

Review On Infertility Of Female Animal's Due To Nutrition's And Managements Problems

Balemual Abebaw¹, Birara ayalneh²

¹University of Gondar College of veterinary medicine and animal science, Department of veterinary clinical Medicine, Gondar, Ethiopia P.O. Box: 196

²University of Gondar College of veterinary medicine and animal science, Department of paraclinical study, Gondar, Ethiopia P.O. Box: 196
balemual.abebaw@gmail.com

ABSTRACT: Nutrition plays a major role on enhancing reproductive efficiency in all animals. Energy and protein are the major nutrients required in the greatest amounts and should be in the topmost priority in order to optimize reproduction in dairy cattle. Minerals and vitamins also cannot be neglected and must be balanced in the diet. In the other hand, the nutrient should not be over-fed as this may also impairs the reproduction. Deficiencies of various trace minerals, inadequate vitamin intakes, energy, protein imbalances and excessive protein intakes are mentioned as contributors to infertility and poor reproductive performance. Progress in improving the fertility of domestic animals has been achieved by studying genetic, nutritional, endocrine, disease and manages mental factors as they contribute to both fertilization failure and embryo mortality. Heat stress affects the fertility and reproductive livestock performance by compromising the physiology reproductive tract, through hormonal imbalance, decreased oocyte quality and poor semen quality, and decreased embryo development and survival. Heat stress decreases the secretion of luteinizing hormone and estradiol resulting in reduced length and intensity of estrus expression, increased incidence of anestrus and silent heat in farm animals.

[Abewaw B, Ayalneh B. **Infertility Of Female Animal's Due To Nutrition's And Managements Problems.** *Researcher* 2017;9(12):45-54]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). <http://www.sciencepub.net/researcher>. 6. doi:10.7537/marsrsj091217.06.

Key words: *Infertility, Nutrition, Heat stress, Reproduction and Livestock*

1. Introduction

Nutrition plays a vital role in the reproductive performances of cows as it influences fertility and may occur at several stages of the reproductive cycle, and also can affect the reproductive axis in most of the points. It gives a crucial influence to the development of postpartum reproductive function in cattle. Livestock industry and animal researchers have long been recognized the importance of proper nutrition for livestock to achieve reproductive success (Amin, 2014). Good reproductive performance positively affects a cow's active herd life and plays an important role in dairy herd economies. Many scientists have studied about the influence of nutrition on cattle fertility. Differences in nutrition probably account for most variation in reproductive performance between herds and among animals within the herds (Bindari *et al.*, 2013).

Over or underfeeding are equally detrimental to normal reproductive function. Underfeeding reduces milk yield, which in turn reduces the growth of calf. This reduces calf weaning weight and delays puberty, and affects in the potential life time productivity of the female calf. Therefore, fertility is a very complex process and the final outcome is the result of a close and well-orchestrated interaction between hypothalamus-pituitary-ovary-uterus. The complexity of this process indicates that any factors

which interfere with the functioning of one or more of these organs involved will also influence the overall fertility outcome (Elfadil, 2014).

The effects of poor nutrition differ depending on whether the main deficiency is in energy, protein, vitamins, minerals or trace elements. Protein and energy are the nutrient components needed in the largest quantities, and directly affect body condition scores (BCS) and normal reproductive performance. Today, many people implicate deficiencies of various minerals, inadequate vitamin intake, and energy-protein imbalances as the major causes of cow infertility and poor herd performance. There is a strong link between nutrition and fertility, where nutrient partitioning to the mammary gland in early-lactation, when dry matter intake (DMI) is reduced, resulting in negative energy balance (NEB) and many associated disorders (Bindari *et al.*, 2013).

Vitamins and minerals also play a significant role in fertility by maintaining membrane integrity, and are involved in hormone production and maintenance of strong immune system. Of particular importance are vitamins A, D and E, macro minerals such as calcium (Ca), magnesium (Mg) and phosphorus (P), and micro minerals such as copper (Cu), selenium (Se) and zinc (Zn) (Andrieu, 2008). Poor nutrition, especially inadequate energy intake, can lead to extended postpartum anestrus, causing excessive body weight

loss and reduction in expression of estrus. It is becoming increasingly clear that a good reproductive management is dependent on proper attention to the optimum nutrition of the cow, whose nutrient requirements vary depending on physiological state and the specific nutrient demands to prevent metabolic disorders in the peri-parturient period (Walsh *et al.*, 2011).

The performance, health, and well-being of livestock are strongly affected by climate. High ambient temperatures, high direct and indirect solar radiation and humidity are environmental stressing factors that impose a strain on animals. Among the environmental variables affecting livestock, heat stress seems to be one of the most intriguing factors hampering animal production in many regions of the world (Boni *et al.*, 2014).

Heat stress is the major cause for infertility and reproductive inefficiency in livestock, resulting in profound economic losses. Heat stress reduces the libido, fertility and embryonic survival in livestock and favors the occurrence of diseases in neonates with reduced immunity. Heat stress affects the fertility and reproductive performance of livestock species through compromising the functions of the reproductive tract,

disrupting the hormonal balance, decreasing the oocyte quality, and thereby decreasing embryo development and survival (Govindan and Bagath, 2016). Therefore, the objectives of this review are:

- To address effect of nutrition on endocrine system, puberty, Post-partum fertility and Lactating cow.
- To address effect of nutrients on reproductive efficiency.
- To highlight heat stress and seasonal effects on reproduction in the dairy cow.

