

Myth: One oral electrolyte is just as good as another

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Abstract

Diarrhea remains the leading cause of mortality in both beef and dairy calves. Calves with diarrhea frequently develop dehydration, strong ion acidosis, electrolyte abnormalities, and are in a state of negative energy balance. Oral electrolyte therapy is a simple and economical method of addressing all of these potential complications. However, there are significant differences in oral electrolyte products available for use in calves and for treatment of diarrhea. Many commercially available oral electrolytes are based off of World Health Organization recommendations for oral rehydration therapy in children, which have differences in pathophysiology of diarrhea as compared to calves. For example, a major difference is that calves produce D-lactate in their colon during diarrhea which leads to a significant acidemia. Therefore, oral electrolyte products commonly used to resuscitate humans may not work effectively in calves. This article will give an overview of oral electrolyte therapy in both children and calves focusing on how to choose an electrolyte product.

Key words: calves, diarrhea, electrolytes

Résumé

La diarrhée demeure la principale cause de mortalité à la fois chez les veaux de boucherie et chez les veaux laitiers. Les veaux diarrhéiques développent fréquemment les symptômes suivants : déshydratation, acidose métabolique sévère, anomalies électrolytiques et bilan énergétique négatif. Un traitement de réhydratation orale à base d'électrolytes est une méthode simple et peu coûteuse de remédier à ces complications potentielles. Toutefois, il existe des différences importantes dans les produits de réhydratation orale à base d'électrolytes pour le traitement des veaux et pour le traitement de la diarrhée. Plusieurs électrolytes oraux disponibles commercialement sont basés sur les recommandations de l'OMS pour le traitement de réhydratation orale à base d'électrolytes chez les enfants. Toutefois, ces derniers montrent un profil pathophysiologique de diarrhée différent de celui des veaux. Par exemple, les veaux contrairement aux enfants produisent du D-lactate dans leur côlon durant la diarrhée ce qui entraîne une acidémie importante. Par conséquent, les produits de réhydratation orale à base d'électrolytes qui sont utilisés couramment pour ressusciter les humains pourraient ne pas fonctionner très bien chez les veaux. Cette présentation donne un aperçu des traitements de réhydra-

tation orale à base d'électrolytes à la fois chez les enfants et chez les veaux et met l'accent sur le choix des produits de réhydratation orale.

Introduction

Neonatal diarrhea remains the most common cause of death in both beef and dairy calves. Despite significant progress in understanding the pathophysiology of neonatal diarrhea, it continues to be a major cause of economic loss to the cattle industry. A complete review of the pathophysiology of diarrhea is beyond the scope of this chapter and has been covered elsewhere.¹⁰ Some pathogens cause secretory diarrhea, causing the small intestine to move from a net absorption of fluid to a net secretion of chloride, sodium, and water into the intestinal lumen. This increase in secretion overwhelms the absorptive capacity of the large intestine, resulting in diarrhea. Other pathogens damage the small intestinal villi which results in failure to absorb electrolytes and water (malabsorptive diarrhea). However, regardless of the pathogen or the mechanism involved, diarrhea increases the loss of electrolytes and water in the feces of calves and often decreases milk intake. This results in dehydration, strong ion (metabolic) acidosis, electrolyte abnormalities (usually decreased sodium and increased OR decreased potassium), increased D-lactate concentrations, and a negative energy balance (from anorexia and malabsorption of nutrients). Therefore diarrhea is by far the most common indication for fluid therapy in neonatal calves. The primary goals of treating calf diarrhea are to 1) correct free water and electrolyte abnormalities; 2) correct acid-base deficits (acidemia); 3) provide nutritional support; and 4) eliminate and/or prevent *Escherichia coli* bacteremia. Three of these 4 goals can be met with oral rehydration therapy. The purpose of this article is to provide an overview of oral electrolyte therapy in calves with particular emphasis on treating diarrhea.

