MINERAL AND VITAMIN: THE SECRET TO BETTER FERTILITY IN DAIRY ANIMALS

Kaushik Majumder[1*], Santanu Pal[2]
[1]M.V.Sc. Veterinary Gynaecology and Obstetrics Division, ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India, [2]Ph.D. Scholar, Veterinary Microbiology, ICAR-Indian Veterinary Research Institute, Izatnagar, 243122, India
Corresponding author email: majumderk1997@gmail.com
DOI: https://doi.org/10.5281/zenodo.16754433

ABSTRACT

Reproductive inefficiency is a major constraint in the dairy industry, especially in developing countries. While infectious, genetic, and hormonal causes are frequently addressed, nutritional factors, particularly deficiencies of essential minerals and vitamins, often go unnoticed. This article explores the scientific basis, physiological roles, field-level manifestations, and practical applications of mineral and vitamin supplementation in improving fertility among dairy animals, with an emphasis on economically viable strategies for rural and semi-urban veterinary practice.

KEYWORDS: Reproductive inefficiency, Dairy animals, Nutritional deficiencies, Mineral and vitamin supplementation, Fertility improvement

INTRODUCTION

Nutrition has a strong link with fertility and is becoming an important concern for dairy farmers, feed suppliers, veterinarians, and animal nutritionists. Infertility and subfertility are significant causes of economic loss in the dairy industry. In India and many developing nations, infertility accounts for over 30-40% of production losses in dairy herds. The profitability of dairy and cow-calf farms is greatly influenced by proper nutrition. The nutritional status of an animal affects fertility at various stages of the reproductive cycle and influences the hormonal (endocrine) system. Good nutrition, especially deficiencies of micronutrients (minerals and vitamins), is often underdiagnosed and poorly managed. These micro-nutrients play crucial roles in maintaining normal reproductive physiology, hormone synthesis, and immune function. Therefore, a better understanding of the role of mineral and vitamin supplementation can significantly help farmers to improve reproductive performance and overall productivity in dairy herds without depending on external hormone treatments.

IMPORTANCE OF MICRONUTRIENTS IN REPRODUCTION

Micro-nutrients such as calcium, phosphorus, zinc, selenium, copper, iodine, manganese, cobalt, and vitamins A, D, E, and B-complex are essential for maintaining reproductive health. Their functions range from hormone biosynthesis and ovarian function to uterine involution and embryonic development.

ESSENTIAL MINERALS AND THEIR REPRODUCTIVE ROLES

Calcium (Ca):

Calcium deficiency is common in high milk-yielding animals during the last stage of pregnancy, at calving, or shortly after, due to the high demand for fetal growth and milk production. Poor dietary calcium or an imbalance in the calcium-to-phosphorus (Ca:P) ratio can cause serious issues. Calcium is vital for muscle contraction, and low levels (hypocalcemia) reduce uterine tone, leading to retained placenta, delayed uterine recovery, infertility, or even uterine prolapse. It also weakens rumen contractions, reduces feed intake, and causes negative energy balance, resulting in anestrus and repeat breeding problems.

Phosphorus (P):

Phosphorus, often referred to as the "fertility mineral," is the second most abundant mineral in the animal body, with nearly 80% stored in the bones and teeth. Its deficiency is more commonly observed than calcium deficiency, particularly in animals that are mainly fed on forages. Lack of phosphorus can cause

delayed maturity, irregular or silent heat cycles, cystic ovaries, repeat breeding, and poor conception rates. Phosphorus also plays an important role in maintaining normal sexual behavior in animals. A blood phosphorus level below 4.5 mg/dL is a clear sign of deficiency. Insufficient phosphorus intake reduces feed consumption, leading to less energy, slower weight gain in heifers, and a higher risk of infertility. For high-yielding dairy cows, the recommended phosphorus level in the diet is about 0.45–0.5% of the dry matter (DM).

Zinc (Zn)

Zinc acts as a cofactor and coenzyme for many enzymes and reproductive hormones, making it essential for normal sexual maturity, fertility, and the timely onset of heat (oestrus). It plays an important role in repairing and maintaining the uterine lining after calving and helps in the early involution of the uterus. Zinc also increases the level of β-carotene in the blood, which is linked to better conception rates and healthy embryo development. A deficiency of zinc can lead to poor conception rates, irregular heat cycles, fetal mummification, and even abortion. Since zinc is required to produce prostaglandins from arachidonic acid, it strongly influences reproductive cycles and pregnancy maintenance. Supplementing zinc has been shown to improve fertility in sheep when given to both rams and ewes.

Copper (Cu):

Copper (Cu) acts as a cofactor for several vital enzymes that play key roles in energy production, iron transport, and the removal of harmful free radicals. Copper deficiency in cattle has been widely linked to reproductive problems. A lack of copper can cause anemia, which negatively affects ovarian function, reduces sexual desire, and leads to silent heat. It is also associated with delayed or suppressed heat cycles, delayed puberty, repeat breeding, low conception rates, and early embryo death. Cows grazing on pastures with less than 5 mg of copper per kg of grass often become acyclic. In ewes, low copper levels can prevent embryo implantation or cause embryo loss and fetal death. In goats, copper deficiency results in low conception rates and up to 50% abortions, usually between the 2nd and 5th month of pregnancy. It can also cause retained placenta, infertility, and absence of heat signs. For proper reproductive health, the recommended dietary level of copper is 10–15 mg/kg on a dry matter (DM) basis.

