

# EFFECT OF NUTRITION ON FERTILITY IN CATTLE – AN OVERVIEW

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Shubham Singha<sup>1,\*</sup>, Prasanna Pal<sup>2</sup>, Jyotimala Sahu<sup>3</sup> and Bharti Sharma<sup>4</sup>

<sup>1</sup> M.V.Sc Scholar, Veterinary Gynaecology and Obstetrics Division, ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India

<sup>2</sup> Ph.D. Scholar, Animal Physiology Division, ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India

<sup>3</sup> Ph.D. Scholar, Livestock Production and Management Division, ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India

<sup>4</sup> Ph.D. Scholar, Animal Nutrition Division, ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India

Email: [shubhamsingha95@gmail.com](mailto:shubhamsingha95@gmail.com)

**T**here is a strong relationship between nutrition and fertility and is a topic of increasing importance and great concern among dairy producers, feed dealers, extension workers, veterinarian and animal nutritionists. The financial viability of cow-calf enterprises is highly affected by nutrition. Nutritional status can affect animal's fertility at different stages of reproductive cycle. It also affects the endocrine system. It plays a vital role in the development of reproductive function after calving in cattle. Scientists have long been recognised the contribution of nutrition in achieving reproductive success in livestock. Differences in nutrition account for the variation in the reproductive performance among animals.

Over or under nutrition, both are equally detrimental to the reproductive functions in cattle. Under-nutrition results in loss of body condition, delay in onset of puberty, increase in calving to conception interval, increasing infertility and reduction in milk yield. A more complete understanding of role of nutrition in reproduction can provide an alternative approach in managing reproduction in commercial farms without the use of exogenous hormones.

## **Effect of nutrition on different reproductive performance of animals**

### **1. Effect of energy**

#### **a. Effect of energy on age of puberty**

There is a close relationship between energy intake and onset of puberty in males and females. Body condition and weight are the main stimulus rather than the age for the puberty to be achieved. Age of puberty decreases with the increase in feed intake. Low feed intake results delay in puberty, reduced follicular development, delay in onset of estrus, infantile ovaries, under-developed udders and silent ovulations. Energy deficiency also impairs the function of endocrine system.

#### **b. Relationship between nutrient energy and post-partum reproductive health**

During early lactation, the peak milk yield overtakes the peak feed intake. Milk production reaches its peak 6 weeks post-partum whereas feed intake reaches its peak 10 weeks after parturition. In this 10 week period, the net nutrient requirement exceeds the net nutrient intake, so animal uses its energy stores like glycogen, protein and triglycerides to meet the deficit results into negative energy balance (NEB). NEB causes inhibition of GnRH secretion from hypothalamus, absence of LH pulses which is required for ovulation. When the cows are in negative energy balance, the blood concentration of Non-Esterified Fatty Acids (NEFA) increases whereas, the concentration of glucose, insulin, Insulin like Growth Factor-1(IGF-1) decreases which ultimately leads to impaired follicular growth, formation of ovarian cysts, non- functional corpora lutea. The interval of first ovulation after calving is also prolonged which impairs the fertility. Improvement in cow's energy balance is an important signal to the ovaries for the resumption of estrous cycle.

#### **c. Negative effect of Overfeeding on reproduction**

Overfeeding is dangerous for heifers as well as for post-partum dairy cows. In over-conditioned dairy cows, appetite is decreased which results into severe NEB. When the heifers are given overnutrition before puberty, they store excess amount of fat in developing udder which leads to decrease in the number of milk producing tissues. In overfed cows after calving, the interval from calving to first ovulation increases which impairs fertility. Overfed heifers show weak estrus behaviour with reduced conception rate.

## **2. Effect of protein on reproductive function in cattle**

In most of the third world countries, animals thrive on nutrient deficient poor quality roughage and crop residues. The main constraint is very low amount of digestible crude protein in roughages. Protein plays an important role in proper growth of fetus and function of reproductive organs. Protein deficiency results in delayed onset of puberty, reduced survivability of embryo, impaired development of embryos in cows and sheep, increased incidences of silent heats and lowered conception rates and cessation of estrous cycle. Protein deficiency in lactating cows leads to emaciation and reduction in milk production. In bulls, protein deficiency causes reduction in sperm concentration in semen.

Overfeeding of protein leads to impairment of hormonal balance and high blood urea levels which has a toxic effect on sperm, ova and developing embryo. High levels of ammonia or urea impair oocyte maturation and subsequent fertilization and embryo development. When cows consume excess protein, they require more services per conception and there is prolonged calving interval.

## **3. Role of minerals on reproduction**

Minerals have a great impact on reproductive function of animals and its alteration causes various problems which leads to lowered reproductive efficiency and resultant economic loss to the dairy industry. As most of the roughages, greens, concentrates and even most of commercial feeds available in Indian market are deficient in important minerals, so adequate mineral supplementation is required.

### **i. Macro-minerals**

#### **a. Calcium**

One of the most important functions of Ca is to allow the muscles to contract. Ca deficiency reduces the muscle contraction, affecting rumen function. Reduced rumen functions affect the dry matter intake and thus severe NEB in animals. As a result, fat mobilization increases which results in ketosis and fatty liver kidney syndrome. Ca deficiency also prevents insulin production which leads to reduction in milk yield and impaired fertility. Ca deficiency also affects uterus tonicity and thus cows may experience prolonged calving and retention of fetal membranes. Involution of uterus can be impaired which will lead to fertility problems. The ration containing 0.75 to 0.8 % Ca on dry matter (DM) basis should be provided to the high yielding dairy cows.

