Value of Salt and Trace Minerals in Animal Feeding

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SALT

For thousands of years it has been known that domestic as well as wild animals need salt. The early explorers in North America, Africa and Asia recorded observations on the ravenous appetites of grazing animals for salt and their traveling to salt pans or deposits where the mineral could be obtained by licking. Therefore, the fact that animals need salt has been recognized long before any scientific or sophisticated knowledge of feeding and nutrition became available.

Role of salt in the body

Salt contains both sodium and chlorine. Some of the sodium is located in the bones but the greatest amount is in the fluids outside the cells. Sodium makes up about 93 percent of the bases in the blood serum and is the predominant basic element involved in neutrality regulation of the blood which is very important. Sodium occurs in considerable amounts in the muscles where it is concerned with their contraction. A deficiency of sodium lowers the utilization of digested protein and energy. Chlorine is found in large amounts both inside and outside of body cells. The chlorides of the blood, primarily as sodium chloride, make up about two-thirds of its acidic ions. This indicates their very important role in acid-base balance in the blood. The gastric juices contain chlorine. The commonly used rations do not contain sufficient salt to supply the needs of the animal and hence the reason for supplementing rations with salt.

Salt serves both as a nutrient and as a condiment. Evidence supporting its effect as a condiment is the fact that it stimulates salivary secretion which contains enzymes of importance in food digestion. Humans definitely can tell the difference between salted food and that which lacks salt. A little sprinkling of salt makes a big difference in the palatability or taste of certain foods. Whether salt in the feed has the same palatability effect on farm animals and pets, such as cats and dogs, is not clear. It is anticipated that it does, but published experimental data on this matter are difficult to find.

Body adjusts to salt intake

When salt is at a minimum, the body adjusts to the deficiency and the urine output of sodium and chlorine nearly stops. On the other hand, if excessive salt intake occurs a correspondingly large excretion of sodium and chlorine by the kidney occurs and water needs increase to accomplish this. Therefore, the body can adjust to a wide range of salt intake providing plenty of water is available. For example, Pistor, et al (1950) at the University of Arizona showed that placing 2 pounds of salt with 3 gallons of water through a fistula into the rumen of a cow caused her to show symptoms of salt toxicity and a critical condition after 8 to 12 hours, but the cow recovered after the salt was flushed out from the rumen. They also showed that 2 pounds of salt given without water restriction caused no distress or harmful effects.

Effect of a salt deficiency

A continuous low salt intake will have harmful effects on the health of animals as evidenced by a decrease in appetite and subsequent weight loss. Feed utilization is decreased which results in more feed being required per unit of gain or product produced. The animals develop a craving for salt and may consume a considerable amount of dirt, rocks, wood and other materials. They will also lick urine, manure and other objects in an attempt to obtain the salt they crave. Milk contains a good amount of sodium and chlorine. Therefore, milk production declines as the salt deficiency progresses.

An example of what happens with a salt deficiency is the study by Smith and Aines (1959) at Cornell University with the dairy cow. The first symptom was a craving for salt which was noticed within 2 weeks and by 4 weeks was a consistent observation. After 2 months the cows showed a depraved appetite. It was manifested by their licking the hands and clothing of barn personnel; consuming quantities of soil soaked with urine or the run-off from a manure pile; licking the barn walls; and drinking the urine from other cows during urination. Then a loss of appetite and body weight occurred. In some cows there was a complete loss of appetite. Milk production decreased as appetite decreased. The cows then assumed a "tucked-up" appearance, developed a dry, harsh skin particularly on the neck, the hair coat became unkept and the cattle became listless. In terminal cases, there was shivering, a staggered gait (most noticeable in the hind legs), weakness, abnormal heart activity, low body temperature (as low as 96.3°F) and then death. In two cases, where cattle had arrived at this terminal condition, they were given 200 grams of salt and made complete recoveries.