2. Literature Review

2.1. Effect of nutrition in female animal fertility

2.1.1. Endocrine system

The primary target area for sensing and reacting to nutritional status is the hypothalamus. The body is regulated by two basic systems, nervous and endocrine. The endocrine or hormonal system, in general, is specifically concerned with the control of metabolic functions, rates of chemical reactions in cells, transport through cell membranes, and other functions such as growth and secretion (Pradhan, 2011).

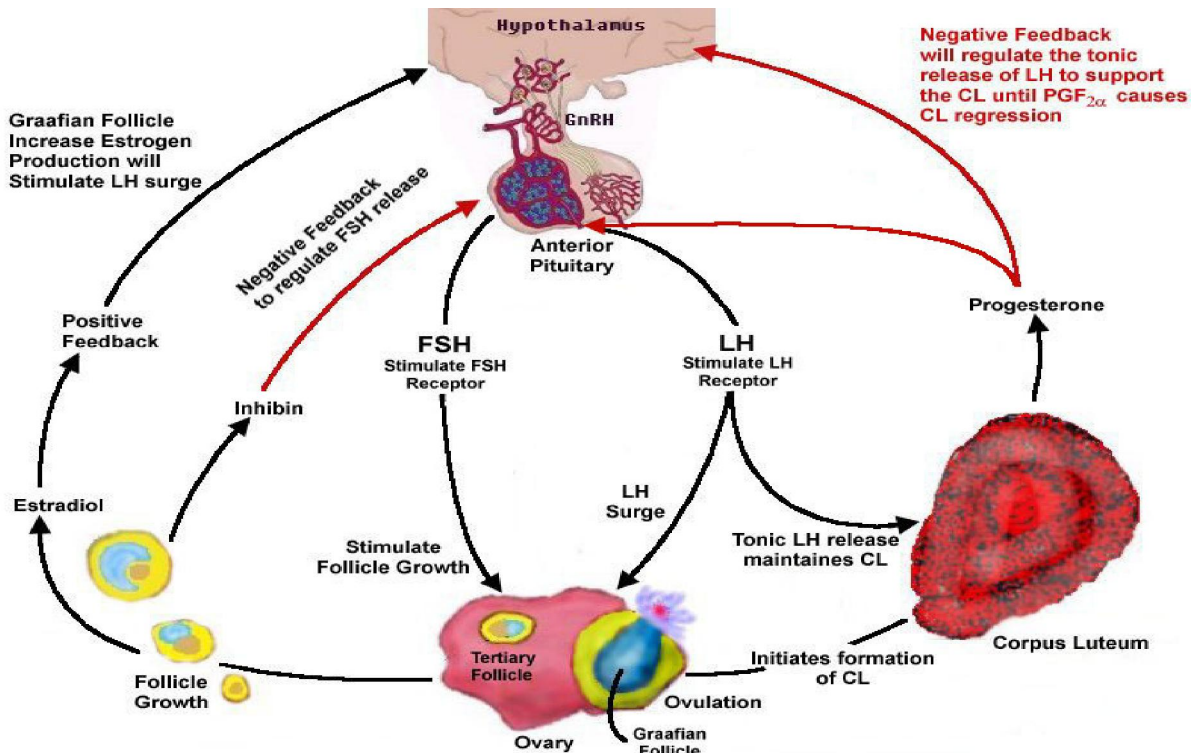


Figure 1: Effect of nutrition on endocrine system (Elfadil, 2014)

Hormones are chemical components comprised of steroids, peptides, proteins, and glycoprotein secreted into body fluids at one site with their actions

on target tissues and organs at adjacent or other sites within the body. The tissue or organ response to the hormone is influenced by the number of receptors

present on the cell membrane or within the cell and by the amount of hormone that is present. The amount of hormone presented will be under the influence of blood flow and concentration. Nutrition or perhaps more specifically certain food nutrients can influence the hormonal status of the animal at several levels (Elfadil, 2014). Inadequate intake of nutrients or inadequate body reserves, needed to meet production requirements, after calving, results in suppressed reproductive performance in cattle. Pituitary and ovarian responses to endogenous or exogenous hypothalamic stimuli appear to be related to postpartum stage as well as to the severity and duration of nutrient deprivation (Moellers *et al.*, 1988).

Potential sites of action of nutrition on ovarian function include systemic effects at: (i) the hypothalamic level via gonadotropin releasing hormone (GnRH) synthesis and release; (ii) the anterior pituitary through control of synthesis and release of follicle stimulating hormone (FSH), luteinizing hormone (LH) and growth hormone (GH); and (iii) at the ovarian level through regulation of follicle growth and steroid synthesis (Lamb, 2009).

