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Important minerals affect the fertility of dairy animals: A review

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Abstract
Reproductive potential of dairy animals is influenced by animal's age, breed, environment, health and management. Under management, poor supplementation or imbalance of minerals greatly affects fertility and performance of animal. Current review highlighted the female's reproductive problems occur due to deficiency of major important minerals which are necessary for animals.

Keywords: Buffalo, minerals, reproductive problems

Introduction
Buffalo is a multipurpose species contributing towards milk, meat production and draft purpose that originated in Mediterranean and Trans gangetic plain region of North-Western India (Barile, 2005a) [1]. Buffaloes contribute more than 55% of total milk production of India. Additionally, this is hardy animal having better adaptability for harsh environmental conditions and important livestock resource for the rural economy due to the fundamental role played by them in many climatically disadvantaged agricultural systems (Gasparrini, 2013) [8]. However, despite of these merits, buffaloes are blamed for slow reproduction, long calving interval, delayed puberty, poor estrus expression and seasonality in breeding (El-Wishy, 2007) [7]. Infertility due to cyclicity failure or anoestrous leads to huge economic losses that are estimated Rs. 372.90 per day in buffalo (Kumar *et al*., 2013) [20].
Low reproductive potential of buffalo has been a major concern for decades (Kumar *et al*., 2014) [21]. This may be due mineral deficiencies, imbalances and toxicity of certain mineral elements may cause reproductive disorders, as minerals play an important role in health and reproduction of the livestock (Sharma *et al*., 2007) [33]. Minerals are required to achieve good and better reproductive performance of dairy animals (Bindari, *et al*., 2013) [2]. Deficiency of essential minerals and poor feeding management may results in delay in puberty (Warriach *et al*., 2015) [37], anoestrous (Kumar *et al*., 2015) [22], repeat breeding (Kumar, 2014) [21], retention of placenta (Sheetal*et al*., 2014) [34], abortion (Mee, 2004) [25] and weak calf syndrome (Logan *et al*., 1990) [23]. This review will focus on some important mineral's importance and their functions to improve reproductive potential of buffalo.

Calcium (Ca): Calcium deficiency mostly occur in high milk yielder during last trimester of pregnancy and parturition or few days following parturition because demand of calcium is Very high, require for growth of foetus and milk production. Dietary deficiency or Ca:P ratio alteration both may results in complications which occur due to calcium deficiency. As calcium have important role in muscles contraction, thus hypocalcaemia affects normal muscles tone of uterus which may lead to retention of placenta and infertility because of delay in involution of uterus after parturition. Low calcium level may cause uterine prolapse because of loss of tone of uterine tone. Decline in muscles contraction of rumen due hypocalcaemia; less feed intake which may lead to negative energy balance thus may causes anoestrous and repeat breeding problems.

Phosphorous (P): Phosphorous is second most abundant mineral found in animal's body and approximately 80% is found in bones and teeth (Suttle, 2010) [36]. Low phosphorous impaired

fertility of animals. Deficiency of phosphorous results in delayed maturity, irregular estrous cycles, increased occurrence of cystic ovaries, repeat breeding conditions and low conception rates (Cromwell, 1997) [6]. Phosphorous is also essential for normal sexual behaviour of animal (Kumar, 2003) [18]. 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 (Chaudhary and Singh, 2004) [4].

Selenium (Se): Selenium is a mineral which act as antioxidant whose deficiency results in many complications but if given in excess quantity then in it may cause toxic effect in animals like lameness, sore feet, deformed claws and loss of hairs from tail. In pregnant animals, selenium toxicity will produce abortions, stillbirth, weak and lethargic calves as selenium accumulate in the fetus at the expense of the cow (Patterson *et al*., 2003) [27]. Requirement of selenium for better immune response in dairy animals is 0.3 ppm (Weiss, 2002) [38]. Low level of it, causes weak, silent or irregular estrus, retained fetal membranes, early embryonic death, still birth or weak offspring and abortions in females (Randhawa and Randhawa, 1994) [31] and selenium supplementation in feed results in improving conception rate at first service following (McClure *et al*., 1986) [24]. In sub clinical selenium deficiency, reproductive performance may be reduced with increased number of services needed per conception, high incidence of mastitis and a retained fetal membrane and this may be explained due to the impaired functioning of neutrofils in selenium deficiency (Goff, 2005) [9].