Salt needs will vary

Many scientists are obtaining experimental information to indicate that salt needs of animals will vary. Sometimes animals need more than is anticipated and sometimes they need less. This indicates that salt needs are not always the same and that various factors will influence salt requirements. Some of these are as follows:

1. Genetic differences in animals. The breeding of the animal may alter salt requirements.

2. The type or kind of concentrates, pasture, hay or silage being fed. Considerable differences in salt consumption can occur with different feeds.

3. The level of salt or other minerals in the water and in the ration. This can vary considerably between areas.

4. The temperature and/or humidity in the area. Large losses of water and sodium occur in the sweat in warm areas. In these areas, the forages and the seeds and seed products are low in sodium.

5. The stage of the life cycle the animal is in. During certain stages of the cycle, salt needs will be different.

6. The rapidity of growth, level of reproduction or productivity or the amount of milk produced during lactation. High producing or rapidly growing animals should have higher needs for salt. Cow's milk contains 630 ppm of sodium and 1150 ppm of chlorine. Heavy milk producers would undoubtedly need more salt than others.

7. The level of potassium in the ration. There is a possibility that an excess of potassium might aggravate a deficiency of sodium (and vice versa). This might be the case when high roughage rations are fed. For example, certain pastures may have as much as 18 times as much potassium as sodium. Cattle consume more salt on high roughage rations than on high concentrate rations. How much potassium itself is involved in this case is not known, however. It has been shown that forages grown on sandy soils, heavily fertilized with potash, have lower forage sodium levels.

8. The sodium content of feeds can vary considerably. Dr. W. J. Monson (1971) stated that some sodium values reported for feeds are too high and need to be re-evaluated. For example, the Atlas on Feed Composition (Crampton and Harris, 1971) reports values for corn of .01 percent sodium and soybean meal (50.8 percent protein) with 0.51 percent sodium. However, Monson (1971) and Combs (1969) both report sodium values of about 0.005 percent for corn and 0.007 percent for soybean meal. This is quite a difference and indicates that some of the old sodium values reported in the literature do not reflect those now being found in certain feeds. This undoubtedly accounts for some of the differences obtained in response between various experiments on salt needs of animals.

9. Availability of sodium and chlorine in various feeds. Very little information is available on this subject.

These factors, and others, indicate that salt needs will vary between different localities as well as under different situations of feeding and management. Therefore, trials with salt under a specific set of conditions cannot be used to generalize for all conditions or in all localities. For example, dairy cattle usually are fed a level of 1 percent salt in the concentrate ration. However, Martz (1973) at the University of Missouri, found that this level of salt was not adequate for his dairy cows. He recommends it be fed free-choice in addition to supplying an adequate amount in the ration.

Meeting salt needs

Animal rations should contain the levels of salt recommended by the various National Research Council (NRC) committees on nutrient requirements of animals. In addition, however, the various classes of livestock should also have free access to salt in case they need more than the ration supplies. As previously mentioned, many factors can cause salt needs to vary.

Excess sweating increases salt needs because sweat will average about 0.7 percent salt. Therefore, horses being trained or used for riding or racing purposes, need extra salt. The horse, like the human, can suffer from heat, fatigue, exhaustion or prostration if supplies of body salt are depleted enough. Therefore, horses should always have free access to salt even though their ration contains a specified amount. Therefore, having salt available free-choice to all classes of livestock is a good recommendation and is low cost insurance. If the animals do not need the salt, they will not consume it.

TRACE MINERALS

Trace mineral deficiencies are being found more frequently throughout the world as more research studies are conducted on them. As soils decline in fertility, more mineral deficiencies are occuring. Dr. O. G. Rasmussen, Triple F Feeds of Des Moines, Iowa reported that analyses of over 4,000 grain samples taken in 11 midwest states over the last 4 years showed that iron, copper, zinc and manganese have all declined. The biggest decline occurred with iron and copper. Selenium deficiencies were not thought to be much of a problem in the U.S.A. just a few years ago. Now, it has been shown that selenium deficient areas exist in 40 states. Selenium deficiencies have been shown to occur with all classes of livestock and poultry. Cobalt and iodine deficiencies have been known in the U.S.A. for many years. Therefore, deficiencies of copper, iron, zinc, manganese, cobalt, iodine and selenium exist and more attention needs to be paid to making sure animal feeding programs supply them.