2.1.2. Puberty

Dietary and energy restriction are used to delay the onset of puberty. Weight is apparently the major factor affecting puberty in animals. Thus restricted feeding that slows down growth will increase age at puberty. Poor nutrition delays puberty, reduces conception rate and increases pregnancy losses in heifers. Inadequate protein intakes which occurs quite often in cattle grazing tropical and subtropical pastures with low protein content (<8%) have been shown to delay puberty. Bindari *et al.*, (2013) reported a negative correlation between dietary protein levels and age at puberty. Generally, the onset of puberty occurs when the heifer reaches approximately 40% to 50% of her mature weight (Amin, 2014).

2.1.3. Post-partum fertility

The reproductive performance of the postpartum cow is related to nutritional status. Postpartum weight loss, due to underfeeding or high lactation demands, extends the postpartum anestrus period. Nutrition plays an important part in the initiation of post-partum ovarian activity in all farm species. If animals are poorly fed during this period as often occurs under tropical grazing systems, post-partum infertility, prolonged rebreeding intervals or nutritional anestrus are commonly observed (Amin, 2014). Cows should be fed well for 22-55 days before parturition and, if possible, for 90 days after parturition (Colazo and Kastelic, 2014) found that cows with a blood glucose concentration of less than 30 mg glucose per 100 ml blood tended to return to service. Cows must, therefore, be on an adequate or rising plane of

nutrition and gaining mass during the mating season if conception is to be successful (Lotthammer, 2001).

2.1.4. Lactating cow

During the final 30 days of gestation, lactation is initiated, with production of colostrum and final growth of the fetus. At day 270 of gestation, the uterus and fetus require energy greater than 1600 kcal per day. Severe anorexia or an imbalance of nutrient intake can predispose the animal to a number of metabolic diseases that constitute the parturition disease complex (Amin, 2014). Cows with hypocalcaemia are at increased risk of suffering dystocia, retained fetal membranes, and ketosis. Dystocia and retained fetal membranes are predisposing factors for post parturient uterine diseases. Disrupted intake accompanied by disrupted energy metabolism can result in an increased level of circulating ketone bodies. Amin (2014) reported that cows with higher concentrations of circulating ketone bodies had more days to first service, decreased first service conception rates, and more days open. More recently, cows with serum beta hydroxyl butyrate concentrations of 1100 $\mu\text{mol/L}$ in weeks 1 and 2 of lactation were found to have increased risk of conception failure (Walsh *et al.*, 2011).

2.2. Effect of nutrients on reproductive efficiency

2.2.1. Energy

The most important nutritional factor affecting reproduction in dairy animals is the energy intake of the animal. Energy intake should be in adequate levels, excess intake during late lactation and the dry period can cause fat cow problems which lower reproductive efficiency in the next lactation. Inadequate energy intake in heifers will lead to delay in sexual maturity. Cows need energy to maintain milk production as well as to initiate and maintain pregnancy (Perry & Dalton, 2011).

The nutritional challenge of negative energy balance is significant and can adversely affect the reproductive performance of the dairy cow. Negative energy balance is a common finding in high yielders during early lactation because of inadequate consumption of feed to meet the nutrient requirements for high levels of milk production. Energy stores in body tissues are mobilized and weight losses occur. This negative energy balance positively affects the reproductive status of the animal because of the longer interval to first ovulation (Walsh *et al.*, 2011).

To achieve the maximum number of estrous cycles before breeding, cows must ovulate during the early postpartum period (<21 days in milk). Growth of follicles and ovulation are dependent on the pulsatile secretion of LH. In cattle in severe negative energy balance, the secretion of LH is inhibited. Disrupted or decreased LH secretion slows the growth and development of the follicle, which delays ovulation

(Amin, 2014). Insulin and insulin like growth factor-I (IGF-I) are also required for normal follicular growth and ovulation. Cows in negative energy balance have reduced levels of IGF-I. This is an important relationship, given that IGF-I amplify the effects of LH on the ovary through potentiating the signaling mechanism for LH (Andrieu, 2008). Therefore, the actions of LH are decreased in cows in negative energy balance because lower IGF-I leads to reduced effectiveness of LH. Consequently, follicles in cows with extremely low IGF-I do not develop normally, and ovulation is delayed because LH is less active. This effect was demonstrated in a study by Bindari *et al.* (2013).

The other possible effects of deficient energy intake are lower conception rates, longer calving intervals, underdeveloped mammary glands, greater incidence of calving problems and cystic ovaries which are most prevalent in high producing dairy cows that are in negative energy balance common link between this disease and negative energy balance is the abnormal secretion of LH (Amin, 2014). Cystic ovaries are associated with increased LH secretion but an inhibition of the pre-ovulatory LH surge. The cumulative effect of these conditions is development of a large cystic follicle that fails to ovulate in the absence of the ovulatory surge of LH. This relationship further strengthens the relationship among energy balance, LH and early postpartum reproductive performance of the dairy cow. Overfeeding often results in weak expression of estrus, subnormal conception rates, high embryonic mortality, decreased mammary gland development and reduced milk production (Krieg, 2008).