Overview of Oral Rehydration Therapy in Children

According to the World Health Organization (WHO), the development of oral rehydration therapy was one of the most significant advances in human medicine of 20th century. Acute diarrhea is 1 of the primary causes of morbidity and mortality among children in low-income countries. In a review of 27 prospective studies from 20 different countries, the incidence of diarrhea was estimated at 3.8 episodes per child per year for children under 11 months of age and 2.1 episodes per child per year for children between 1 and 4 years of age.¹⁸

Although child survival rates have improved with modern medicine, 8.8 million children worldwide still die every year before reaching the age of 5.⁴⁰ Diarrhea has been shown to be responsible for about 10% of child deaths in the Americas, 25.2% of deaths in Africa, and 31.3% of deaths in southeast Asia.⁹ The WHO introduced oral rehydration solutions in 1979 in an effort to reduce the morbidity and mortality associated with diarrhea in children. The original solution consisted of glucose (111 mmol/L), sodium (90 mmol/L), potassium (20 mmol/L), chloride (80 mmol/L), and citrate (10 mmol/L) or bicarbonate (30 mmol/L). The osmolality of this original oral electrolyte solution (OES) was 310 mOsm/L. This oral electrolyte solution (OES) was considered both safe and effective for treating diarrhea in children. In 2004, the WHO recommended a modified formulation where glucose and sodium were both reduced to 75 mmol/L (with total osmolality decreasing to ≤ 270 mOsm/L). This new electrolyte reduced the volume and duration of diarrhea and also decreased the need for intravenous fluid therapy as compared to the original formulation.^{13,14} The rationale for decreasing the osmolality of the original OES was to decrease the osmotic load of the solution which was thought to be aggravating fluid loss and in some cases inducing hyponatremia.¹⁶

More recent advances in oral rehydration therapy include the use of glucose polymers (like rice and/or wheat) instead of glucose monomer to decrease the volume and duration of diarrhea.¹² The objective is to slowly release glucose into the intestine and improve the absorption of water and salt from the OES. The addition of zinc to OES used in humans has also become common. Diarrhea can lead to zinc deficiency, and the resulting zinc deficiency can lead to a more severe and prolonged diarrhea. In a meta-analysis of 16 trials that included 15,231 participants with acute diarrhea and 6 trials involving 2,968 people with chronic diarrhea, zinc supplementation reduced the duration of diarrhea in both groups.²³ Based on these data, the WHO now recommends the addition of zinc to OES and supplementation should be 20 mg per day for 10 to 14 days in children with diarrhea. Even newer recommendations include the use of short-chain fatty acids (SCFA) such as acetate, propionate, and butyrate that have been shown to stimulate sodium and fluid absorption in the colon by a cAMP-dependent mechanism. To deliver SCFA to the colon, some research has suggested the addition of resistant starch (starch resistant to amylase digestion in the small intestine) to OES. Specifically the resistant starch product that has been used is called high-amylose maize starch (HAMS). To date, 3 different trials with HAMS-ORS conducted in India have demonstrated a substantial decrease in diarrhea duration both in adults and children hospitalized for diarrhea.² Recommendations have been made to establish a new HAMS-containing oral electrolyte as the standard treatment for acute diarrhea in children around the world. A recent systematic review estimated that oral rehydration therapy could prevent 93% of death loss in children due to diarrhea.²⁶

Pathophysiology of Diarrhea in Children and Calves

To a significant degree, children and calves have very similar etiologies of diarrhea. The Global Enteric Multicenter Study (GEMS) was a large, 3-year prospective study that looked at pathogens present in 9,439 children (age 0 to 59 months) with diarrhea and 13,129 control children without diarrhea. The most common causes of diarrhea in this study were rotavirus, *Cryptosporidium*, enterotoxigenic *E. coli* (producing heat-stable enterotoxin), and *Shigella*.¹⁹ Obviously, the first 3 of these pathogens are also responsible for the majority of diarrhea seen in neonatal calves. Most children with diarrhea have low sodium concentrations, although hyponatremia has been described and most children have low to normal potassium concentrations, although hyperkalemia is occasionally seen. In a recent study involving 185 children hospitalized for severe diarrhea, 61% had hyponatremia, 35% had normal serum sodium levels, and 4% had hypernatremia (defined in this study as a serum sodium >146 mmol/L). In addition, 44% of children had low potassium concentrations, 55% had normal potassium, and only 1% had hyperkalemia (serum potassium >5.5 mmol/L).²⁸ This is not completely dissimilar to calves which usually have hyponatremia that accompanies diarrhea although hypernatremia is occasionally described. Hyperkalemia appears to be significantly more common in calves than children and was found in 34% of calves with diarrhea in a recent study (defined as serum potassium concentrations >5.8 mmol/L).³⁹

