

# What to Look for in an Oral Electrolyte Product

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There are five major infectious causes of diarrhea in calves less than 21 days of age: *E. coli* K99, rotavirus, coronavirus, Cryptosporidia, and *Salmonella* species. Noninfectious factors such as insufficient or poor quality colostrum, poor sanitation, stress, and cold weather can also cause or contribute to neonatal calf diarrhea. Regardless of the cause, diarrhea results in increased loss of electrolytes and water in the feces of calves and decreases milk intake. Ultimately, this process causes dehydration, metabolic acidosis (the blood is more acidic than it should be), electrolyte abnormalities including a critical sodium deficiency, and a negative energy balance from the lost nutrients and lack of milk. Oral electrolyte solutions have typically been used to restore fluids, correct the pH and electrolyte levels in the blood, and provide nutritional support with the added benefit of being relatively inexpensive and easy to administer. However, there are a tremendous number of products on the market to choose from and they differ considerably. This article is intended to provide guidance in selection of an oral electrolyte product according to the latest research.

Accurate assessment of a calf with diarrhea is necessary to determine if oral fluid therapy is adequate or if intravenous fluids are indicated. Please consult the December 2012 issue of KY Dairy Notes regarding how to perform this assessment or a table summarizing these assessments and treatment options including the amount of fluids required can be found at: <http://www.extension.org/pages/65519/early-identification-of-sick-dairy-calves-important-to-their-survival-and-future-milk-production>. After determination that oral fluids are needed, the solution chosen must satisfy the following four requirements:

1. It must supply enough sodium to rapidly correct the losses that have occurred;
2. It must include agents (glucose, citrate, acetate, propionate, or glycine) that actually encourage absorption of sodium and water from the intestine;
3. It must provide an alkalizing agent (acetate, propionate, or bicarbonate) to correct the blood from being too acidic;
4. It must provide energy because calves with diarrhea are in a negative energy balance.

Sodium, chloride, and potassium are all lost in the feces of calves with diarrhea. Sodium is the most important of these and most research suggests a level of 90-130 mmol/L is necessary to correct dehydration. However, sodium absorption from the small intestine will only occur if there is glucose or an amino acid such as glycine, alanine, or glutamine that the sodium can join with and cross into the cells in the gut. The ratio of glucose to sodium present in an oral electrolyte solution should fall somewhere between 1:1 and 3:1. Volatile fatty acids such as acetate and propionate are also known to increase intestinal absorption of sodium. With dehydration, potassium is lost in the feces and urine so calves may experience a profound loss of body potassium stores. A common clinical sign in calves with chronic diarrhea is extreme muscle weakness due in large part to this loss of potassium. Oral electrolyte products should contain between 10-30mmol/L of potassium. A relatively new theory called the "strong ion theory" encourages the use of products that deliver an excess of strong cations (sodium and potassium) relative to the concentration of strong anions (chloride) in order to help correct a portion of the acid-base balance in the blood. This "strong ion difference" or "SID" is calculated

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as follows:  $[Na^+] + [K^+] - [Cl^-] = SID$  and should fall in the range of 60-80 in an oral electrolyte product. Chloride should be present in the range of 40-80 mmol/L ; concentrations at the lower end of the suggested range will beneficially increase the SID.

It is extremely important that the oral or IV fluids chosen for rehydration will be able to increase blood pH from an acidic state to a more neutral state. This is normally accomplished by alkalinizing agents such as bicarbonate, acetate, or propionate found in oral electrolytes. Although all have similar effects, acetate and propionate have several advantages over bicarbonate:

1. Acetate and propionate help sodium and water to be absorbed in the small intestine but bicarbonate does not;
2. Acetate and propionate are sources of energy but bicarbonate is not;
3. Acetate and propionate will not alkalinize (raise the pH) in the abomasum or true stomach but bicarbonate will; this is important because an acidic stomach kills harmful bacteria before they can reach the small intestine and finally,
4. Acetate and propionate do not interfere with milk clotting in calves whereas bicarbonate has been shown to interfere with this normal digestive process. For this reason, experts recommend that bicarbonate-based electrolytes not be fed at the same time as milk or milk replacer. Conversely, products with acetate or propionate do not cause digestive disturbances and are well tolerated when fed with milk.

Commercial preparations may also vary in the amount of particles dissolved in the solution. A “hypertonic” oral electrolyte product has a very large amount of glucose in the preparation and may have the denotation “HE” for high energy. These differ from “isotonic” solutions which have a similar amount of particles in the solution as is normally found in the bloodstream. Hypertonic solutions give greater nutritional support because of the higher glucose level yet they have been associated with abomasal bloat and increased diarrhea if the calf is unable to absorb this large amount of sugar. Depressed calves that refuse milk can be given a hypertonic electrolyte product while milk feeding is withheld. A hypertonic oral solution of 500-600mOsm/L is ideal in dairy calves or beef calves separated from the dam. Beef calves that continue to suckle or dairy calves with a good appetite will need isotonic solutions. **It is necessary to continue feeding milk or milk replacer to calves with scours because milk is better at maintaining a normal blood glucose level than any electrolyte solution.** Never mix electrolytes with milk or milk replacer as these products are designed to be mixed with water only.

In summary, it is important to examine the oral electrolyte product label and understand the contents. Unfortunately, ingredients are often presented in different ways that make comparisons difficult. Consult a veterinarian or nutritionist to properly evaluate your oral electrolyte product before your next case of neonatal calf diarrhea.