Sulfur (s)

Sulfur is a naturally occurring mineral that is a key constituent of several nutrients considered essential to animal health. S-dependent nutrients include the amino acids methionine, cysteine and taurine, as well as the vitamins biotin B7 and thiamin B1. **Because a wide array of foods, particularly high-protein foods contain S, deficiencies of the mineral are generally rare**. The S-containing compounds increased motility and viability of the spermatozoa. On the contrary, sulfur dioxide (SO_2) is a well-known toxic pollutant to which humans and animals may be exposed. A decline of the seminal quality after exposure to seasonal air pollution consisting primarily of SO_2.

Trace elements

Trace elements are essential not only for health, growth and production but also for normal the reproduction. In cattle, organic supplementation improves reproduction conception rates. Though, the ovarian activity of ruminants is influenced by mineral deficiency. They are also involved in synthesis of hormones that are important for reproduction. While, their deficiency affects both steroid and thyroid hormone production.

Copper (Cu)

Copper is a necessary component of number of enzymes including superoxide dismutase, lysyl oxidase and thiol oxidase. **These enzymes function** to eliminate free radicals that increase tissue susceptibility to bacterial infections, increase structural strength and elasticity of connective tissues and blood vessels and increase strength hoof, minimizing lameness.

Reproductive problems that relate to Cu deficiency manifest themselves in inhibited conception rate even though estrus may be normal. Symptoms of a **Cu deficiency** include early **embryonic death**, **resorption of embryo, increased retained placentas** and **necrosis of the placenta**.

Weak and silent heats have been reported. Dairy cows with higher serum Cu levels had fewer services per conception (1:1.15). Proper Cu supplementation of the sire is needed for production of quality semen.

Feeding a total of 10 to 15 ppm Cu in the ration dry matter or supplementing with 10 ppm Cu should meet dairy cattle needs. The following mineral ratios may be helpful in maintaining Cu levels in blood: Zn: Cu 4:1, Cu: Mo 6:1 and Fe: Cu 40:1.

Zinc (Zn)

Zinc is an essential component of over 200 enzyme systems of which the metabolic action includes carbohydrate and protein metabolism, protein synthesis, nucleic acid metabolism, epithelial tissue integrity, cell repair, cell division, vitamin A and E transport and utilization. In addition, Zn plays a major role in the **immune system** and **certain reproductive hormones**. Moreover, Zn is known to be essential for **proper sexual maturity**, **reproductive capacity**, and more specifically **onset of estrus**. Zinc has a critical role in the **repair and maintenance of the uterine** lining following parturition, speeding **return to normal reproductive function and estrus**.

In bulls, a **Zn deficiency** results in poor semen quality and reduced testicular size. Zinc has also been shown to increase plasma beta carotene levels. Increased plasma beta carotene has been directly correlated to **improved conception rates** and embryonic development.

Improved Zn status also **improves fertility** by **reducing lameness**, **resulting in cows more willing to show heat and improved mobility and performance of bulls.** In addition, Zn supplementation also increases **the ejaculate volume, sperm concentration, viability and motility of sperm in crossbred bulls**.

Studying on fertile and infertile male, it was observed that seminal Zn levels were lower for infertile male than fertile male and researchers suggested that poor Zn nutrition may be a risk factor for infertility in male.

The recommended dietary content of Zn for dairy cattle is typically between 18 and 73ppm depending upon the stage of lifecycle and dry matter intake (NRC, 2001). **Cu, Cd, Ca** and **Fe** reduce Zn absorption and interfere with Zn metabolism.

Cobalt (Co)

Cobalt is needed for proper vitamin B12 synthesis. Maintaining adequate vitamin B12 status benefits both the dam and offspring. Milk and colostrums in particular, contain high levels of vitamin B12 which is required for **the conversion of propionate to glucose and for folic acid metabolism**. A Co deficiency ultimately results in a vitamin B12 deficiency. Deficiency of Co and vitamin B12 at parturition causes depressed milk production and colostrums yield and quality. **Inadequate Co levels in the diet or Co deficiency** have been correlated with poor fertility, prolonged uterine involution, irregular estrous cycle, lower conception rates, and early calf mortality. **Mn, Zn, I** and **monensin** may reduce cobalt deficiency.

Manganese (Mn)

Manganese is an activator of enzyme systems in the metabolism of carbohydrate, fats, protein and nucleic acids. Manganese appears to have a vital role in reproduction. It is necessary for **cholesterol synthesis**, which in turn is required for synthesis of the **steroids, estrogen, progesterone** and **testosterone**. Insufficient steroid production results in decreased circulating concentrations of these reproductive hormones resulting in **abnormal sperm in males** and **irregular estrus cycles in females**. **A deficiency in Mn** may be associated with suppression of estrus, cystic ovaries and reduced conception rate.

The maintenance requirement for absorbed Mn was set at 0.002 mg/kg of body weight (1.2 mg/day for an average Holstein cow), the growth requirement was set at 0.7 mg/kg of growth, pregnancy requirement was set at 0.3 mg/d, and the lactation requirement was set at 0.03 mg/kg of milk (NRC, 2001). Gestating cattle may need up to 50 mg of Mn/Kg of DM because it helps in skeletal cartilage and bone formation of fetus.