Salt & Trace Minerals

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UNIQUENESS OF SALT AS A CARRIER OF OTHER MINERALS

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INTRODUCTION

It has long been known that animals have a specific appetite for sodium chloride (salt). Actually the appetite is more for sodium than chloride but salt is the cheapest source of sodium. If salt is provided free choice, ruminants grazing forages will consume adequate amounts to meet their sodium and chloride requirements. Equally important animals will not over consume salt to the point that toxicity occurs if adequate drinking water is available. In his textbook published in 1912, Kellner stated that “salt possesses, in a very high degree, the properties of a spice; it improves the appetite and makes many feedstuffs palatable which without salt, would not be readily eaten”.Animals such as cattle, sheep, goats, and deer, grazing pastures are usually dependent on a free choice mineral supplement to provide any minerals that are not supplied in adequate amounts in their forages. The palatability characteristic of salt is important because most trace minerals and major minerals are not very palatable, and salt is the driving force that not only promotes but also regulates intake of free choice mineral supplements.

The term “nutritional wisdom” has been used to describe an animal’s ability to recognize that a particular mineral is deficient in their diet, and consequently to select and consume (if a source of the mineral is available) a source of the mineral in adequate amounts to meet their requirement. The ability of animals to consume different minerals based on their need or requirement has been studied using cafeteria style mineral feeders. With cafeteria style mineral feeders animals are offered a choice of up to 11 different minerals in separate compartments. This paper will discuss the ability or in most instances the inability of animals to select and consume minerals based on their nutritional need.

SODIUM DEFICIENCY AND APPETITE FOR SALT

Animals exhibit an appetite for sodium that can easily be satisfied by providing salt free choice or adding salt to the complete diet of animals raised in confinement. There is little question that animals exhibit a high degree of nutritional wisdom in regard to their need for sodium. A strong appetite for salt is apparent long before signs of deficiency occur, indicating the ability of animals to recognize that they are not receiving adequate salt. Dairy cows receiving no salt in their diet show an increased appetite for salt after two or three weeks (Maynard and Loosli, 1969). Interestingly, cows receiving no salt did not express clinical signs of deficiency for approximately one year. Overtime the dairy cows exhibited unthriftness, loss of appetite, and a drastic decline in body weight and milk production.

The desire of sodium-deficient cattle and sheep to increase their consumption of salt has been

studied experimentally by surgically cannulating a major salivary gland (parotid) and removing saliva. Ruminants secrete large volumes of saliva during feed ingestion and rumination, and saliva is very high in sodium. When saliva is removed and not replaced, sheep and cattle rapidly become sodium deficient. Following removal of saliva from the parotid gland, sheep offered rock salt free choice consumed 5 to 15 grams per day (Denton, 1982). This was much higher than the normal intake of 0.5 to 2 grams of rock salt per day. When saliva was removed from calves, they rapidly develop the ability to select solutions containing either sodium chloride or sodium bicarbonate (Bell and Williams, 1960). These studies clearly demonstrate the ability of cattle and sheep to recognize that they are deficient in sodium and to increase their free choice consumption of salt.

The ability of animals to sense the need, and select for sodium is not unique to cattle and sheep. Horses deficient in sodium show a specific appetite for salt (Ralston, 1984). Stockstad and coworkers (cited by Denton, 1982) studied intake of various mineral compounds by big game animals in western Montana, over a two-year period, when the minerals were provided individually in separate compartments. Sodium compounds evaluated included salt, sodium bicarbonate, sodium phosphate, and sodium iodide. All sodium compounds were consumed in large quantities during the study. Chloride and phosphate compounds other than sodium chloride and sodium phosphate were consumed in only small amounts or not at all. Of the trace minerals evaluated in this study only cobalt (cobalt chloride) was consumed by the wild animals. Copper, iron, and iodine forms other than sodium iodide were not consumed. Deer that were consuming a diet that contained approximately 27% of their sodium requirement, also selected and readily consumed salt when it was offered free choice in cafeteria style feeders (Ceacero et al., 2009).

OTHER MACROMINERALS AND NUTRITIONAL WISDOM

When macrominerals (other than sodium) are deficient in the diet, there is little evidence that animals recognize the need for the mineral and consume it in adequate quantities to satisfy their requirement. Early studies indicated that cattle consuming phosphorus-deficient diets exhibited a deprived appetite resulting in animals chewing on bones. Because of the high phosphorus content of bones, it was assumed that cattle were chewing on bones to derive phosphorus. Gordon et al. (1954) studied the ability of cattle and sheep grazing phosphorus-deficient pastures to correct their deficiency by selecting and consuming adequate quantities of a phosphorus containing supplement. Over a two-year period animals were exposed to two troughs containing calcium carbonate and one trough containing a mixture of 50% calcium carbonate and 50% dicalcium phosphate. Animals failed to show a preference for the phosphorus-calcium mixture over calcium carbonate alone, and did not consume sufficient amounts of phosphorus over the two-year period to correct their phosphorus deficiency. Studies in lactating dairy cows also have indicated little relationship between diet phosphorus contain and free choice intake of dicalcium phosphorus (Coppock et al., 1976; Muller et al., 1977).