#### **b. Phosphorus**

Low intake of phosphorus leads to delayed sexual maturity, inactive ovaries, low conception rates, decreased fertility rate and irregular estrous cycle. Increased occurrence of cystic ovaries, decreased milk production, decreased ovarian activity also occur at low phosphorus intake. Plasma phosphorus concentration consistently below 4.5 mg/dL indicates the deficiency. Bone phosphorus is more sensitive indicator of phosphorus status in the body. Total dietary levels of 0.75% Ca and 0.45% P and 1.5: 1 Ca:P ratio should be maintained in the diet of lactating cow. Phosphorus deficiency decreases total feed intake which causes a lower energy supply and lower weight gain in heifers, so it is a risk factor in poor fertility. Dietary requirement of phosphorus for high producing cows is 0.45 to 0.5 % on DM basis.

## **ii. Micro-minerals**

### **a. Zinc (Zn)**

Zn is an essential component of more than 200 enzymes which help in carbohydrate and protein metabolism, nucleic acid metabolism, vitamin A and E transport and utilization etc. Zn is essential for proper sexual maturity, reproductive capacity, onset of estrus etc. Zn has an important role in repair and maintenance of uterine epithelium after parturition. Zn deficiency is associated with prolonged labour, lower birth weight, abortion and fetal mummification. Zn deficiency leads to delayed puberty, failure of implantation, lower conception rates and reduced litter size.

In male, Zn deficiency also leads to atrophy of seminiferous tubules, reduced testicular size, lack of libido and may also adversely affect spermatogenesis. Animal should be given 23 to 63 mg/kg Zn on DM basis for proper reproductive function.

### **b. Selenium(Se)**

Selenium is a powerful anti-oxidant and protects the cells from oxidative stress. Severe Se deficiency causes retention of fetal membranes, abortion, irregular estrous cycles, still birth, early embryonic mortality, mastitis, metritis and ovarian cysts. Sub-clinical Se deficiency leads to reduced reproductive performance with increased number of services per conception, poor uterine involution, weak or silent heats, abortion and birth of weak calves which is unable to stand or suckle. In male animals, Se deficiency causes low sperm production and poor sperm quality. Se supplementation improves sperm motility. Diets should contain at least 0.1 ppm Se for proper reproductive performance.

### **c. Copper (Cu)**

Cu acts as co-factor of different vital enzymes which helps in energy metabolism, iron transport, elimination of free radicals etc. Cu deficiency leads to early embryonic death, necrosis of placenta, retention of placenta and resorption of embryos. The main important sign of Cu deficiency is decreased fertility. In Cu deficiency, estrus is weak and silent. There is also increase in days open due to inactive ovaries. Cu should be present in diet as 10 – 15 mg/kg on DM basis for proper reproduction.

### **d. Iodine (I)**

Iodine is required for thyroid hormones. Signs of I deficiency are delayed puberty, cessation of estrus and anovulatory estrus periods. Iodine deficiency, during pregnancy leads to birth of weak or dead or hairless calves. Diet of lactating cow should contain at least 0.5 ppm Iodine on DM basis.

### **e. Manganese (Mn)**

Mn deficiency is rare in ruminants. The main disorder in Mn deficiency is infertility, poor growth rate in calves and congenital limb deformities. Mn deficient cows are likely to have poorly developed follicles, silent heat, delayed ovulation, reduced conception rate and cows may abort or give birth to weak calves. In males, Mn deficiency leads to absence of libido, reduced number of sperm in ejaculate and reduced sperm motility. Diet should contain 15-25 mg/kg Mn on DM basis.

### **f. Cobalt (Co)**

Co is an important element of vit B<sub>12</sub>. It is required for DNA synthesis. Signs of Co deficiency include irregular estrous cycles, delay in uterine involution and reduced conception rate. For lactating cows, dietary requirement of Co is 0.1 ppm on DM basis.

## **4. Relation between Vitamins and reproductive function of cattle**

### **a. Vitamin-A**

It is a fat-soluble vitamin. It maintains the healthy tissue in reproductive tract. Vitamin A directly affects the structure and function of the uterus, gonads and pituitary gland. Its deficiency leads to delay in sexual maturity, low conception rate, abortion, birth of dead weak calves, metritis, retained placenta and suppressed libido in males. Deficiency also causes

delay in ovulation, uterine ovulation, first estrus after calving and increased chance of cystic ovaries. Fresh green roughages contain high concentration of vitamin A. Supplementation of vitamin A before and after calving increases conception rates. Dietary requirement of vitamin A is 4400 IU/kg body weight on dry matter basis.

#### **b. Vitamin E**

Vitamin E acts as intra-cellular antioxidant to protect the cells from free radicals. In absence of vitamin E, these free radicals damage cell membranes, impair the synthesis of steroids, prostaglandins, sperm motility and development of embryo. Vitamin E has influence on embryonic and early fetal development. Vitamin E deficiency leads to decreased ovulation rate, conception rate, milk production, uterine motility, sperm motility and transport. There is placental retention, low sperm count, high incidence of cytoplasmic droplet. The dietary requirement of vit E is 90 IU/kg on dry matter basis.

#### **Conclusion**

It is clear that nutrition plays instrumental role in reproduction. Nutrition either deficient amount or in excess can impair the proper reproductive function in animals. At present, the best recommendation is to provide the dairy cows a diet which is balanced in all nutrients and meets all the nutrient requirements.

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