

## **NUTRITIONAL FACTORS AFFECTING REPRODUCTION**

### Energy:

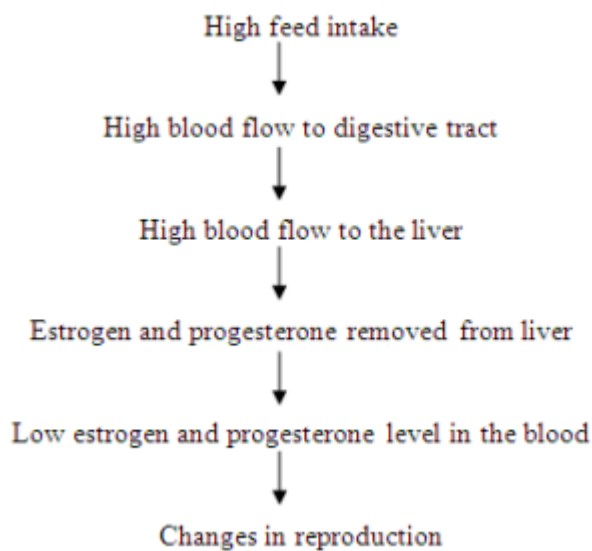
Insufficient intake of energy, protein, vitamins, and micro- and/or macro-minerals has all been associated with suboptimal reproductive performance. Of these nutritional effects on reproduction, energy balance is probably the single most important nutritional factor related to poor reproductive function in animals. Short and Adams prioritized the metabolic use of available energy in ruminants ranking each physiological state in order of importance, as follows:

- 1) basal metabolism
- 2) activity
- 3) growth
- 4) energy reserves
- 5) pregnancy
- 6) lactation.
- 7) additional energy reserves
- 8) estrous cycles and initiation of pregnancy.
- 9) excess energy reserves

Based on this list of metabolic priorities for energy, reproductive function is compromised because available energy is directed towards meeting minimum energy reserves and milk production. Restricting energy intake during late gestation increases the length of postpartum anestrous and reduces subsequent pregnancy rate. The impact of insufficient energy intake during late gestation cannot be overcome by increasing energy intake postpartum.

Excessive energy intake during late lactation and the dry period can cause “fat cow” problems which lower reproductive efficiency in the next lactation. When heifers are fed inadequate amounts of energy, they reach sexual maturity later. If energy deficient rations are fed to heifers that have begun to have normal estrous cycles, they may stop cycling. An example is heifers fed diets composed mainly of poor quality hay. They often will not show signs of estrus during late winter. If

grain is provided, or they are put on good pasture, normal estrous cycle activity will resume as they begin to consume adequate amounts of energy .Caution should be used with feeding excessive amounts of nutrients before or after calving. Not only is it costly, but animals with excess body condition have lower reproductive performance and more calving difficulty than animals in moderate body condition .Excessive energy intakes during the late lactation and dry periods can lead to “fat cow” problems. Cows that are over-conditioned when they calve have a higher incidence of retained placenta, more uterine infections and more cystic ovaries. They also have a higher incidence of metabolic disorders and have a greater tendency to go off feed. All of these problems can result in poor reproductive performance .



- Decreased duration of estrus (Standing heat)
- Increased double ovulation rate (Increased twinning)
- Decreased conception rate
- Increased Pregnancy loss

Figure 1 Schematic representation of the potential physiological pathway that may produce the changes observed in high-producing lactating dairy cows.

### **Protein :**

The effect of dietary protein on reproduction is complex . Prolonged inadequate protein intake has been reported to reduce reproductive performance. More recently it has been found that reproductive performance may be impaired if protein is fed in amounts that greatly exceed the cow's requirements. Overfeeding of DIP either as protein or urea has been associated with decreased pregnancy rates in female dairy and beef cattle .It appears that exposure to high levels of ammonia or urea may impair maturation of oocyte and subsequent fertilization or maturation of developing embryos. However, supplying adequate energy for excretion of excess ammonia or urea may prevent decreases in fertility in dry cows or heifers . In addition, not all studies have observed negative effects of elevated BUN concentrations on embryo quality or pregnancy rates . Overfeeding protein during the breeding season and early gestation, particularly if the rumen receives an inadequate supply of energy may be associated with decreased fertility . This decrease in fertility may result from decreased uterine pH during the luteal phase of the estrous cycle in cattle fed high levels of degradable protein.

excessive protein might be harmful in some situations, but not in others. Some of the following effects have been demonstrated to explain the poor reproduction sometimes observed with excessive levels of protein in the diet:

- 1 • High levels of blood urea may occur, which has a toxic effect on the sperm, the ova, and the developing embryo.
- 2• The balance of hormones may be altered—progesterone levels are low when the blood contains high levels of urea.
- 3• In the early lactating cow, high levels of protein may exacerbate the negative energy balance and delay the return of normal ovarian function .

### **Fats :**

The impact of fats on reproduction in cattle is a focus of considerable research . Because fatty acids and cholesterol are substrates for hormone synthesis, increasing fat in the diet may increase levels of reproductive hormones (progesterone, prostaglandins) or fats may act directly on the reproductive axis. Therefore, the effects of fat may be independent of or additive to those of increased energy availability. Cattle diets usually contain less than 2 or 3% fat. Supplementing fat to improve reproduction was initially attempted to increase the

energy density in the diet. High fat diets for cattle contain 5% to 8 % fat. Exceeding these dietary fat levels impairs rumen function. Lactating cows are the primary animals to be supplemented because of their increased energy requirements, and the difficulty involved with getting these cows rebred.