Zinc (Zn): Zinc is an essential mineral which is a component of various enzymes which involved in metabolism, epithelial tissue integrity, cell repair and division, vitamin A and E transport and their utilization (Kumar, 2015) [22]. Deficiency of Zn leads to abortion, fetal mummification and lower birth weight, and it plays a major role in the immune system and certain reproductive hormones (Capuco *et al*., 1990) [3]. Zn has also been shown to increase plasma β-carotene level which is correlated to improvement in conception rates and embryonic development (Short and Adams, 1988) [35]. Zn has also been shown to increase plasma β-carotene level which is correlated to improvement in conception rates and embryonic development (Short and Adams, 1988) [35]. Zinc has a significant role in repair and maintenance of uterine lining following parturition and early return of post-partum estrus (Green *et al*., 1998) [10]. Delayed puberty and lower conception rates, failure of implantation and reduction of litter size are also found in association with the zinc deficiency in feed (Kreplin, 1992) [15].

Copper (Cu): Copper (Cu) is present in and essential for the activity of numerous enzymes, cofactors, and reactive proteins (Suttle, 2010) [36]. Copper deficiency has been associated with delayed or depressed estrus (Phillippo *et al*., 1982) [28]; however, results have been inconsistent. Cu is necessary for production of melanin pigment and interaction of copper and estrogen are also observed. Cu deficiency delayed onset of puberty, repeat breeding, low conception and early embryonic mortality (Nix, 2002). Low fertility associate with delayed or depressed oestrus have been reported in dairy animals which graze on copper deficient pastures (Kreplin *et al*., 1992) [15]. Deficiencies of Cu have also been associated with retained placenta and decreased conception rates and anoestrus (Mudgal *et al*., 2014) [26]. Dairy cows with higher serum Cu levels had significantly less days to first service, fewer services per conception and fewer days to open.

Iodine (I): Reproduction is influenced through iodine's action on the thyroid gland. Inadequate thyroid function reduces conception rate and ovarian activity. Iodine is important for development of foetus and maintenance of general basal metabolic rates. The effect of iodine on secretion of thyrotropin-releasing factor, which in turn stimulates prolactin secretion, can also have effect on length of estrus cycle (Khillare, *et al*., 2007) [14]. Iodine deficiency in herds, leads to impaired fertility and an abnormally high abortion rate (Hetzel, 1990) [12]. Incidence of retained placenta and post-partum genital infections is also high (Hemken, 1960) [11]. Signs of iodine deficiency include delay in puberty, suppressed or irregular estrus (Puls, 1994) [29], failure of fertilization, early embryonic death, still birth with weak calves, abortion, increased frequency of retained placenta in females and decrease in libido and deterioration of semen quality in males (Sathish Kumar, 2003) [18].

Manganese (Mn): Manganese have essential role in reproduction, it required for cholesterol synthesis which is necessary for steroids, estrogen, progesterone and testosterone (Kappel and Zidenberg, 1999) [13]. Thus, deficiency of Mn may lead to inhibition of steroids which result in irregular estrus cycles in dairy animals. A deficiency of Mn may be associated with suppression of estrus, cyclic ovaries and reduced conception rate (Patterson *et al*., 2003) [27]. Post-partum anestrus in dairy cows has proven to be reduced following manganese supplementation (Krolak, 1968) [16] so thus the number of services required per conception increased (Rojas, 1965) [32].

In conclusion, the mineral deficiencies cause reproductive disorders, as minerals play an important role in health and reproduction of the dairy animals. Minerals are required to achieve good and better reproductive performance of dairy animals. The Ca, P, Se, Zn, Cu, I and Mn play great role in reproduction either in direct role by repairing endometrial epithelium, role in capacitation and fertilization process or indirect way through helping in routine metabolism process.

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