



Maximise your herd's potential

## ELECTROLYTES AND ORAL REHYDRATION THERAPY

In the healthy body, the kidneys, cells and lungs control the chemical composition of blood and the balance of water and electrolytes (body salts) in body fluids & tissues.

Diarrhoea (scours) contains large amounts of water as well as electrolytes (body salts); this loss of fluids and salts results in dehydration of the calf.

Dehydration causes the controlling mechanisms to fail and the fluid and electrolyte loss produces a change in body chemistry that can lead to depression and subsequent death.

Therefore oral rehydration solutions should be formulated to enhance water absorption, water retention, to restore normal electrolyte balance and to reverse acidosis.

### **What are electrolytes and why are they important?**

Many farmers who raise calves loosely use the term “electrolytes” to describe the oral rehydration therapy they use to rehydrate scouring calves. More technically, electrolytes are negatively or positively charged particles which are important for the correct functioning of the organs, cells and nervous system. The most important of these electrolytes are sodium, chloride and potassium. When they get out of balance the electrochemical functions of the body start to malfunction. Acidosis results from an imbalance of electrolytes.

In calves, the symptoms of electrolyte imbalance and subsequent acidosis are usually behavioural and include:

- a lack of interest in their surroundings,
- lethargy,
- general weakness,
- unco-ordination,
- wobbly gait,
- weak suckle reflex.

Once the pH of the blood falls below 7.2, calves lose the ability to:

- suck,
- blink,
- stand,
- respond to touch.

As acidosis progresses, calves become comatose, heart and lung function is compromised and calves often die of cardiac arrest.

The symptoms of acidosis are similar to those of low blood sugar levels. Calves use sugars from the digestion of milk to keep warm as well as for growth; if these reserves are not being replenished calves lose their ability to maintain body heat. This is the reason that very sick calves often have a sub-normal body temperature.

The purpose of oral rehydration therapy is to restore the fluid and electrolyte balance in the body and to reverse the effects of acidosis. How effective a product will be at achieving this is directly linked to the balance of ingredients it contains.

### **Are all electrolytes the same?**

No, there are some very good products on the market and there are some that are just expensively priced versions of what you could mix from the contents of your pantry cupboard.

### **What should I look for on the label?**

Most electrolyte mixes are sold in a powder form or as a concentrated liquid which needs to be diluted before use. There are several critical ingredients which you should look for when choosing an electrolyte mix. However, the most important ingredient of oral rehydration solutions is the one you add yourself.

- **Water** is the most important ingredient of oral rehydration solutions. Life cannot exist without water. Dehydration is the lack of water in the body therefore dehydrated calves require extra water. Water dissolves electrolytes so they can pass into the bloodstream and the tissues. Oral rehydration therapy should be given in addition to normal feeds. Mixing electrolyte products with milk feeds defeats the purpose of these products.
- **Sodium** draws water to it, so when sodium moves from the intestine to the blood and tissues, water will follow it. Sodium should be included at a ratio of at least one to one with glucose to be absorbed efficiently. Animals have the ability to regulate their sodium intake, so solutions containing sodium will be preferentially consumed by dehydrated calves.
- **Glucose** (sometimes listed as dextrose) facilitates sodium, and therefore water, absorption from the intestine. It is also useful as a minor energy source for sick calves. The amount of energy supplied by electrolyte mixes is not a substitute for the nutritive value of milk.

- **Glycine** is an amino acid which provides pathways for sodium absorption. It is also added to electrolyte mixes because it has been shown to enhance the absorption of glucose. In assessing an electrolyte mix the total amount of glycine and sodium should not exceed 145 mmol/L. The total of glycine and sodium should also equal a one to one ratio with glucose.
- **Potassium** helps maintain fluid balance in the body and is involved in nerve function and muscular contraction, particularly of the heart.
- **Chloride** is needed to maintain pH of the blood and for metabolism. Normal kidney function regulates the levels of chloride and sodium in the blood. In severe dehydration, this ability is lost.
- **Alkalinising agents** are added to decrease acidosis and may also provide some energy. Alkalinising agents commonly found in electrolyte mixes are sodium bicarbonate, citrate, lactate, acetate & propionate. Bicarbonate and citrate interfere with the clotting of milk in the abomasum. Sodium bicarbonate is a very common additive in electrolyte mixes. If feeding an oral rehydration solution with bicarbonate or citrate, *it should be fed at least 1½ – 2 hours before or after a milk feed*, to avoid further disruption of intestinal function. There is some evidence that volatile fatty acids (VFAs – e.g. acetate or propionate) are preferable to sodium bicarbonate because:
  - they can aid in sodium absorption in the calf's small intestine,
  - they do not increase abomasal pH,
  - they may inhibit the growth of Salmonella species,
  - they produce energy when metabolized,
  - they are easily metabolized and have no negative effect on milk digestion.
- **Mucopolysaccharides** or gelling agents such as psyllium (ispagula), pectin, guar gum etc. There is no conclusive scientific evidence that these additives are either beneficial or harmful in oral rehydration mixes. They may tend to slow the passage of fluid through the intestine, possibly allowing more nutrients to be absorbed and they may coat inflamed intestinal mucosa. There is evidence that psyllium is useful in binding toxins. My experience has been that they reduce the severity of diarrhoea and its effects on calves.

The recommended inclusion rates of various ingredients is fairly specific as too much of one ingredient can be as damaging as too little. The table below summarises the recommended range of the common ingredients.

<b>Ingredient</b>	<b>Recommended inclusion rate</b>
Sodium (Na)	60 - 130 mmol/L
Glucose	110 – 140 mmol/L
Glycine	Na + glycine should not exceed amount of glucose
Potassium (K)	10 – 20 mmol/L
Chloride(Cl)	40 – 80 mmol/L
Alkalinising agent	40 – 80 mmol/L

**Osmolarity** is a measure of the concentration of particles (dissolved electrolytes and glucose) in a solution. Low osmolarity fluids (<350mOsm/L) are called “isotonic” because they are equal to the normal osmolarity of the blood. These often do not have enough glucose in them to be useful for oral rehydration. High osmolarity fluids (>600mOsm/L) are called “hypertonic” because they are more concentrated than normal body fluids. They can worsen diarrhoea by drawing more fluid from the tissues into the intestine. Useful osmolarity levels are somewhere between these two levels.

### **Home made electrolyte mixes.**

There are many recipes available for electrolyte mixes. If you are using an electrolyte mix to feed to healthy calves (e.g. to minimise the stress of transport) they can be a cheap alternative. In an emergency, a home made mix is more beneficial than plain water.

Whatever the reason for use, care must be taken to measure ingredients very carefully, especially if multiplying the recipe. Sugar in any form must be avoided as calves cannot digest sugar and it may increase scouring and dehydration.

One recipe for a homemade oral rehydration solution:

1 tsp. low sodium salt

2 tsp. baking soda

50g fruit pectin

1 can beef consommé

Add water to make 2 litres. Feed at the rate of 1ℓ per 10 kgs of bodyweight 3 to 4 times a day. Feed milk 2 hours before or after due to bicarbonate content.

adapted from Feeding the Newborn Dairy Calf (1984)

Another recipe is:

60g glucose/dextrose

13g sodium bicarbonate

6g sodium chloride

3g potassium chloride

Make up to 2 litres with warm water.

Feed milk 2 hours before or after due to bicarbonate content.