Value of trace minerals

A number of studies have shown that the addition of trace minerals to animal rations are beneficial in animal productivity. Only a few will be mentioned as examples. These include studies by Smithson and Essig (1970) at Mississippi State University which showed that trace mineral supplements were beneficial for beef cows grazing permanent pasture during a three-year trial. A study at Ohio State University by Cline and Mahan (1972) showed that the deletion of trace minerals from growing-finishing pig rations resulted in a lowered feed intake and gain but feed efficiency was not affected. When the trace minerals were added back to the diets an immediate growth response was observed. A Purdue University study by Conrad et al. (1959) with growing pigs showed that adding a trace mineral mixture improved gains 15.4 percent as compared to the controls fed no trace minerals. A Nebraska study by E. R. Peo (1966) with growing-finishing pigs was conducted on pasture. On the average, trace minerals increased gains 0.09 pounds per pig per day. The study showed that the investment in trace minerals amounted to 4.7 cents per pig but returned $1.64. This meant that for each penny invested in trace minerals there was a return of 35 cents.

Cost of adding trace minerals

The question is frequently asked: "How much more does it cost to feed trace mineralized salt as compared to plain salt?" This is a good question since many think it is quite expensive to feed trace minerals. A survey conducted by Bohstedt (1966) indicated that livestock and poultry consumed the levels of salt per year shown in Table I. Dr. Bohstedt's figures on salt consumption are similar to those which Cunha (1972) obtained on a world-wide survey on salt consumption by animals.

The levels of salt consumption shown in Table I will vary depending on the ration fed, the area of the country, and many other factors as previously discussed. They are, however, average figures and can be used to good advantage as a guide.

The cost of adding trace minerals to salt is very little in animal feeding, ranging from a low of less than half a cent for poultry to 53.5 cents for dairy cattle for a whole year. Horses and beef cattle can be supplied trace minerals in the salt for a year for less than 25 cents; and calves, swine and sheep for less than 10 cents. This is certainly low cost insurance. One cannot argue against the added cost being high, compared to the benefits which may be received.

The low cost of adding trace minerals (iodine, copper, iron, cobalt, zinc and manganese) to salt is one reason why trace mineralized salt is recommended throughout the world by Cunha (1971). There is enough evidence to show that trace mineral deficiencies occur in some parts of all the major livestock producing areas in the world. Hence, the reason for recommending trace mineral use.

TABLE I

Average Salt Consumption Per Year in United States*

Animal	Pounds of Salt Consumed Yearly	Approximate Yearly Cost for Trace Minerals in Salt**
Dairy cattle	53.5	53.5¢
Horses	24.0	24.0¢
Beef cattle	22.0	22.0¢
Heifers (1-2 yr. old)	18.0	18.0¢
Calves	9.0	9.0¢
Swine	9.0	9.0¢
Sheep	9.0	9.0¢
Lambs	4.5	4.5¢
Poultry (in feed)	0.417	0.4¢

*A United States survey conducted by Dr. G. Bohnstedt, Professor Emeritus, Department of Animal Husbandry, University of Wisconsin in 1966.

**Assuming that trace mineralized salt costs $20.00 more per ton or one cent more per pound than plain salt. In many cases the cost will be less than one cent per pound and occasionally it will be more.

Reasons for using trace minerals

Many argue against the use of trace minerals in their state or country until they can experimentally show a need for them. The author would not agree with this reasoning because if an Experiment Station runs a trial and finds that a trace element does not help at one location, there is no assurance that trace minerals are adequate throughout that state or country. A deficiency area could exist 25, 50 or 100 miles or more from there. In a sense, trace mineral deficient areas are like an iceberg, only much more so. For every trace mineral deficient area showing (or known), far more are hidden and undetected. For example, when a cobalt deficiency was first found in Western Australia it was believed to be confined to about 5,000 acres. Further studies now show that at least 25,000,000 acres are cobalt deficient in Western Australia. There are many other examples, with other trace minerals, to show that trace element problems extend over far wider areas than formerly supposed. A recent example is low selenium areas which are now known to exist in 40 of the states in the U.S.A.

whereas a few years ago it was not thought to be much of a problem.