2.2.2. Protein

Although protein is generally regarded as less important than energy for reproduction, low protein intake can also cause infertility. However, it may be difficult to differentiate the effects of low protein intake from concurrent low energy intake, because protein deficiency usually leads to decreased appetite. It has been found that reproductive performance may be impaired if protein is fed in amounts that greatly exceed the cow's requirements. Dietary protein and protein digestion have been categorized by location and rate of digestion of the protein (Moellers *et al.*, 1988).

Dietary crude protein (CP) that is fermented by rumen micro flora is defined as rumen-degradable protein (RDP). This protein is degraded to ammonia, single amino acids, and peptides. Ammonia produced in excess of that which the microbial population can utilize is absorbed from the rumen and transported in the circulatory system. A major portion is converted to urea in the liver. Feeding diets high in total CP or diets containing an excess of RDP or soluble CP can

predispose lactating cows to elevated blood urea nitrogen (BUN) levels (Elfadil, 2014).

Urea is added to some dairy rations as a source of nitrogen which the rumen bacteria can convert into protein. Elevated blood levels of ammonia or urea or both could alter secretions produced in the reproductive tract itself and affect viability of the ova, sperm or embryo. In addition, the hormonal balance required for normal function also may be involved. High-protein diets increase the urea nitrogen content of uterine secretions but found no differences in fertility or in vitro embryo development. Bindari *et al.* (2013) found that high crude protein (CP) diets changed the concentrations of magnesium, potassium, phosphorus and zinc in uterine secretions. Overall, high protein diets increase the nitrogen content of uterine secretions, in addition to shifting mineral composition; however, a direct effect of these changes in utero on fertility and embryo viability is less clear (Amin, 2014). Altered hormonal balance caused by elevated BUN levels also may decrease fertility and reproductive. Excessive ammonia or chronically elevated ammonia may alter hormonal status and thus performance of the animal (Elfadil, 2014).

2.2.3. Fat

Supplemental Poly Unsaturated Fatty Acids (PUFA) has been shown to increase progesterone (P4) concentrations by enhancing development of luteal cells, reducing uterine synthesis of prostaglandin (PGF2 α), delaying luteolysis, and directly alleviating hepatic steroid metabolism. Additionally, supplemental PUFA may also increase circulating insulin concentrations, which in turn has also been shown to reduce hepatic expression of P4 catabolic enzymes. Feeding fat increases follicle numbers and the size of the dominant follicle. PUFA supplementation may increase reproductive performance directly by improving uterine environment and embryo development, perhaps by increasing circulating concentrations of P4 (Reprod *et al.*, 2017).

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 (Krieg, 2008).

Feeding high fat diets to cycling heifers and postpartum cows increased progesterone production and the lifespan of the corpus luteum (CL). Higher progesterone levels during the luteal phase generally result in improved fertility. Increasing dietary fat also results in increased follicular growth. More small and medium follicles are present in cows and heifers fed high fat diets. In addition, this increased follicular growth is often accompanied by increased estrogen and/or progesterone production. These changes in follicular growth and hormone production may enhance reproduction (Perry & Dalton, 2011).

2.2.4. Minerals

Minerals are also important for good reproductive performance as deficiency of it is associated with decreased reproductive performances. Proper herd management should be designed to optimize the production of the highest quality product, while minimizing any adverse effects on the health and welfare of the animals. Adequate balances of

major and minor trace mineral plays important roles in health as well as reproductive efficiency. The potential for minerals to play a significant role in herd fertility is indisputable (Andrieu, 2008).

Mineral elements that are of particular importance are categorized into major [calcium (Ca), phosphorus (P), potassium (K), sodium (Na), chlorine (Cl), sulphur (S) and magnesium (Mg) and trace elements iron (Fe), iodine (I), copper (Cu), manganese (Mn), zinc (Zn), cobalt (Co) and selenium (Se)]. Micro minerals are very essential part of animal's ration which is required only in micro amount and excess feeding of some of these may show toxicity symptoms. Micro minerals are involved in several biological processes, such as component of metallo-enzymes and enzyme co factors. These works both as activator of enzymes involved in intracellular detoxification mechanism of free radicals and in stabilization of secondary molecules. Some of these are component of hormones and thus directly regulates endocrine activities (Corah, 1996).

Table1: Normal level of minerals which is given to female animals

Minerals	Rainy seasons	Dry seasons	Critical level
Macro minerals (g/k.g)			
Ca	5.56(0.24)	5.82(0.30)	<3.0
P	8.68(1.07)	8.55(0.57)	<2.5
Mg	1.52(0.16)	1.83(0.04)	<1.0
Micro-minerals (mg/k.g)			
Fe	56.29(4.46)	58.17(4.57)	<30
Mn	34.37(0.80)	34.20(0.85)	<40
Se	1.33(0.04)	1.37(0.04)	<0.1
CU	0.74(0.02)	0.63(0.05)	8.0
Zn	5.63(0.17)	4.86(0.21)	30

(Kumar *et al.*, 2011)

Calcium: calcium related disorders (deficiencies) are mostly very common during parturition or within few days following parturition. The Ca: P ratio, alteration may affect ovarian function through its blocking action on pituitary gland. This results in prolongation of first estrus and ovulation, delayed uterine involution, increased incidence of dystocia, retention of placenta and prolapse of uterus (Smith and Akinbamijo, 2000). Moreover low calcium level in blood is also associated with anestrus whereas excess of calcium can affect the reproductive status of animal by impairing absorption of phosphorus, manganese, zinc, copper and other elements from gastro intestinal tract. 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. A major concern in the mineral feeding of

dry cows relates to providing optimum levels of calcium and phosphorus in order to decrease the occurrence of milk fever. Prevention of milk fever is an important consideration in maximizing reproductive efficiency (Yasohtai, 2014).