One major difference between children and calves with diarrhea is the development of acidosis. Although children with diarrhea can present with a low blood pH, it is less common than calves and typically the acidosis is much less severe. For example, 1 study from Poland reviewed medical records from 401 children hospitalized for diarrhea due to rotavirus in 2014. Metabolic acidosis (blood pH ≤ 7.35) occurred in only 24% of patients.³⁵ In another study of 200 children hospitalized for diarrhea, most cases presented with a normal blood pH and in the 11 cases described as "severe," mean blood pH was 7.23 ± 0.16 .¹⁵ In contrast, a study looking at 806 calves with naturally occurring diarrhea found a median blood pH of 7.16 with approximately 25% of calves having pH values of ≤ 7.0 .³⁸ A significant part of the acidosis in calves is due to the production of D-lactic acid which comes from bacterial fermentation of malabsorbed nutrients in calves with diarrhea.²⁹ Calves with diarrhea have a significantly higher serum concentration of D-lactic acid as compared to normal calves,^{20,22} and intravenous administration of D-lactate to normal calves has been demonstrated to induce many of the adverse clinical signs traditionally associated with metabolic acidosis.²² Therefore, correction of the strong ion acidosis when treating diarrhea in calves represents a much greater priority than it would in children. The general recommendation to include an alkalizing agent at a concentration of 30 mmol/L in OES designed for children is not appropriate for OES to be used in calves. An additional problem with sodium

bicarbonate concerns its stability. When mixed with other salts in packets in tropical climates, bicarbonate reacts with glucose or sucrose to form a brown color (caused by polymers of 5-hydroxymethylfurfuraldehyde). Since infant diarrhea is very common in places like Africa, South America, and Southeast Asia with warm climates, several companies have elected to remove the bicarbonate from OES to improve stability and prolong product shelf-life. Sometimes the sodium bicarbonate is replaced with sodium citrate, however some OES contain no alkalizing agent.

Oral Rehydration Therapy in Calves

Current knowledge regarding the use of OES to treat diarrhea in calves would say the product must satisfy the following 4 requirements: 1) supply sufficient sodium to normalize the ECF volume; 2) provide agents (glucose, citrate, acetate, propionate, or glycine) that facilitate absorption of sodium and water from the intestine; 3) provide an alkalizing agent (acetate, propionate, or bicarbonate) to correct the acidosis usually present in calves with diarrhea; and 4) provide energy, as most calves with diarrhea are in a state of negative energy balance.³² Factors to consider when choosing an oral electrolyte solution include the following.

Sodium concentration - Sodium is the osmotic skeleton of the extracellular fluid and therefore of plasma. Because sodium is the principal determinant of the volume of the ECF volume, it must be present in an oral electrolyte solution to rapidly correct the losses that have occurred with dehydration and diarrhea. The ideal sodium concentration for oral rehydration therapy in calves is not completely known, however most research would suggest it should be between 90 and 130 mmol/L. Products containing sodium at significantly lower concentrations are not able to adequately correct dehydration. Oral electrolyte products with very high sodium concentrations might be expected to cause hypernatremia, and have also been shown to delay abomasal emptying rates because of increased osmolality.

Chloride concentration - Although calves lose chloride during diarrhea, this loss does not occur nearly to the same degree as sodium.⁶ A general guideline has been that oral electrolyte products should contain chloride in concentrations between 40 and 80 mmol/L.

Potassium concentration - Like sodium and chloride, potassium is lost in the feces of calves with diarrhea. Therefore all calves with diarrhea have a total body deficit of potassium. However, in acute cases of diarrhea calves may have elevated blood potassium concentrations (hyperkalemia).³⁹ With dehydration, aldosterone is released from the pituitary gland. Aldosterone acts on the kidney to conserve sodium and water at the expense of increased potassium losses. Therefore in chronic cases of diarrhea, calves can have profound depletion of body potassium stores and generally have low serum concentrations of potassium. Clinical signs of hypokalemia include profound muscular weakness which

is often present in calves with chronic diarrhea. General recommendations are that oral electrolyte products used in calves with diarrhea contain potassium concentrations between 10 and 30 mM/L.

