

# Selenium Addition to Feeds

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Selenium added to rations as sodium selenite or sodium selenate. Selenium is an essential nutrient at 0.1 parts per million for almost all livestock species. Many studies have indicated the rate of growth and health of animals and poultry is improved when selenium is added to feeds at 0.3 parts per million. Clearly, selenium is a required feed additive but addition rates should be strictly controlled.

The most immediate danger in adding selenium to feeds is toxicity to animals and poultry. The LD50 (lethal dose for 50% of test animals) is about 7 parts per million selenium (7 grams per metric tonne). Two parts per million is the threshold at which a negative impact on health of animals or poultry may be expected. The ratio of the addition rate (0.3 ppm) to the toxicity threshold (2ppm) is about 7 to 1. No other nutrient is so toxic at such a low level of addition.

In most instances, losses attributed to selenium toxicity are not caused by formulation errors but rather by manufacturing problems. "Carryover" from premixes containing added selenium may result in lethal levels of selenium in finished feeds that immediately follow in a production sequence. In several instances, pure sodium selenite remained in conveyers and elevators to be released into non-target concentrates at toxic levels. Errors can be prevented by appropriate manufacturing and quality assurance procedures.

The dietary intake of selenium may be deficient for humans in certain areas of the world including Finland and New Zealand. It is more than adequate almost everywhere else and is excessive in a number of countries including regions of China, Venezuela and the USA. The greatest concern may be in nursing infants where high levels of selenium in mother's milk may interfere with zinc metabolism resulting in stunted growth.

The average dietary intake of selenium by an adult male in the USA is about 180 cg/day. The essential level established by the National Academy of Sciences in 1991 is 70 mcg/day. Human nutrition does not improve as a result of 0.3 ppm supplementation of animal rations and selenium addition to feeds may cause human dietary intake to exceed 200 mcg/day.

The greatest concern regarding selenium supplementation of feeds is the potential for an adverse environmental impact.

The US Environmental Protection Agency reduced allowable selenium in lakes and rivers from 35 parts per billion to 5 parts per billion in 1986. This agency is now considering reducing the upper limit to 2 parts per billion or less. In controlled studies, EPA found that nearly 50% of the reproduction of bluegill fish was prevented when 2.5 parts per billion selenium was present in their water habitat.

several major rivers in the Western United States including the San Joaquin in California and the Colorado often exceed 2 parts per billion and sometimes are above 5 parts per billion in 1986. Fish and Wildlife and Geological Survey Scientists have opposed any

addition of selenium to rivers where water criteria are being violated. The US Food and Drug Administration estimated that adding 0.3 ppm Se to feeds would increase the selenium level of lakes by not more than 1.2 parts per billion.

Later FDA estimates suggested that increases could be as much as 7 parts per billion. The US Department of the Interior, representing both US Fish and Wildlife and US Geological Survey and the US Environmental Protection Agency have both indicated that the FDA's estimates are scientifically inadequate and are based on largely unsupported projections.

A factor not adequately considered in selenium supplementation of feeds is that sodium selenate is more stable than sodium selenite in premixes and is also more bioavailable (by 30-50%) for ruminants than sodium selenite. The same nutrient effect can be achieved for many species by adding 0.2 part per million selenium as sodium selenite compared to 0.3 parts per million selenium as sodium selenite.

Efficacy in manufacturing premixes is also a major issue. Sodium selenite is reactive and unstable especially in premixes containing vitamin C. It can easily be reduced to elemental selenium that is relatively unavailable. In at least one case, sodium selenite was dissolved in water and sprayed onto ground corn as a carrier. The result was evolution of highly toxic selenium hydride vapor. The premix when analyzed contained only 50% specified selenium.

Adequacy of mixing is also an issue. When only 0.3 parts per million selenium is added to a feed, the premix should be prepared to exacting standards. It is not unreasonable to demand that 0.5 gram "grab" samples of premixes should meet specifications when analyzed chemically. It is important to remember that sodium selenite is hygroscopic and cakes easily. This does not make the problem of manufacturing a premix any easier.

Selenium is an essential nutrient and must be added to feeds. It is also highly toxic demanding care in handling. Although the cost of adding selenium to feeds is only a few cents per ton it demands more attention than other micro nutrients.

It is not socially responsible or acceptable business practice to add more selenium to feeds than is necessary to achieve adequate nutrition. Reasonable care should be taken to maximize the benefits of selenium while minimizing negative impact.

*Mr. David Eisenberg has promoted the use of encapsulated sodium selenate as an additive to livestock feeds. During the past few years his company has campaigned actively to reinstate the premix analysis requirement for selenium eliminated by the FDA in 1987. Opponents of the FDA's 1987 action increasing permitted edition of selenium from 0.1 part per million to 0.3 parts per million and eliminating the premix analysis requirement maintain that existing and potential problems of animal and human toxicity exist and that environmental damage is caused by accumulation of selenium in waterways. This adversely affects the reproduction of aquatic species and waterfowl. The American Feed Industry Association, and the National Broiler Council support the existing level of supplementation to allow adequate growth of pigs and poultry especially in the Eastern States of the USA where soils are generally deficient in selenium. Clearly more research is needed on the impact of dietary supplementation on environmental selenium levels. Many countries look to the USA for regulatory guidance and the outcome of lawsuits and interagency agreements in late 1993 will influence dietary use of selenium worldwide through to the turn of the century. Editor.*