Iodine (I):

Iodine supports reproduction by regulating thyroid gland function, which affects conception rates, ovarian activity, and metabolism. Deficiency can lead to poor fertility, delayed puberty, irregular heat cycles, high abortion rates, retained placenta, and post-partum infections. During pregnancy, a lack of iodine may result in weak, dead, or hairless calves. Lactating cows should receive at least 0.5 ppm iodine in their diet on a dry matter (DM) basis to maintain reproductive health.

Manganese (Mn):

Manganese (Mn) deficiency is uncommon in ruminants, but it plays an important role in reproduction. Manganese is required for cholesterol synthesis, which is necessary for producing reproductive hormones like estrogen, progesterone, and testosterone. A lack of manganese can reduce hormone production, leading to irregular heat cycles, suppressed estrus, and lower conception rates. The main problems caused by manganese deficiency are infertility, poor growth in calves, and birth defects such as limb deformities. Cows deficient in manganese may have poorly developed follicles, silent heat, delayed ovulation, repeat breeding, abortions, or weak calves. To prevent these issues, the diet should contain 15–25 mg of manganese per kg of dry matter (DM).

Selenium (Se):

Selenium (Se) is a strong antioxidant that protects body cells from damage caused by oxidative stress. However, excessive selenium can be toxic and cause problems like lameness, sore feet, deformed hooves, and loss of tail hair. Severe selenium deficiency can result in retained placenta, abortions, irregular heat cycles, stillbirths, early embryo death, mastitis, metritis, and ovarian cysts. Even mild (sub-clinical) deficiency reduces reproductive performance, leading to more service per conception, poor uterine involution after calving, weak or silent heats, abortions, and birth of weak calves that cannot stand or suckle. A minimum of 0.1 ppm of Selenium in the diet is necessary for proper reproductive health.

IMPORTANT VITAMINS IN FERTILITY

Vitamin A:

Vitamin A is a fat-soluble vitamin essential for maintaining healthy tissues in the reproductive tract. In cattle, it is one of the most common vitamin deficiencies. Vitamin A supports

the proper functioning of the uterus, ovaries, and pituitary gland, while its deficiency can damage the uterine lining (endometrium), affecting placental development. Problems are most often seen during late pregnancy. Signs of deficiency include shorter gestation, retained placenta, birth of blind or weak calves, low conception rates, delayed sexual maturity, abortions, and reduced fertility in both males and females. It can also cause delayed ovulation, uterine infections, and cystic ovaries. Deficiency usually occurs when cattle are fed poor-quality or old stored forages. Fresh green fodder is a rich source of vitamin A, and supplementation before and after calving improves conception rates. The dietary requirement is about 4,400 IU/kg body weight on a dry matter (DM) basis.

Vitamin E:

Vitamin E acts as an essential intracellular antioxidant, preventing oxidative damage to cell membranes and supporting steroid and prostaglandin synthesis, sperm motility, and embryonic development. Its deficiency leads to reduced fertility, lower milk yield, impaired uterine motility, placental retention, decreased sperm quality, and increased cytoplasmic droplets. The dietary requirement of vitamin E is approximately 90 IU/kg on a dry matter basis.

Vitamin B:

B-complex vitamins act as cofactors in important metabolic processes and are essential for reproduction and healthy fetal development. Deficiency of folic acid can lead to birth defects and reduce the uterus's response to estrogen. In ruminants, supplementation of B vitamins is usually not required as they are synthesized by rumen microbes. However, vitamin B12 deficiency can reduce appetite and feed intake, leading to delayed sexual maturity and shrinkage of the ovaries and uterus.

Vitamin D:

Vitamin D is essential for the proper metabolism of calcium and phosphorus and the normal hardening of bones. Receptors for active vitamin D (1,25-dihydroxy D3) are present in many reproductive organs such as the ovary, uterus, placenta, testes, and pituitary gland. A lack of vitamin D affects reproduction by disturbing calcium and phosphorus balance. In dairy cows, vitamin D deficiency can lead to problems like anestrus (no heat), milk fever, metritis (uterine infection), and retained placenta. According to the National Research Council (1989), the recommended intake is 450 IU of vitamin D per pound of dry matter, while the current recommendation is around 30 IU per kg of body weight.

CONCLUSION

Mineral and vitamin supplementation is an often-overlooked but highly effective strategy to improve reproductive efficiency in dairy animals. When applied strategically, with proper deworming and farmer awareness, it offers a sustainable and cost-effective solution to common reproductive problems encountered in the field. Integration of nutritional management with veterinary reproductive practices is essential for achieving optimal fertility, healthier calves, and improved economic returns to farmers.

REFERENCE

1. Singha, S., Pal, P., Sahu, J., & Sharma, B. (2019). EFFECT OF NUTRITION ON FERTILITY IN CATTLE–AN OVERVIEW. *Editorial Board*, 18
2. Patowary, P. and Saikia, B. N. (2022). Role of Vitamins and Minerals in Animal Reproduction and Fertility. *Vigyan Varta 3*(2): 16-19.
3. Verma, A., and Kumar, P. (2018). Important minerals affect the fertility of dairy animals: A review. *The Pharma Innovation Journal, 7*(11), 136-138.
4. Grewal, R. S., Singh, A. K., and Kaur, J. (2011). Role of micronutrients in reproduction: an overview. *Veterinary Practitioner, 12*(1), 113-117.
5. NRC. (2001) Nutrient requirements of dairy cattle. 7th edition. *National Academic Press*. pp. 105-146.

Cite this article:
Kaushik Majumder, Santanu Pal. (2025). Mineral and vitamin: the secret to better fertility in dairy animals. Vet Farm Frontier, 02(07), 7–9. https://doi.org/10.5281/zenodo.16754433