Many times, as has been demonstrated, trace mineral deficiencies are located only in certain parts of an area, state or country. To study every area of a state or country is almost impossible and, if possible, the study might take 10 to 20 years or longer. In the meantime, one should not take the chance of animals suffering from borderline or severe trace mineral deficiencies.

Cunha (1971) reported that when he first went to the state of Washington in the early 1940's he saw calves born with crooked legs in one area of the state. At that time he did not know the cause. About 20 years later it was shown to be caused by a deficiency of manganese. If trace minerals had been fed in the early 1940's, this condition would have been prevented all those years.

Another important factor to consider is that feeds from one area of a state or country are shipped to others. It is almost impossible to isolate areas of specific trace mineral deficiencies even if the information were available to pinpoint each one of them. There is nothing to prevent feed grown in a trace mineral deficient area from being shipped to another area where the feed grown there is supposedly adequate. For example, grain grown in midwestern states where selenium, iodine and possibly other trace mineral deficient areas exist is shipped to, and fed in, many other areas of the United States. Thus, the reason for recommending the use of trace minerals for animal feeding anywhere in the U.S.A. or in the world.

There are some who question the possibility of toxicity occurring when trace minerals are used even though the ration may possibly contain close to the level needed. This should cause no problem because there is a big safety factor between the level of a trace mineral which is needed and the level which will cause a harmful effect. Therefore, if a ration ends up having a little excess of trace minerals this will cause no harmful effects. In fact, this might be beneficial since there is considerable variation in trace mineral needs depending on the animal itself, the ration fed and various feed, mineral and nutrient interrelationships. Therefore, a little trace mineral in excess should not be harmful and may be helpful. The only exception to this is with copper in sheep. If the sheep are located in certain areas which are low in molybdenum, this causes copper to accumulate at higher levels in their livers. Under these conditions, a level as low as 8 to 11 ppm of copper in the diet of sheep can sometimes cause toxic effects.

The cost of adding trace mineral elements is very small compared to the good they can do. It must also be stressed that borderline deficiencies of trace minerals frequently occur. In fact, this now is more of a problem than acute mineral deficiencies. The farmer does not see specific symptoms which are characteristic for each one of the trace mineral elements. The only thing that happens is that the animal grows or reproduces at a reduced rate, uses feed less efficiently and operates at less than optimum health. The end result is inefficient production and lower profitability. Therefore, a profitable and efficient farm operation needs to make sure the trace mineral elements are provided. In highly competitive animal enterprises this could be the difference between profit and loss.

Salt as a carrier for trace minerals

Salt is a natural carrier for trace minerals since all animals need salt. Moreover, when cattle, horses, sheep and other animals are on pasture with little, none, or varying amounts of concentrate feeding one can always supply trace mineralized salt free-choice in a mineral box or salt block. Thus, regardless of the amount of concentrates fed, and especially if none are fed at all, the animal can still consume salt and the trace minerals contained therein.

FDA has approved the use of selenium for swine, poultry and horses. It is suggested that eventually selenium be approved for use with all classes of livestock. The addition of selenium to trace mineralized salt is a good method of supplying it to all farm animals but this has not been approved yet.

Adding calcium and phosphorus

There are many instances where calcium and phosphorus are added to a trace mineralized salt mixture. This is done when a complete mineral mixture is desired. Specific amounts of calcium and/or phosphorus can be added to trace mineralized salt to meet certain specific objectives in an animal feeding situation. This means that varying levels of calcium and/or phosphorus can be used depending on the animal or the kind of feeding program involved. Therefore, salt use can be very versatile and it can be used plain, with added trace minerals or with calcium and/or phosphorus also added.

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