In chicks there is some evidence to support a specific appetite for calcium during calcium deficiency. Hughes and Wood-Gush (1971) gave calcium-deficient chicks a choice of a diet low in calcium or the diet supplemented with 2% calcium carbonate. Approximately 80% of the chicks showed a preference for the calcium-supplemented diet. However, ponies (Ralston, 1984) and lambs (Pamp et al., 1977) do not show a preference for calcium supplements when fed calcium-deficient diets. Pamp et al. (1977) conducted a study to determine whether lambs fed a diet deficient in calcium would select and consume adequate amounts of calcium when several different minerals were offered free choice. Ten minerals were offered in separate containers to one-half of lambs fed a diet either adequate or deficient in calcium. Growth rate of lambs fed the calcium-deficient diet was greatly reduced during the 60-day study compared to

lambs fed the same diet but supplemented with sufficient calcium. Lambs fed the calcium-deficient diet and offered the different minerals free choice did not consume adequate amounts of calcium carbonate to prevent the growth depression caused by calcium deficiency. For the entire study intake of salt was similar for lambs fed calcium-adequate and calcium-deficient diets, supporting the specific appetite of animals for salt regardless of their nutritional status.

Animals do not appear to have a specific appetite for either potassium or magnesium, even when receiving diets deficient in these minerals (Denton, 1982). Most forms of magnesium are known to be unpalatable to cattle. A supplement consisting of a mixture of magnesium oxide and magnesium sulfate was consumed in very small amounts when offered free choice to lactating dairy cows in cafeteria style feeders (Muller et al., 1977). Similarly, consumption of magnesium oxide by deer was very low when different minerals were offered cafeteria style (Ceacero et al., 2009). Because of the poor palatability of magnesium it is necessary to combine magnesium sources with palatable ingredients, such as salt, molasses, and grain byproducts, to achieve sufficient magnesium intake to prevent grass tetany in cattle. Tags on most high magnesium mineral supplements indicate that the magnesium supplement should be fed as the sole source of salt. If an alternate source of salt is available cattle will likely consume it instead of the magnesium supplement.

TRACE MINERALS AND NUTRITIONAL WISDOM

Limited research suggest that large wild game animals (Denton, 1982) and deer (Ceacero et al., 2009) may have an appetite for cobalt, especially when fed diets deficient in cobalt. For other trace minerals there is no evidence that animals are capable of regulating their intake based on nutritional wisdom.

Ensuring adequate consumption of trace minerals from free choice mineral supplements is important in animals grazing pastures. However, it is equally important that intake of trace minerals from free choice supplements be controlled to prevent toxicity. Zervas et al. (2001) found that lambs receiving high levels of trace minerals in their diet were unable to distinguish between a mineral supplement containing normal levels of trace minerals and one high in trace minerals. In this study lambs were fed alfalfa hay and a concentrate mix that differed in the amount of trace minerals added. The concentrate mix contained no supplemental trace minerals, a trace mineral premix, or the trace mineral premix added at three times (3X) the normal level. After receiving the diets for 31 days, lambs in each group were offered two different mineral lick blocks. Both mineral blocks contained 50% salt, but one contained 3X greater trace mineral content than the other. Lambs receiving the concentrate mix with no added trace minerals consumed more total mineral lick than the other two groups. However, they consumed a greater percentage of the 1X mineral lick (55%) than the 3X mineral lick block (45%). In contrasts lambs receiving the concentrate mix that contained the trace mineral premix at 3X the normal level consumed more (67 vs. 33%) of the high trace mineral lick than the 1X trace mineral block. Liver and plasma zinc and copper concentrations were higher in lambs receiving the high trace mineral concentrate mix than in those receiving the normal level of supplemental trace minerals in their concentrate mix. Interestingly, despite their high zinc and copper status, lambs receiving high concentrations of trace minerals in their diet selected more of the high mineral block than the normal trace mineral block.

SUMMARY

Sodium is the only mineral that animals clearly exhibit nutritional wisdom. Animals receiving inadequate sodium in their diet will seek a source of sodium, and if salt or some other source of sodium is available, they will consume it in amounts sufficient to meet their nutritional

sodium requirement. Salt is an excellent carrier for other minerals included in free choice mineral supplements because of the specific appetite that animals have for salt. The palatability of salt promotes consumption of minerals in free choice minerals that would otherwise not be consumed in adequate amounts. Salt also is important in controlling the consumption of free choice mineral supplements, thus helping to prevent overconsumption of trace minerals, such as copper and selenium, that can cause toxicity.

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