Nonruminant Nutrition: Mineral-Mineral Interactions: Implications for Nutrition

457 Ionomics: Mineral nutrition, physiology, and interactions as a biological system. J. Fleet* and D. Salt, *Purdue University*, *West Lafayette, IN*.

Inorganic elements (metals, non-metals, transition elements, and electrolytes commonly called "minerals" in nutrition science) are critical to all life processes as enzyme cofactors, stabilizers of proteins, structural components of tissues, second messengers, regulators of acid-base balance, participants in redox reactions, and for the maintenance of cellular electrical potential. For this reason, the required mineral elements are essential for the optimal function of a broad array of physiological systems and dysregulation of their metabolism can influence, or be a marker of, disease processes. While traditional reductionist approaches have revealed many aspects of mineral metabolism and function, significant gaps still exist. For example, we don't know all of the proteins that mediate mineral metabolism or whose function is altered by changes in mineral status. It is also clear that mineral-mineral interactions exist but we don't fully understand how they influence the absorption, excretion, storage, and utilization of chemically similar elements. This presentation will explain how understanding the breadth of biological processes influenced by minerals, identifying the genes that control mineral metabolism, and revealing the importance of interactions between inorganic elements can be accomplished by using a new approach that examines the metabolism of minerals in toto, or as an "ionome".

Key Words: ionome, minerals

458 Trace mineral interactions, known, unknown and not used. G. M. Hill* and J. E. Link, *Michigan State University*, *East Lansing*.

Potentially, trace mineral interactions can occur anywhere from the feed to the organ of storage to exogenous secretions etc. If and where they take place or if it makes a difference, also depends on your point of view. Excess dietary trace elements provided by feedstuffs are usually assumed to be non-existent and/or not available for the animal's use. However, their role in altering the functional outcome for another trace element may be as critical as meeting the animal's unknown requirement. Using the treatise of Hill and Matrone (1970) we can expect interactions based on the chemical and physical properties of the element. For example in aquatic birds, Miller (1996) found an hepatic Mg-Zn interaction due to the spherically symmetric valence orbitals with similar ion pair formation and both ions involved in catalytic hydrolysis of ATP. Yet, this interaction is seldom studied in livestock. Well known interactions such as Fe and Zn are affected by source, species of the element, dietary concentrations and which element is in excess. However, it is not possible to look at the biochemical markers of these two elements without also considering Cu. In areas where I is deficient, the supplementation of Fe and I is another consideration often forgotten due to the large amounts of Fe found in Ca sources. Since Zn is essential in the conversion of β-carotene to vitamin A, perhaps we need to broaden our interaction model to consider all 5 nutrients. One of the most relevant interactions today due to the varying concentration of S in DDGS is the Co/Mo/S interaction. While this may be of greater interest in ruminant animals, it should be noted that a Cu/Fe/Mn and S amino acid interaction also occurs in non-ruminants. Few interaction studies have utilized molecular techniques, so the tools of today are needed to understand practical application of interactions. Clearly, the potential for interactions can affect the functional outcome we desire in dietary formulation.

Key Words: trace elements, interactions

459 Macromineral interactions. J. S. Radcliffe*, *Purdue University*, *West Lafayette, IN*.

Our understanding of mineral availability, absorption, and utilization is minimal at best. Historically, minerals have been individually studied and requirements determined. However, research has reported numerous interactions between minerals. One of the most noted interactions is between Ca and P in which it has been reported that excess Ca can cause the formation of insoluble Ca-phosphate salts, resulting in decreased P availability. In human medicine this is exploited as a treatment for hyperphosphatemia, where Ca carbonate is used as a phosphate binding agent. However, it is unclear in animal nutrition what should be done with Ca when varying P levels are investigated or when phytase is included in the diet. In reality there are dozens of mineral interactions occurring at any time making it difficult to study any one mineral individually. Another way of stating this is that the concentrations and proportions of every mineral in the diet may impact the results of the mineral being studied. It is impossible to take account for all mineral interactions experimentally, but a better understanding of mineral interactions is needed for proper interpretation of results and requirement estimates.

Key Words: mineral, interactions

Physiology and Endocrinology: Estrous Synchronization of Beef Cattle

460 ASAS Early Career Achievement Award Presentation: Control of the estrous cycle for fixed-time artificial insemination (TAI) in beef cattle. G. C. Lamb*, *North Florida Research and Education Center, University of Florida*, *Marianna*.

Early estrus-synchronization protocols focused on regressing the corpus luteum with an injection of prostaglandin $F_{2\alpha}$ (PG) followed by detection of estrus. Later, estrus-synchronization systems involved the use of exogenous progestins, which (when administered) prevented estrus from occurring. Gonadotropin-releasing hormone was utilized to control follicular waves to synchronize ovulation and luteinization of large dominant follicles. Our research aimed to develop: 1) reliable protocols that relied solely on TAI; 2) protocols that required a maximum of 3 animal handlings; and 3) protocols that are successful in estrous cycling and noncycling females. In cows, insertion of a CIDR during the 7-d interval between the initial GnRH injection and PG enhanced pregnancy rates by 9 to 10%. In a multi-location study, a fixed-timed AI (TAI) protocol yielded similar pregnancy rates as a protocol involving detection of estrus plus a clean-up AI (54 vs. 58%, respectively, for cows and 53 vs. 57%, respectively, for heifers). A meta-analysis of data for a TAI protocol containing a progestin resulted in pregnancy rates of 54.7% and 50.3% for cycling for noncycling cows, respectively. A similar analysis for the same TAI protocol without a progestin resulted in pregnancy rates of 47.1% and 34.0% for cycling and noncycling cows, respectively. Recent work has indicated that human chorionic gonadotropin more effectively caused ovulation of follicles in cycling