Mineral nutrition research in recent years has focused on reducing mineral excretion; however, very little work has focused on accurate determination of mineral requirements. To more accurately define and understand mineral requirements, it is essential that a better understanding of mineral absorption mechanisms and their regulation be achieved. This is particularly important because the cost of mineral supplements is on the rise. As a result, this symposium, “Mineral absorption: What is known?” was organized by the Nonruminant Nutrition Program Committee for the 2008 Joint Annual Meeting of the American Society of Animal Science and the American Dairy Science Association. This symposium was held on July 8, 2008, in Indianapolis, IN. Specific aims of the symposium were 1) review our current knowledge of Zn, Cu, Fe, Mn, and P absorption; 2) review the results of studies involving transgenic mice and how these results affect our thinking of Ca absorption and metabolism in livestock; and 3) learn more about recent technological developments that may aid in the identification of organic trace mineral complexes. To accomplish these aims, 5 speakers were invited.

The first invited speaker was Gretchen Hill, whose presentation was titled “Transporters in the absorption and utilization of Zn and Cu” (Hill and Link, 2009). Hill discussed the 2 protein families involved in Zn transport, ZnT and Zip proteins. The ZnT family of proteins maintains the inward concentration gradient for Zn by aiding in the efflux of intracellular Zn and by promoting the movement of intracellular Zn in cytosolic vesicles. Zip proteins appear to work in the opposite direction, moving extracellular Zn or vesicular Zn into the cytosolic pool. However, Zip proteins have yet to be identified and studied in livestock species. Hill then discussed Cu absorption mediated by 2 high affinity Cu transporters, Ctrl and Ctr3. The role of Cu chaperone proteins in binding and transporting cytosolic Cu and the interaction of Cu and Zn rounded out her presentation.

The second invited speaker was Jerry Spears whose presentation was titled “Absorption and metabolism of iron and manganese” (Spears and Hansen, 2008). Spears discussed the importance of reducing ferric Fe (Fe$^{3+}$) to ferrous Fe (Fe$^{2+}$) in the gastrointestinal lumen to allow for absorption through the divalent metal transporter (DMT1). To maintain the chemical gradient, Fe is rapidly transported from the enterocyte to the bloodstream by ferroportin 1, where it is rapidly oxidized back to ferric Fe by hephaestatin and bound by transferrin. Spears explained that manganese (Mn$^{2+}$) is also transported into the enterocyte via DMT1 but that this process is not very efficient, with less than 1% of dietary Mn being absorbed.

The third invited speaker was Alexandros Yiannikouris, whose presentation was titled “Identification of organic trace minerals: What does this tell us about potential routes of absorption?” Yiannikouris discussed recent technological advances in the identification of organic minerals still bound to their peptide carrier. Using this technology, Yiannikouris has been able to identify mineral-peptide complexes that appear to remain intact through the absorption process, indicating the possibility of absorption through a peptide transporter.

The fourth invited speaker was Scott Radcliffe whose presentation was titled “Active phosphate absorption: What do we know and is it important?” (Radcliffe, 2008). Radcliffe discussed the active phosphate transporter (NaPi-2b), which plays an increasingly important role as dietary P concentrations are reduced. Work conducted with pigs in Radcliffe’s laboratory indicates that as the concentration of dietary P is reduced, active phosphate transport capacity is enhanced via a translocation of NaPi-2b from a subapical pool to the brush border membrane of enterocytes.
The fifth and final invited speaker of this symposium was Jim Fleet, whose presentation was titled “Intestinal calcium absorption: Mechanisms learned from transgenic and knockout mice” (Fleet, 2008). Of all of the minerals discussed in this symposium, mechanisms surrounding Ca absorption and transport are probably the best defined. However, Fleet discussed how recent gene knockouts of the intestinal brush border membrane Ca transporter (TRPV6) or the cytosolic Ca shuttle (calbindin D9k) have minimal impact on intestinal Ca absorption mediated by vitamin D. As a result, researchers have to rethink what they thought they knew about Ca absorption.

Mineral requirements are often overlooked in nutrition, and our lack of knowledge is often covered for by providing dietary excesses. As we attempt to more precisely define and meet mineral requirements, it is essential that we have a better understanding of how minerals are absorbed and what factors, dietary or otherwise, can affect the efficiency of absorption. This symposium reviewed the current knowledge regarding the absorption of a handful of minerals and how this knowledge may aid in practical diet formulations in the future.

LITERATURE CITED