Phosphorus: This mineral has been most commonly associated with decreased reproductive performance in dairy cows. Inactive ovaries delayed sexual maturity and low conception rates have been reported when phosphorus intakes are low. In a field study when heifers received only 70-80% of their phosphorus requirements and serum phosphorus levels were low, fertility was impaired (3.7 services per conception). Services per conception were reduced to 1.3 after adequate phosphorus was supplemented (Burton and Sci, 2012). Phosphorus is stated to be one of important element for normal sexual behavior. Delayed onset of puberty and silent or irregular estrus

in heifers, failure of estrus and long inter calving period in cows and still born or weakly expelled calves or even embryonic death due to lack of uterine muscle tone are reported to be some of important clinical manifestation exhibited by the animals from phosphorus deficient areas. On the contrary the excess of phosphorus renders the endometrium susceptible for infection. Reduced fertility and reduced or delayed conceptions are the prime signs of phosphorus deficiency and this can be overcome with proper phosphorus supplementation. Whereas moderate deficiency may lead to repeat breeding condition and poor conception rate (Smith and Akinbamijo, 2000).

Sodium and potassium: Both of these elements are indirectly related to reproduction in animals as the deficiency of sodium can affect the normal reproductive physiology by preventing the utilization of protein and energy whereas deficiency of potassium is well known to cause muscular weakness and thereby affect the musculature of female genital tract causing impairment in the normal reproductive process. Research suggests that feeding high levels of potassium (5% DM basis) may delay the onset of puberty, delay ovulation, impair corpus luteum (yellow body) development and increase the incidence of anestrus in heifers. Lower fertility was noticed in cows fed high levels of potassium or diets in which potassium-sodium ratio was too wide (Yasohtai, 2014).

Selenium: The source of selenium deficiency is the soil deficient in selenium. Selenium deficiency in dry cows has been reported to cause abortions, a high incidence of embryonic fetal loss, poor fertility, increased incidence of metritis, a higher level of general infection and the birth of dead or weak calves retained placenta. Diets should contain at least 0.1 ppm selenium on a dry matter basis. 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 (Andrieu, 2008).

Iodine: Inadequate thyroid function reduces conception rate and ovarian activity. Thus, iodine deficiency impairs reproduction and iodine supplementation has been recommended when necessary to insure that cows consume 15-20 mg of iodine each day. However excess iodine resulted in abortion and decreased resistance to infection and disease (Kumar *et al.*, 2011).

Copper: Copper deficiency signs are decline in fertility, inactive ovaries and high incidence of Retention of Placenta (ROP). Daily requirement of Copper is 10 ppm. Copper (Cu) availability is also strongly affected by other minerals, in areas where

Sulfur or Molybdenum is high, Cu supplementation should be increased (Yasohtai, 2014).

Cobalt: Cobalt is required for the microbial synthesis of Vit-B 12. Deficiency signs are unthriftiness and anemia as well as delayed uterine involution, irregular estrus cycles and decreased conception rate. Dietary requirement of Cobalt for lactating cows is 0.1 ppm of Dry Matter Intake (Smith and Akinbamijo, 2000).

Manganese: Manganese is required for activation of many enzyme systems and also involved in luteal tissue metabolism. Deficiency symptoms are delayed return to estrus postpartum, reduced conception rate and delayed ovulation. Abortions and small birth weights also reported due to inadequate Manganese intake. Dietary requirement is 40 ppm of ration on Dry Matter Basis (DMB) (Smith and Akinbamijo, 2000).

Zinc: Zinc is recognized as an essential nutrient required for normal growth. Zinc has been identified as a cofactor for more than 200 proteins and enzymes. Zinc's role in metabolism, growth and repair of normal epithelial tissue, the role in reproduction is not fully understood. Zinc deficiency signs are delayed testicular development in young bull and testicular atrophy in the adult. Also atrophy of seminiferous tubules and cessation of spermatogenesis. Lower conception rates have been reported in cows. Dietary requirement is 40 ppm of ration on DMB. This is adequate for normal testicular function. Feeding trace mineral salt should be providing adequate amounts of Cu, Co, Mn and Zn for normal reproduction (Machado *et al.*, 2013).

Iron: It is required for the synthesis of hemoglobin and myoglobin as well as many enzymes and cytochrome enzymes of electron transport chain. Iron functions in transport of oxygen to tissues, maintenance of oxidative enzyme system and is concerned with ferritin formation. Deficiency in adult animals is rare due to its ubiquitous presence in the feed stuffs. The reproductive performance of Iron deficient animals may be badly affected due to anemia, reduced appetite and lower body condition. A deficient animal becomes repeat breeders and require increased number of inseminations per conception and occasionally may abort (Machado *et al.*, 2013).

