replacers. However, once the calf has a fully functioning rumen, it is capable of supplying its own B vitamins. Therefore these are not normally added to concentrate mixes.

Calcium (Ca) and phosphorus (P)

The main function of both calcium and phosphorus is skeletal growth. Nearly 99% of the calcium in the body is found in the skeleton, while 80% of the phosphorus is in the bones and teeth.

The remaining Ca is extracellular and plays a role in nerve conduction, muscle contraction, blood clotting and immune system activation. The remaining P is involved in energy utilization and transfer, acid-base and osmotic balance, and for cattle is required by ruminal microbes for growth and cellular metabolism.

Deficiency of Ca and P is rare in milk fed animals. Calf starter should contain 0.7% Ca and 0.45% P. This meets the recommended Ca:P ratio of approximately 2:1.

Selenium

Selenium plays an important role in the antioxidant system as a component of the enzyme glutathione peroxidase. Selenium deficiency can result in the development of White Muscle Disease in calves, which results in the degeneration and necrosis of both skeletal and cardiac muscle. In addition, un-thriftiness, weight loss, and diarrhoea are other signs of a deficiency. A calf starter should contain 0.3ppm selenium.

Copper

Copper deficiency can result in fragile bones, anaemia, sudden death due to heart failure and reduced immune response. Calf starter should contain 10ppm copper.

Vitamin A

Vitamin A is important for development of a calf's vision. It also contributes to the calf's basic growth and development because it plays a role in the maintenance of cell tissue. A typical calf starter should contain 4,000 IU/kg.

Vitamin D

Vitamin D is partially responsible for good bone development, as it is required for Ca absorption. Insufficient vitamin D results in sub-optimal bone development and therefore sub-optimal growth. A calf starter should contain 600 IU/kg. Vitamin D.

Vitamin E

Vitamin E is an important antioxidant in the body. A deficiency of vitamin E in young calves results in White Muscle Disease. Affected animals may show stiffness, lameness, or even cardiac failure. The typical calf starter should contain 25 IU/kg Vitamin E.

Table 1. Typical nutrient requirement for a calf starter.

Nutrient Specification	
Minerals	
Crude Protein	18%
Calcium	0.7%
Phosphorus	0.45%
Magnesium	0.10%
Sodium	0.15%
Potassium	0.65%
Chlorine	0.20%
Sulphur	0.20%
Iron	50 mg/kg
Zinc	40 mg/kg
Manganese	40 mg/kg
Copper	10 mg/kg
Iodine	0.25 mg/kg
Cobalt	0.10 mg/kg
Selenium	0.30 mg/kg
Vitamins	
Vitamin A	4,000 IU/kg
Vitamin D	600 IU/kg
Vitamin E	25 IU/kg

Source: NRC, 2001.

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Key points when feeding concentrates:

- The calf should have access to concentrates from three to four days to stimulate rumen activity. The rumen is usually functioning well by 10-12 weeks.
- Concentrates should be introduced by placing a small amount in a shallow bucket. When the calf finishes drinking, rub a little concentrate on its muzzle to encourage the calf to taste it.
- Calf concentrates should be highly palatable, coarse-textured, high in energy and protein and low in roughage (> 15%).
- By three weeks a calf should be able to digest small amounts of grain, meal and hay.
- Any feed changes must be introduced slowly.

Calves should have access to concentrates from three to four days of age.

KEY FACTS:

Calves can be weaned once they are consistently consuming 1kg of concentrates per day. This level of intake can be reached by eight weeks if access to palatable starter and water is available *ad lib*.

9 Feed additives.

A number of feed additives can be added to calf rations to help improve calf digestion, health and support optimum growth and performance. These include probiotics, prebiotics, yeast, and yucca extracts.

I. Probiotics

Probiotics are live bacteria that are fed to, and benefit, the animal through improvements in their microbial gut flora. Feeding beneficial lactic acid bacteria is thought to inhibit the growth of pathogenic bacteria by:

I. Decreasing the pH in the large intestine through the production of lactic acid.
II. Competitive attachment to the digestive tract lining.
III. Competition for nutrients.
IV. Stimulation of the host's immune system.
V. Direct antagonism between lactic acid bacteria and the pathogenic bacteria.

Following colostrum feeding, calves can be fed probiotic orally. This is commonly done through milk replacer feeding. Some benefits of feeding probiotics to calves include:

- Protection of young animals against gastrointestinal disorders.
- Assistance against digestive disorders due to stress.
- Improved feed efficiency.
- Improved growth rate/weight gain.
- Reduced faecal *E.coli* count in pre-ruminant calves.
- Improved immune system.

However, there is also research showing the failure of probiotics to produce beneficial effects. This may be due to one or more of the following reasons:

a) Some probiotics don't contain enough viable bacteria or they contain the wrong strains of bacteria.
b) The bacteria are unable to survive in the stomach and small intestine.
c) The bacteria fail to competitively exclude harmful bacteria.
d) The animals already have a correct microbial balance between the lactobacilli and coliforms in the intestinal tract.

II. Prebiotics

Prebiotics are carbohydrates which are not broken down in the small intestine. They are fermented in the large intestine, acting as a feedstuff for the growth of beneficial bacteria. Mannanoligosaccharides and β-glucan are commonly used prebiotics that are able to prevent pathogenic bacteria sticking to the lining of the digestive tract. Prebiotics can also decrease the coliform numbers in the large intestine and colon of calves.

Through these mechanisms, prebiotics can improve average daily gain and reduce faecal

E.coli counts in calves.

III. Yeast products

There are two types of yeast products on the market: live yeast products and yeast cultures.

I. Live yeast products contain viable yeast (such as *Saccharomyces cerevisiae*) and the media on which the yeast is grown.
II. Yeast culture contains the media in which the yeast was grown, the metabolites made by the live yeast cell during the manufacturer's fermentation process, and dead yeast cells.

Direct feeding of yeast products has become a popular trend in cattle rearing. It is claimed they stimulate rumen fermentation and bacterial growth, and thereby increase dry matter intake and consequently improve animal performance. In calves, feeding yeast has been shown to:

- Reduce the incidence and duration of diarrhoea.
- Increase rumen development measurements e.g. VFAs.
- Increase ADG and feed intake.
- Lower faecal scores.
- Reduce *Salmonella* intestinal colonisation of the intestine and faecal shedding.

However some research studies have found only limited effects of yeast on both intake and gain efficiency. This suggests that the response of calves to yeast cultures can be both variable and inconsistent.

IV. Yucca extract

Yucca extract is prepared by processing the cactus plant *Yucca schidigena*.

Yucca inclusion in the diet of pigs and poultry is common practice with a significant reduction in ammonia levels found.

For calves, the inclusion of Yucca extract in their diet can improve rate of gain and feed efficiency. This may be due to the reduction of rumen fluid ammonia levels and increases in microbial growth, resulting in increased microbial protein synthesis and increased protein availability in the small intestine.