Sodium absorption - Sodium absorption by the small intestine is a passive process, and is linked to the movement of actively absorbed or secreted solutes. If sodium is present in the lumen of the small intestine without either glucose or amino acid, there is either a small net absorption or no net sodium movement across the jejunum. One of the earliest mechanisms of intestinal sodium absorption discovered was linked with sugar.⁸ Glucose can be co-transported with sodium from the intestinal lumen to the inside of the enterocyte at the brush border membrane. Because this mechanism was well understood by the 1960's, almost all early oral electrolyte formulations were mixtures of sodium and glucose. Neutral amino acids such as glycine, alanine or glutamine can also facilitate sodium absorption in the small intestine by a mechanism similar to glucose. In addition, volatile fatty acids such as acetate or propionate have also been shown to facilitate sodium absorption in the gut.³³

Osmolality - Commercially available oral electrolyte products in North America can range from roughly isotonic (280 to 300 mOsm/L) to extremely hypertonic (700 to 800 mOsm/L). The primary difference in most of these products is the amount of glucose that is added. High-osmolality solutions provide greater nutritional support to calves relative to lower osmolality products; however, milk or milk replacer is better able to maintain normal serum glucose concentration much better than either hypertonic or isotonic oral electrolyte solutions.⁷ However, as expected, oral electrolyte solutions rehydrated calves and prevented the development of metabolic acidosis more effectively than did milk replacer because they have a much higher sodium concentration. Multiple studies have demonstrated that high-osmolality oral electrolyte solutions maintain higher serum glucose and lower β -OH butyrate (ketone) concentrations when compared to lower-osmolality electrolyte solutions.^{3,7} The downsides of high osmolality are 1) it could worsen diarrhea and 2) it will slow abomasal emptying. The first downside was what led most OES designed for children with diarrhea to be formulated with a lower osmolality. Most calves with enteric pathogens already have hypersecretion of electrolytes and water into the small intestinal lumen, which could be exacerbated with the feeding of hypertonic solutions (electrolyte or milk replacer). Raising the intraluminal tonicity would serve to increase the secretion of water and electrolytes into the intestinal lumen, thus increasing the severity of diarrhea. This effect would likely be magnified with severe villus damage, which is often present in diarrheic calves. Studies in children documented decreases in severity of diarrhea when using lower osmolality OES.^{13,14}

Oral electrolyte solutions with extremely high osmolalities have also been shown to slow abomasal emptying rates as compared to isotonic products.^{27,31} This suggests that

electrolyte products with a very high osmolality (or high glucose concentrations) would be likely to induce abomasal ileus, thus increasing the risk of bloat and/or abomasitis.⁴ So although the ideal osmolality of an oral electrolyte solution for calves is not completely understood, a moderate-osmolality solution (400 to 500 mOsm/L) would be ideal in dairy calves or in beef calves that have been separated from the dam. Certainly if milk is to be withheld for any length of time, a hypertonic oral electrolyte solution would be indicated to provide energy to the calf. However, lower-osmolality solutions might be appropriate for calves that were still suckling or drinking milk. Another consideration is that OES frequently get added to milk or milk replacer for feeding, which further increases osmolality. My recommendation is to avoid OES with extremely high-osmolality products. In general I prefer to get the calf's nutrition (glucose) from milk and use OES for improving dehydration, correcting acidosis, and replacing electrolytes.

Alkalinizing ability – As discussed above, acidemia and metabolic/strong ion acidosis occur in almost all cases of calf diarrhea. Research has demonstrated that acidotic calves are unable to correct their metabolic acidosis when rehydrated with non-alkalinizing solutions (ie. milk or OES without alkalinizing agents).¹⁷ Therefore it is imperative that OES to be used in calves with diarrhea be able to increase blood pH. Classically this has been done by adding alkalinizing agents (ie. bicarbonate, acetate, or propionate) to oral electrolyte mixtures. More recently, there has been growing interest in looking at the strong ion difference (SID) of electrolytes as they relate to the efficacy of a different product to promote alkalinization. In reality, both (having an alkalinizing agent and a high SID) are likely important. Acetate, propionate, bicarbonate, and citrate are all considered alkalinizing agents and are frequently present in commercial oral electrolyte solutions. Bicarbonate-containing fluids are very effective at correcting a severe acidosis, since bicarbonate reacts directly with H⁺ ions to form CO₂ and H₂O. Acetate and propionate are also alkalinizing agents and have been shown to have alkalinizing effects similar to bicarbonate. Acetate and propionate are only effective alkalinizing agents when they are metabolized, a process which forms water and creates bicarbonate ions (bicarbonate precursors). This metabolic process appears to still function efficiently in calves with severe diarrhea, as the alkalinizing ability of the acetate has been shown to be as effective as bicarbonate.¹ Acetate and propionate have several advantages over bicarbonate:

