CHAPTER I

INTRODUCTION

India ranks first in milk production in the world with 121.8 million tones total milk production during 2010-11 with average per capita daily milk availability of 281 grams (Department of Animal Husbandry, Dairying and Fisheries, Government of India), which is significantly low as compared to the developed countries. A major concern in the Indian dairy sector is low animal productivity as the average milk yield of Indian cows is only about 3.4 kilograms a day against a world average of 6.3 kilograms a day. The low animal productivity is mainly due to poor nutrition, health and low genetic potential of the animals. At present, the country faces a net deficit of 62.7 per cent green fodder for livestock (Xth Five Year Plan Document, Government of India). Another important contributory factor for low production is mineral imbalances in soils, forages and dairy animals (McDowell 2003).

At least 16 minerals are nutritionally essential for ruminants and are grouped into macro and micro-minerals. The macro-minerals are calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), potassium (K), chlorine (Cl) and sulfur (S). The micro-minerals are copper (Cu), molybdenum (Mo), zinc (Zn), iron (Fe), manganese (Mn), cobalt (Co), iodine (I), selenium (Se) and chromium (Cr). The essentiality of the minerals rests upon their role as structural and functional components of body organs, metalloenzymes, metalloproteins and hormones, and their involvement in wide range of metabolic processes like maintenance of acid-base balance, osmotic pressure, electric potential across cell membranes and nerves, energy metabolism and cell membrane integrity (Kaneko et al 2008). Therefore, it is imperative that minerals are maintained
within normal levels within the body to promote normal tissue growth, homeostasis, enzyme functions, cell regulation and immune functions. However, under Indian conditions, imbalances of minerals do occur in dairy animals due to deficiency or excess of minerals in soils, low availability of green fodder and lack of awareness about dietary management particularly the mineral supplementation. It was because of this, the studies conducted in different parts of India had reported widespread occurrence of mineral imbalances in dairy animals (Mandal et al 1996, Baruah et al 1998, Singh 1999, Ramana et al 2000, Sharma et al 2006, Tiwary et al 2010).

A severe deficiency of minerals in the dairy animals often occur in clinical form, however a less severe deficiency generally occur in sub-clinical form. The clinical deficiencies of minerals can be identified easily and corrected, but the sub-clinical deficiencies occur more frequently than recognised by most livestock owners due to lack of specific symptoms (Judson and McFarlane 1987, Enjalbert et al 2006). However, the most naturally occurring mineral deficiencies in dairy animals are area specific (Garg et al 2004), which are related to type of soils and water, climate, mineral composition of soils and plants, and agronomic practices (McDowell 2003). Consequently, significant correlation has been observed between mineral status of soils, forages and dairy animals (Sharma et al 2009). So, there is a need to define regional mineral imbalances by systematic mapping survey based upon concurrent analysis of minerals in soils, forages and animals, and this can help in easy identification and correction of sub-clinical mineral imbalances in dairy animals.

Many of the essential minerals had been found in low levels in soils and crops from the Punjab state of India (Nayyar et al 1990). Moreover, the finite nutrient resources
of these soils had exhausted at a faster rate since the ushering of green revolution due to high intensity of cropping that resulted in appearance of macro and micro-mineral deficiencies in these soils. It was because of this, widespread deficiency of many essential minerals viz. Ca, P, Cu, Zn and Mn had been reported in forages grown in different parts of the state (Singh 2000, Chhabra 2006). Consequently, several workers had reported existence of Ca, P, Cu, Zn, I and Mn deficiencies in dairy animals from various parts of Punjab (Randhawa 1993, Singh 1999, Singh 2002a, Mircha 2009). Leg stiffness, lameness, anorexia, chronic debility, pica, anaemia, low milk yield, leucoderma, achromotrichia, nutritional haemoglobinuria, bone disorders and reproductive impairment had been observed in the mineral deficient animals. Similarly, based upon a survey in the Sub-mountainous Kandi belt of Punjab, Singh (2002) concluded that only 13.7 per cent buffaloes and 8.7 per cent crossbred cattle had normal mineral status.

Based upon soil type, rainfall, temperature, vegetation and topography, the state of Punjab had been divided into five agro-eco-subregions viz. Sub-mountain (Siwalik hills), North-eastern undulating, Piedmont and alluvial plain, Central alluvial plain and South-western alluvial plain (Kumar et al 2008). The South-western sub-region, which covers Mukatsar, Bathinda, Mansa and parts of Ferozepur districts differs considerably from the other sub-regions with respect to its soils, climate, groundwater quality and agronomic practices. The soils of the area are predominantly calcareous aridisols developed under hot and arid to semi-arid climatic conditions. The groundwater of this sub-region is highly saline and alkaline, and brackish groundwater had also been observed in some pockets. Moreover, this sub-region is a fluoride (F) endemic area and
recently, Aulakh et al (2009) had reported that the F concentrations in 66.0 per cent groundwater samples from this region were more than the safe limit of 1.0 ppm. He also observed considerably higher arsenic (As) concentrations that varied from 11.0 to 688.0 ppb in the same groundwater. It was because of this, the existence of bovine fluorosis had been reported in the past in this sub-region by few workers (Sharma et al 1997, Singh 2006).

Fluorosis, a serious health hazard for humans and animals, is endemic in many parts of the world including India (Khandare et al 2005). Animals particularly the ruminants are more susceptible to fluorosis due to higher water intakes with longer food and water retention in the gastrointestinal tract. Following absorption, about 99.0 per cent of the F gets deposited in skeletal tissues and produce osteofluorotic lesions characterised by overt dental and bone lesions, lameness, deformed hooves, anaemia, loss of body condition and emaciation (Radostits et al 2007). Moreover, the F being a strong electro-negative ion interacts with many cations like Ca, P, Mg, Cu and Zn, and affects their metabolism negatively. This interaction of F with other minerals possibly plays a role in pathogenesis of chronic F intoxication and also results in appearance of essential mineral imbalances in dairy animals.

Considering the agro-ecological status of the South-west sub-region of Punjab, which is characterised by high environmental temperature, low rain fall, shorter fodder growing period length along with poor quality of groundwater having high F contents, there is a possibility of existence of mineral imbalances and related health problems in dairy animals of this region. Although, few previous workers had observed existence of fluorosis in dairy animals of this region (Sharma et al 1997, Singh 2006), but a
comprehensive work pertaining to assessment of mineral status of animals in relation to soils, water and forages of the area, and its implications on health and productivity of animals leading to development of effective preventive or curative measures was lacking.

Keeping these points in view, the present study was designed with the following objectives,

1. To conduct base line survey on mineral imbalances in dairy animals of Mansa and Ferozepur districts of South-Western agro-ecological sub-region of Punjab.
2. To study clinical and biochemical profile in natural cases of mineral imbalances in dairy animals.
3. To evaluate dose response of therapy in animals with specifically identified mineral imbalance.