Molybdenum: Mo is interdependent with Cu with reference to body system of ruminants. Generally lower level of one occurs in presence toxic level of another. Therefore proper balance of Cu and Mo in soil and plant is essential for normal absorption of each other in ruminants (Elfadil, 2014). Molybdenum deficiency decreases libido, reduced spermatogenesis and causes sterility in males and is responsible for delayed puberty, reduced conception rate and anestrus in females (Kumar *et al.*, 2011).

2.2.5. 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 (Corah, 1996).

Vitamin A: Vitamin A maintains the tissue integrity of reproductive tract. Its deficiency will lead to delayed sexual maturity, abortion, the birth of dead or weak calves, retained placenta and metritis. The recommended daily supplementation for dairy cows is 30,000-50,000 units. Beta-carotene (carotene) also has been investigated as a nutrient having special requirements for reproduction. Dairy cows and heifers consuming diets deficient in β -carotene suffered with following problems like delayed uterine involution, delayed first estrus after calving, delayed ovulation, increased incidence of cystic ovaries, more early embryonic death and abortion. β -carotene supplementation at 300 mg/cow/day reportedly restored reproductive function to normal (Smith and Akinbamijo, 2000).

Vitamin D: It 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 re absorbed in older animals. Calves may be born dead, weak or deformed. Cows may not show heat when exposed. Recent research has implicated Vitamin D with heart health, cancer and infectious diseases. In areas where sunlight is limited or on operations where animals are housed indoors, supplemental vitamin D is required. If an animal is losing weight or has a poor body condition score, vitamin D can be deficient. Cows receiving a normal amount of natural light manufacture their own Vitamin D. Most commercial concentrates contain supplemental vitamin D in amounts sufficient to meet the cow's requirement of 10,000 IU per day (Yasoithai, 2014).

Vitamin E: Along with Selenium it functions as an antioxidant and is important in the prevention of white muscle disease in calves. Recently 1000 IU of supplemental Vit E during the last 40 days of gestation significantly reduced the incidence of Retention of Fetal Membranes (RFM) in dairy cows fed diets containing greater than 0.12 PPM Se. Daily requirement of Vit. E is 15 IU/kg of feed (Smith and Akinbamijo, 2000).

Table2: Role of micronutrients in reproduction

Micronutrient	metabolic function	Deficiency consequences
Vitamin A	Steroid genesis, embryonic synchrony	Delayed puberty, low conception rate, high embryonic mortality, reduced libido
Vitamin E	Intra – membrane free radical detoxification	Low sperm concentration and high incidence of cytoplasmic droplets, retained fetal membrane
Selenium	Component of GSH – Px	Reduced sperm motility and uterine contraction, cystic ovaries, low fertility rate, retained fetal membrane
Copper	Enzyme component and catalyst involved in steroid genesis and prostaglandin synthesis	Low fertility, delayed estrus abortion/fetal resorption
Zinc	Constituent of several metallo enzymes; carbohydrate and protein metabolism	Impaired spermatogenesis and development of secondary sex organs in males, reduced fertility and litter size in multiparous species

(Bindari *et al.*, 2013)

2.3. Heat stress and seasonal effects on reproduction in the dairy cow

Heat stress is a major contributing factor to the low fertility of dairy cows inseminated in the late summer months. The decrease in conception rate during the hot season can range between 20 and 30% compared to the winter season. There are clear seasonal patterns of estrus detection, day to first

service and conception rate in dairy cows and lower conception rates are consistently observed in summer months compared to winter months (Boni *et al.*, 2014). The effects of heat stress on fertility appear to carry into the autumn. The low fertility generally associated with the warm months of the year (June to September) remains in the autumn (October and November) even though the cows are no longer exposed to heat stress.

It has been suggested that this could be a lasting effect of heat stress during the hot months on the antral

follicles that will develop into large dominant follicles 40–50 days later (Rensis and John, 2003).