- As discussed above, acetate and propionate facilitate sodium and water absorption in the calf intestine and colon, whereas bicarbonate does not.
- Acetate and propionate produce energy when metabolized, whereas bicarbonate does not.
- Acetate and propionate do not alkalinize the abomasum, whereas bicarbonate does.³⁴

Abomasal acidity provides a natural barrier to ingested bacteria, and maintaining a low abomasal pH will decrease

the number of viable coliform bacteria that reach the small intestine. This increases nonspecific resistance to intestinal colonization. Therefore the increase in abomasal pH seen with electrolyte products that contain high concentrations of bicarbonate may facilitate growth of bacterial diarrheal pathogens, and thus increase the severity, duration, and mortality rate associated with diarrhea in calves.

Strong ion theory is a different approach to looking at acid-base abnormalities and is covered in detail elsewhere.^{5,21} Based on strong ion theory, it is not necessarily imperative that an electrolyte solution contain an alkalinizing agent to correct metabolic acidosis; rather, the product must deliver an excess of strong cations (Na⁺) relative to the concentration of strong anions (Cl⁻). Therefore it has been advocated to consider the strong ion difference (SID) of an oral electrolyte solution when choosing a product. This can be calculated as follows: [Na⁺] + [K⁺] – [Cl⁻] = SID. Although there has not been any definite research to determine the optimal or minimum SID that an oral electrolyte product should contain, a minimum SID of 50 to 80 mEq/L would be recommended in a calf with diarrhea. Recent studies in calves demonstrate SID is a valid approach when formulating oral electrolytes for use in calves with diarrhea and acidosis.^{30,36} Ultimately, the ideal electrolyte solution for use in calves with diarrhea should contain at least 50 mM/L of an alkalinizing agent (preferably acetate and/or propionate), and have a SID of at least 50 to 80. Unfortunately, products without alkalinizing agents and with very low SIDs are commonly available in North America and should be avoided in calves with diarrhea (Table 1).

Incorporating Human Advancements into Calf Oral Rehydration Therapy

Use of glucose polymer-based OES has been tried in calves but was not successful. In one study, calves fed the rice-based OES developed diarrhea and were unable to properly digest the rice-based carbohydrate source.³⁷ There has also been an attempt to supplement calves with zinc hoping to shorten the severity and duration of diarrhea like has been shown in humans. In this study, 3 groups of calves were divided into 3 groups at the onset of diarrhea: a control group, a group supplemented with inorganic zinc (zinc oxide), and another group supplemented with organic zinc (zinc methionine). Liver biopsies showed no difference in zinc levels between calves at the start of the trial; however, liver zinc concentrations were significantly increased in the calves supplemented with zinc methionine by the end of the trial. However, there were no significant differences in duration of diarrhea, severity of diarrhea or clinical cure rates between any of the groups.¹¹ Therefore, at this time we do not have any data that would recommend the routine incorporation of zinc into OES for use in calves. It also becomes apparent that “what works well in humans” does not necessarily automatically translate into a recommendation that should be incorporated into calf diarrhea treatment. Most

