



Components of Oral Electrolyte Solutions

From Electrolyte & Water Balance in Calves
Developed by Rob Costello, Technical Specialist

Overview. *Electrolyte solutions should be formulated for their ability to enhance water absorption, water retention and to reduce acidosis. Since diarrhea can have a serious effect on bacterial populations in the digestive tract, inclusion of specific direct-fed microbials favors conditions for growth of beneficial bacteria and reestablishment of a normal intestinal environment.*

Water is the most important nutrient for sustaining life. Water corrects dehydration and acts as a solvent for electrolytes.

Sodium (Na^+) is the major extracellular ion in the body. Water follows the movement of Na^+ , making it the major electrolyte component as well. As Na^+ is absorbed from the digestive tract into the blood and into cells, it causes water to move along with it. Cells absorb sodium through simple diffusion. It is also co-transported into cells along with glucose and amino acids. Sodium can also play a role in voluntary uptake of electrolyte solutions. Since mammals regulate sodium intake, calves will preferentially drink sodium-containing solutions as sodium loss increases.

Glucose is a sugar, or carbohydrate, that facilitates sodium absorption. Glucose is co-transported with Na^+ from the digestive tract. This enhances Na^+ absorption and water uptake from the small intestine.

Glucose also provides a minor energy source for the calf. However, an electrolyte solution should not be looked at as a replacement for energy provided by milk replacer.

High glucose electrolyte solutions are sometimes presented and used as a replacement for milk or milk replacer during diarrhea. Six quarts of such a solution provides about 75% of the daily energy needed by a baby calf for maintenance, while providing none of the protein required by the calf. Glucose, which is absorbed more quickly than lactose (milk sugar), causes a rapid increase in plasma glucose. Insulin is released into the calf's

bloodstream to lower the elevated plasma glucose level. This insulin response is excessive in young calves. Within three hours after administration of the high glucose electrolyte solution, plasma glucose is lower than the pretreatment level.

Glycine is an amino acid that is co-transported with Na^+ and works along with glucose to facilitate sodium and water absorption. Glycine is the most easily synthesized amino acid and is most often included in electrolyte solutions.

Potassium (K^+) is the major intracellular ion. Potassium helps maintain the integrity of the cell membrane and is involved in neural function and muscular contraction. Advanced dehydration leads to acidosis and severe electrolyte imbalance, causing a loss of cell membrane potential and cell death. A high supplemental level of K^+ can be lethal.

Chloride (Cl^-) is the major negative ion (electrolyte) involved in acid-base and water balance in the body. The kidneys use Cl^- to adjust and maintain equilibrium. Potassium chloride and sodium chloride are excellent Cl^- sources.

Ascorbic Acid (vitamin C) cannot be synthesized by calves until they are about 3 weeks old, and is therefore considered an essential nutrient for calves less than three weeks of age. Ascorbic acid is an antioxidant and is found in high concentrations in steroid secreting cells. The concentration of ascorbic acid in plasma is lower in stressed calves than non-stressed calves. Oral supplementation of ascorbic acid elevates the ascorbic acid level in plasma of preruminant calves.

Direct-Fed Microbials (DFMs) are specific, genetically superior species of bacteria that support conditions in the intestinal tract that are favorable to the growth of beneficial microorganisms and are unfavorable for pathogens. DFMs help prevent intestinal colonization by pathogens through production of antimicrobial compounds such as lactic acid, hydrogen peroxide, modified bile acids, and bacteriocins, which are effective bactericidal/bacteriostatic compounds. DFMs compete with pathogens for attachment sites for growth, compete for nutrients, neutralize toxins and stimulate the host immune system.

Bacillus bacteria are lumen organisms and do not attach to intestinal cells before providing their beneficial effects. This characteristic makes *Bacillus* an excellent microbial additive during diarrhea. Water moves rapidly into the digestive tract during diarrhea, making bacterial attachment and colonization more difficult. Attachment is first required for most other lactic acid bacteria. *Bacillus* produce an abundant array of enzymes and antimicrobial compounds with activity against pathogens. *Bacillus* are very hardy organisms and survive under harsh conditions.

Lactobacillus bacteria rapidly colonize the newborn intestinal tract and are the predominate microorganisms in the small intestine. They

survive the digestive process and attach to the epithelial lining, making them an excellent compliment to *Bacillus*. They grow best at a pH of 5.5 and are very effective against *E. coli*.

Bifidobacteria are primary colonizers of the large intestine, growing best at a pH between 6.5 and 7.0. Bifidobacteria are antagonistic toward *E. coli* and Clostridium.

Fructo-oligosaccharides (FOS). FOS are naturally occurring plant sugars. When fed to animals, they travel intact to the large intestine where they provide a source of nutrients for beneficial bacteria such as Bifidobacteria. FOS have been shown to increase volatile fatty acid production in the large intestine and improve calcium and magnesium absorption. FOS cannot be digested by the animal or by pathogenic bacteria, and are an excellent complement to direct-fed microbials containing bifidobacteria.

Glutamine/Glutamate are amino acids that have been shown to improve villi height and overall intestinal morphology during periods of stress and following injury. Both glutamine and glutamate provide a local fuel source for enterocytes, the absorptive cells of intestinal villi.

MERRICK'S, INC.

A Division of Merrick Animal Nutrition, Inc.

2415 Parview Rd • P.O. Box 620307 • Middleton, WI 53562-0307 USA
800-MER-RICK (637-7425) • 608-831-3440 • FAX: 608-836-8943

©Merrick's Inc., 2005

www.merricks.com