Section 3

Milk replacer
Nutritional Specification

Introduction

The primary nutrients in milk replacer are protein, fat, carbohydrates, vitamins and minerals. It is a legal requirement for milk replacers to have a declaration of ingredients in descending order of inclusion. It is therefore almost impossible to accurately assess the quality of milk replacer from the label. A farmer can only get a rough idea of the suitability of a given milk replacer for the purpose of rearing calves from the oil, protein, fibre, and ash content.

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Milk replacer
Nutritional Specification

1 What is the optimum protein content of milk replacer?

A good quality milk replacer will contain only milk derived protein sources.

Most research studies in calf-to-beef systems have shown no economic or animal performance advantages to feeding milk replacer with greater than 20% crude protein content. However, feeding milk replacer with protein levels below 20% reduces liveweight gain.

For farmers aiming to achieve very high levels of calf growth (i.e. greater than 900g/day), higher levels of crude protein are required (i.e. 25-27%).

2 Why is the protein source in milk replacer important?

Protein sources can be either milk or plant/vegetable proteins. For the first 2-3 weeks of a calf's life, milk-derived proteins are important as these are the only proteins a calf can digest efficiently. After three weeks of age, a higher level of plant-derived proteins can be tolerated with no ill-effects on the calf.

Milk Proteins: milk-derived proteins sources include skim milk powder and whey powder. Young calves should receive MR based on skim milk powder or whey protein concentrate.

Vegetable proteins: commonly used vegetable proteins are soya protein, wheat gluten, and pea protein. In general, digestibility and subsequent calf growth and feed efficiency are lower with vegetable proteins than with milk derived proteins.

Soya protein products can contain a variety of anti-nutritional factors that further decrease the digestibility in young calves, although recent advancements in processing have improved the quality of soy-protein products. Pea proteins are known for their rapid sedimentation, which puts them at a disadvantage.

3 What is the ideal fat content in milk replacer?

Milk replacers can contain 10-25% crude fat, with 18-20% fat content ideal. Research at Teagasc Grange has shown no benefit to feeding MR with higher than 18% fat content. Calves less than two weeks old cannot digest non-milk fats as well as milk fats, so milk replacer high in milk fat lowers the risk of diarrhoea. Higher fat milk replacers may suppress concentrate intake, so may not be suited to systems requiring early weaning. However, studies have shown that reducing the fat content of the MR from 18% to 12% does not have any effect on concentrate intake or live weight gain.

Fat sources should be highly digestible and preserved with an antioxidant. Fats commonly used include tallow, lard, palm and coconut oil. Coconut and palm oil have a similar digestibility to milk fat (approximately 96%).

4 What fibre content should there be in milk replacer?

Crude fibre content over 0.15% generally indicates the inclusion of plant protein in a product. However, just because a product has low crude fibre does not rule out the inclusion of plant protein entirely, as soya protein concentrate is low in fibre.

Diets of calves under three weeks of age should contain <0.15% crude fibre.

KEY FACTS:

For every 0.1% increase in fibre content in milk replacers, about 10% of the total protein has been derived from plant, rather than milk, sources.

5 Ash, vitamins and minerals in milk replacer.

Some manufacturing processes can lead to a high mineral content in whey protein products (e.g. delactosed whey), which can increase the risk of diarrhoea. The ash content of milk replacer should therefore not be higher than 8%, with target ash content of 6.5-7.5%.

Table 3. Mineral and vitamin requirements of calves.

Calcium	1.0%
Phosphorus	0.7%
Vitamin A	9,000 IU/kg
Vitamin D	600 IU/kg
Vitamin E	50 IU/kg

Source: Nutrient Requirements of Dairy Cattle. National Research Council, 2001.

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6 Milk replacer appearance.

Milk replacer powder should be easily dissolved and not leave any sediment at the bottom of the feeder. It should be free of lumps and foreign material. Even though the colour and odour is not necessarily a guide to its quality, MR should not have any unpleasant, burnt or other off-odours and should be cream in colour.

If the powder is orange to orange-brown in colour and has a burned or caramelized smell, it may have undergone Maillard Browning as a result of excessive heat during storage. In this case, there will be some loss of nutrient quality and product palatability.

7 What are acidified milk replacers?

Acidified milk replacers are essentially normal milk replacers to which organic acids (sorbic, citric, malic or fumaric) and/or organic salts (calcium sorbate, sodium formate or calcium formate) have been added in various combinations to give an overall inclusion level of 1.0 to 2.0%. Extra quantities of emulsifiers are added also to prevent fat separation when the milk is left standing.

Acidified milk replacers have a pH of 5.7 to 5.9 (pH of normal milk replacer is 6.3 to 6.5) and are guaranteed to remain stable for a minimum of 48 hours. However, prevailing temperatures will affect the length of time they remain stable. Since most calf-rearing takes place in spring, temperature is not usually a problem.

8 Are there any benefits to feeding acidified MR?

In addition to the longer shelf-life, the following nutritional advantages may result from acidification:

- Less diarrhoea, due to the acid conditions controlling the rapid multiplication of harmful bacteria such as *E.coli.*
- Better feed efficiency due to improved clotting time and improved enzyme activity.

9 Practical considerations for mixing and feeding milk replacer.

Feeding:

- MR should contain at least 20% protein, >10% fat and no more than 10% starch and sugars (sucrose).
- Ideally start feeding MR once the calf has received adequate colostrum and transition milk (generally at three to four days of age).
- Do not over-feed calves, especially during the first three weeks of life, as it may cause scouring.
- Consider MR as a feed, not a drink. *Ad lib* clean water is essential from day three for proper rumen development and feed intake.

Mixing:

- MR is usually reconstituted at a concentration of 125g/litre of mixed milk. Add 125g of powder to 875ml of water to give one litre of mixed milk at 12.5% milk solids. It is essential to always read and follow the manufacturer's recommendations.
- Use scales to measure the powder correctly and ensure consistency.
- Never suddenly change the quantity of milk being fed.
- Reconstitute by adding the total amount of powder required to half the measured volume of water, mix thoroughly and then add the balance of warm water (ideally 39°C; never greater than 45°C) to make up the correct volume.
- Aim to feed calves at body temperature (37-39°C).
- Maintain a high standard of cleanliness throughout the preparation and feeding process.

Always add the replacer to the water. Adding the water to the dry milk replacer will cause the powder to stick to the sides of the container, resulting in poor mixing.