Table 1. A comparison of oral electrolyte products available in North America.¹

	Sodium (mM/L)	Potassium (mM/L)	Chloride (mM/L)	Strong ion difference	Alkalinizing agent	Total osmolality (mOsm/L)
Advance Arrest (Milk Specialties) [†]	46	7	30	23	bicarbonate (12 mM/L)	245
Bounce Back (Manna Pro) [†]	136	10	112	34	bicarbonate (48 mM/L)	
Bovi-Mate ORS (Drench-Mate)	130	20	60	90	acetate (60 mM/L) and propionate (30 mM/L)	600
Bovi-Mate Elyte (Drench-Mate)	124	22	60	87	citrate (30 mM/L)	450
Bluelite Replenish (Techmix)	128	28	80	68	acetate (68 mM/L) & propionate (21 mM/L)	440
Blue Ribbon Calf Electrolytes (Merrick) [†]	144	20	75	89	none	390
Bovine Bluelite C (Techmix)	59	24	56	27	none	269
Calf-Lyte II (Vetquinol)	112	15	43	84	acetate (80 mM/L)	428
Calf-Lyte II HE (Vetquinol)	112	15	43	84	acetate (80 mM/L)	726
Calf Restart One-4 (Techmix)	54	12	70	0	none	
Calf Quencher (Vedco)	142	24	80	86	bicarbonate (86 mM/L)	731
Deliver (Agri-Labs) [†]	67	16	49	34	bicarbonate (36 mM/L)	305
Diaque (Boehringer Ingelheim)	90	15	55	50	bicarbonate (25 mM/L) & acetate (12 mM/L)	377
Electrolyte-F-Calf (Bio Agri Mix, Canada)	92	15	43	64	acetate (60 mM/L)	385
Electrolife Renew (MB Nutritional Sciences)	100	20	50	70	acetate (60 mM/L)	350
Entrolyte HE (Zoetis)	106	26	51	81	bicarbonate (80 mM/L)	739
Epic calf electrolyte (Bioniche)	92	30	45	77	acetate (52 mM/L)	360
Hydrafeed (A&L Laboratories)	110	10	40	80	bicarbonate (80 mM/L)	380
Hydralyte (Vet-A-Mix & AgriLabs)	90	30	45	75	acetate (60 mM/L)	614
Land O Lakes Base + Add Pack (Land O Lakes)	119	23	56	86	acetate (51 mM/L) and citrate (10 mM/L)	455
Land O Lakes Complete (Land O Lakes)	121	20	78	64	bicarbonate (38 mM/L)	490
Resorb (Zoetis)	75	25	80	20	none	315
Revibe HE (Zoetis)	120	20	50	90	acetate (80 mM/L)	466
Revitylte (Vets Plus, Inc)	110	20	50	80	bicarbonate (80 mM/L)	459
Revitylte Gelling (Vets Plus, Inc)	110	20	50	80	bicarbonate (80 mM/L)	417
Sav-A-Caf Electrolytes Plus (Milk Products, LLC)	138	12	123	27	bicarbonate (25 mM/L)	547
TheraCaf Plus (Milk Products, LLC)	128	27	70	80	bicarbonate (44 mM/L) & acetate (6 mM/L)	472
VitaLyte Plus (Vita Plus Corp.)	150	31	45	136	bicarbonate (80 mM/L)	527

¹This listing does not include every product available in North America. No discrimination or specific endorsement of any product is intended.

[†]Signifies data was calculated from product label instead of provided by the manufacturer. In some cases there was insufficient information on the label to provide an exact calculation so values may be exact.

OES trials done in children with diarrhea are comparison trials between 2 products where the main variable examined is clinical outcome. There are reviews and meta-analyses, however clinical outcome can be influenced by a number of factors. In contrast, the majority of research in calves with OES has looked directly at changes in extracellular fluid and/or plasma volume, improvement of acidosis, or influence on electrolyte concentrations. Although we don't have large systematic reviews in veterinary medicine on oral rehydration therapy, as pointed out previously the human data on oral rehydration therapy has significant limitations since the underlying data used in these reviews relied heavily on indirect or imprecise data.²⁴

Summary and Conclusions

The goals of oral fluid therapy are to replace fluid, acid-base, and electrolyte deficits; and to provide nutritional support. They are indicated in any diarrheic calf that has at least a partially functional gastrointestinal tract. If oral electrolytes are administered to a calf with ileus, the fluid pools in the rumen resulting in bloat and rumen acidosis. In general, a calf with any sort of suckle reflex or that demonstrates any "chewing" action can be considered to safely tolerate oral fluids. Oral electrolyte solutions also continue to serve as the backbone of treatment protocols for diarrhea in neonatal calves because they are cheap and easy to administer on-farm.

However, there are significant differences in oral electrolyte products sold in North America (Table 1) and some products will certainly resuscitate calves more effectively than others. Using an OES that has an adequate sodium concentration (to correct dehydration) along with an alkalinizing agent, good SID, and moderate osmolality will improve morbidity and mortality when treating calves with diarrhea. As was stated in a previous manuscript by Dr. Robert Michell, simply recommending oral electrolyte rehydration in this decade is as imprecise as advocating “antibiotics” would be without considering the drug or condition being treated.²⁵ So to think OES are all the same is a myth, and practitioners are encouraged to put some thought into what product they are recommending and/or using in practice for treating calves with diarrhea.

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