### **Minerals:**

Minerals are important for all physiological processes in animals including reproduction . Mineral deficiencies and imbalances are often cited as causes of poor reproduction. It is clear that adequate amounts of minerals must be provided, but little is known about the effects of marginal deficiencies and imbalances. The same is true of excessive intakes of minerals which may indeed be harmful. Producers should avoid overfeeding minerals. If a little bit is enough, twice as much will not be better and may in fact cause problems .

#### **• Phosphorus (P):**

There has been much debate and research conducted on phosphorus supplementation effects on reproductive function .Decreased fertility rate, feed intake, milk production, decreased ovarian activity, irregular estrous cycles, increased occurrence of cystic ovaries, delayed sexual maturity and low conception rates have been reported when phosphorus intakes are low .

#### **• Calcium (Ca):**

Most experimental work relating calcium to reproduction has centered on the effect of the calcium: phosphorus ratio. Controlled experiments demonstrated no effect of altered ratios on reproduction in heifers or lactating cows. Ratios (Ca:P) between 1.5:1 and 2.5:1 for lactating cows should not result in problems. Milking cows should always be provided adequate amounts of calcium to maximize production and minimize health problems. One of the functions of calcium is to allow the muscle contraction. Clearly a reduction in muscle contractility will lead to a decrease in dry matter intake (DMI) as rumen function decreases, leading to severe Negative energy balance (NEB). As consequences, there is an increase in fat mobilization that may result in fatty liver syndrome and ketosis

#### **• Selenium (Se):**

Selenium is important for normal spermatogenesis and largely as a component of seleno-proteins phospholipid. Diets should contain at least 0.1 ppm selenium on a dry matter basis [30]. In some herds, feed sources must be supplemented with

selenium injections to maintain blood levels above the recommended 8-10 mg/100 ml. In herds where selenium levels are extremely low, injections are often required to rapidly return blood selenium levels to normal. After injection, feed supplements may provide enough selenium to maintain adequate blood levels in the cow. Blood tests are recommended to confirm selenium status when questions arise.

Marginally selenium deficient animals will abort, or calves will be weak and unable to stand or suckle. Research indicates that selenium supplementation reduces the incidence of retained placentas, cystic ovaries, mastitis and metritis. In addition, cattle that maintain adequate blood selenium levels have reduced incidence of abortions, still births and peri-parturient recumbency.

• **Zinc (Zn) :**

Zinc is an essential component of over 200 enzyme systems of which the metabolic action include carbohydrate and protein metabolism, protein synthesis, nucleic acid metabolism, epithelial tissue integrity, cell repair and division, and vitamin A and E transport and utilization.

**Potassium (K):**

Limited research suggests that feeding high levels of potassium may delay the onset of puberty, delay ovulation, impair corpus luteum (yellow body) development and increase the incidence of anestrous in heifers.

• **Chromium (Cr):**

Chromium potentiates insulin action, resulting in increased uptake of glucose and amino acids by cells in the body . A chromium deficiency in lactating cows may result in increased incidence of ketosis and decreased milk production. Improved energy balance in early lactation may improve reproduction .

• **Salt (Sodium and Chloride):**

Salt deficiencies can affect the efficiency of digestion and indirectly the reproduction performance of cows . Sodium and chloride normally do not appear in feedstuffs in adequate amounts to meet animal requirements and should be provided free choice at all times .

**Vitamins:**

The vitamin requirements of dairy cows are met by a combination of rumen and tissue synthesis, natural feeds and feed supplementation .Most commercial concentrates contain supplemental vitamins so the probability of infertility due to a vitamin deficiency is greatly reduced. When commercial concentrates are not fed, vitamin supplements should be provided. Proper vitamin and mineral balance must be provided in dry cow rations when feed intake is restricted and (or) low quality forage is fed to control or reduce body condition. To ensure adequate intake, vitamins and minerals should be fed in small amounts of low energy concentrates or mixed in a complete dry cow ration .

• **Vitamin A:**

Vitamin A is one of the fat soluble vitamins and is well known to regulate the development, cellular growth and differentiation, and tissue function. Its metabolites affect ovarian follicular growth, uterine environments and oocyte maturation [38]. Vitamin A is required for maintaining healthy tissue in the reproductive tract. In deficient cattle, delayed sexual maturity, abortion, the birth of dead or weak calves, retained placenta and metritis have been reported.

• **Vitamin D:**

Vitamin D is required for normal calcium and phosphorus metabolism. However, deficiencies are seldom encountered in commercial herds. Animals with vitamin D deficiency symptoms have a stiff gait, labored breathing, weakness and possibly convulsions. Swollen knees and hocks can also occur. Bones may be soft (rickets) or be reabsorbed in older animals. Calves may be born dead, weak or deformed. Cows may not show heat when exposed.

• **Vitamin E :**

Vitamin E functions as an intra-cellular antioxidant scavenging for free reactive oxygen and lipid hydroperoxidases, and converting them to non-reactive forms, thus maintaining the integrity of membrane phospholipids against oxidative damage and peroxidation .The investigation for the role of vitamin E in reproduction continues. To date there is no documented evidence that vitamin E deficiency is a significant cause of reproductive failure in dairy herds.