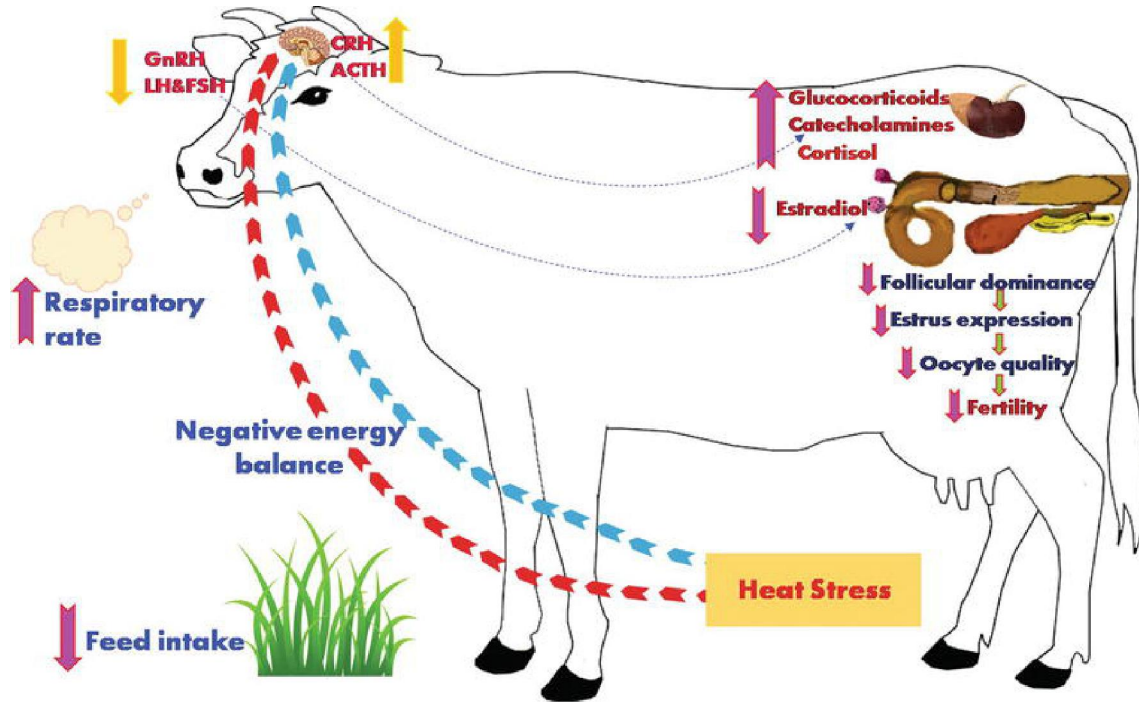


Figure2: Impact of heat stress in reproductive performance (Govindan, 2016)

2.3.1. The effect of heat stress on reproductive patterns in dairy cows

In heat stressed cows the duration and intensity of estrus was reduced in some studies but was unchanged in others. The balance of these and other studies suggest that heat stress reduces the duration and intensity of estrus in dairy cattle. For example, in summer, motor activity and other manifestations of estrus are reduced and the incidence of anestrus and silent ovulation are increased. These effects lead to a reduction in the number of mounts in hot weather compared to cold weather, leading to poor detection of estrus. Therefore, in hot climates there is a reduction in the number of inseminations and an increase in the proportion of inseminations that do not result in pregnancy (Rensis and John, 2003).

2.3.2. The effect of heat stress on gametes and embryos

The formation of gametes is temperature sensitive. Normal spermatogenesis requires a temperature that is below normal body temperature and recent evidence indicates that the development of oocytes is also temperature sensitive. The effect of heat stress on fertility might then be the result of a direct effect of high ovarian temperatures on oocyte quality (Govindan, 2016). The intrauterine environment is also compromised in cows that are heat stressed; there is a decrease in blood flow to the uterus

and an increase in uterine temperature. These changes inhibit embryonic development, increase early embryonic loss and reduce the proportion of successful inseminations. High ambient temperature will also affect pre attachment stage embryos but the magnitude of the effect decreases as embryos develop. The production of embryos by superovulation is often reduced and embryonic development compromised in hot seasons. Heat stress can affect endometrial prostaglandin secretion, leading to premature luteolysis and embryo loss. Most embryo loss occurs before day 42 in heat stressed cows (Rensis and John, 2003).

2.3.3. Heat stress effect on follicular development

Heat stress delays follicle selection and lengthens the follicular wave and thus has potentially adverse effects on the quality of oocytes and follicular steroid genesis. Summer heat stress reduces the degree of dominance of the dominant follicle and more medium-size subordinate follicles survive. Thus, the duration of dominance of the pre ovulatory follicle is increased in summer, and in beef heifers, duration of dominance is negatively correlated with fertility. When individual follicular dominance is reduced, more than one dominant follicle can develop and this may explain the increase in twinning that may be seen in summer. In this way, heat stress can both decrease follicular

steroid secretion and increase twinning rate at the same time (Colazo and Kastelic, 2014).

3. Conclusion And Recommendations

Animal production contributes much to the development of the national economy and to the better living standards of the rural and urban area as well. Reproductive performance is the one that can influence the profitability of the dairy farms in terms of increasing or decreasing milk yield, reproductive culling rate and market price of dairy cows. It can be affected by a network of genetic (hereditary), environmental and managerial factors (malnutrition, lack of intensive follow ups and stress) and their complex interactions. Heat stress is a major contributing factor to the low fertility of dairy cows inseminated in the late summer months. There is a widely observed decrease in the fertility of postpartum dairy cows inseminated in the summer compared to cows inseminated in winter. However, the plasma levels of LH and estradiol are decreased in heat stressed cows and this is one of the main factors contributing to low fertility during the hot months of the year. It is clear that nutrition is directly related to reproduction in the dairy cow. Nutrient either in deficient amount or in higher amount has been shown to be capable of altering reproduction. The best recommendation at present is to provide a feeding program for dairy cows which is balanced for all nutrients and meets all known nutrient requirements. The interactions of nutrition on reproductive performance in cattle involve the most important dietary components like energy, protein, minerals, and vitamins. However further investigation is required regarding minerals and vitamins and its mechanisms in reproductive performances. Nutritional effects appear to be regulated at the ovarian and hypothalamic-pituitary levels which appear to be the main metabolic pathway affecting follicular function. The minerals that affect reproduction in cattle are generally found within the trace element group, although deficiencies of calcium and phosphorus can also affect fertility. Based on the above conclusions, the following recommendations are forwarded:

- ✓ Rations should be balanced for energy, protein, vitamins and minerals to meet nutrient requirements using laboratory analysis of the total diet.
- ✓ Adequate diagnostic facilities for reproductive problems are needed.
- ✓ There should be a means for frequent and detailed examination of reproductive organs.
- ✓ Awareness among farmers regarding management of reproductive disorders due to nutrition leading to imbalance should be created.

Corresponding Author:

Balemual Abebaw
College of veterinary medicine and animal science
Department of veterinary clinical medicine
Tewodros campus, university of Gondar
Gondar, Ethiopia p.o. Box: 196
Telephone: +251931758018 / +251918150354
Email: balemual.abebaw@gmail.com

References

1. Amin, R. U. (2014) 'Nutrition: Its role in reproductive functioning of cattle-a review, 2(1), Pp. 1–9.
2. Andrieu, S. (2008) 'Is there a role for organic trace element supplements in transition', *The Veterinary Journal*. Elsevier Ltd, 176(1), pp. 77–83. doi: 10.1016/j.tvjl.2007.12.022.
3. Bindari, Y. R. *et al.* (2013) 'Effects of nutrition on reproduction- A review', 4(1), Pp. 421–429.
4. Boni, R., Perrone, L. L. and Cecchini, S. (2014) 'Heat stress affects reproductive performance of high producing dairy cows bred in an area of southern Apennines', *Livestock Science*. Elsevier, 160, Pp. 172–177. doi: 10.1016/j.livsci.2013.11.016.
5. Burton, C. and Sci, B. A. (2012) 'Dietary Phosphorus Requirements of the Modern Dairy Cow, 4, Pp. 170–222.
6. Colazo, M. G. and Kastelic, J. P. (2014) 'Reproductive management in cattle and sheep', *animal reproduction in livestock*, 4, Pp. 140–195.
7. Corah, L. (1996) 'Trace mineral requirements of grazing cattle', 59(95).
8. Elfadil, M. (2014) 'Economic Impact of Infertility in Crossbred Dairy Cows: The Case of Eastern Nile Locality, Sudan Moamer Hassan', (August), Pp. 195–197.
9. Govindan, B. (2016) 'Mitigation of the Heat Stress Impact in Livestock Reproduction', *research-article*, 170(5), Pp. 180–225.
10. Krieg, K. (2008) 'Causes of Reproductive Failure in Cattle', *Extension Livestock Specialist*, 5, Pp. 120–150.
11. Kumar, S. *et al.* (2011) 'Importance of micro minerals in reproductive performance of livestock, 4(5), Pp. 230–233.
12. Lamb, G. C. (2009) 'Influence of Nutrition on Reproduction in the Beef Cow Herd', 5(4-6), Pp. 150–175.
13. Lotthammer, K.-H. (2001) 'Influence of nutrition on reproductive performance of the milking/gestating cow in the tropics, 4, Pp. 36–47.
14. Machado, V. S. *et al.* (2013) 'Effect of an injectable trace mineral supplement containing selenium, copper, zinc, and manganese on the health and production of lactating Holstein cows',

- The Veterinary Journal*. Elsevier Ltd, 197(2), Pp. 451–456. doi: 10.1016/j.tvjl.2013.02.022.
15. Moellers, J., Moellers, J. and Dvm, B. S. (1988) 'Nutritional Causes of Infertility in Dairy Cows Nutritional Causes of Infertility in Dairy Cows, 50(2).
 16. Perry, Dalton, and G. (2011) 'Management factors influencing fertility in beef cattle breeding programs', *Applied Reproductive Strategies in Beef Cattle*, 5, Pp. 165–192.
 17. Pradhan, R. (2011) 'Reproductive Disorders in Cattle due to Nutritional Status, 14(1), Pp. 45–66.
 18. Rensis, F. De and John, R. (2003) 'Heat stress and seasonal effects on reproduction in the dairy cow a review', 60, Pp. 1139–1151. doi: 10.1016/S0093-691X(03)00126-2.
 19. Reprod, J., Genet, M. and Abraham, F. (2017) 'An Overview on Functional Causes of Infertility in Cows', 5(2). doi: 10.4172/2375-4508.1000203.
 20. Smith, O. B. and Akinbamijo, O. O. (2000) 'Micronutrients and reproduction in farm animals, Pp. 549–560.
 21. Walsh, S. W., Williams, E. J. and Evans, A. C. O. (2011) 'Review article A review of the causes of poor fertility in high milk producing dairy cows', *Animal Reproduction Science*. Elsevier B.V., 123(3-4), Pp. 127–138. doi: 10.1016/j.anireprosci.2010.12.001.
 22. Yasothai, R. (2014) 'Importance of minerals on reproduction in dairy cattle', 3(6), Pp. 2051–2057.

12/25/2017