

## CHAPTER I

### INTRODUCTION

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Mineral elements have a great diversity of uses within the animal body. Generally, they are essential for growth, reproduction and health status (Underwood, 1981). Notably, they are involved in a variety of digestive, physiological and biosynthetic processes. For example, they are structural components of the skeletal anatomy of the body, (i.e., in muscles, bones, teeth, etc), constituents of body fluids (electrolytes) and components or activators of enzymes, coenzymes and hormonal mechanisms, (Underwood, 1981; Boland, 2003). In these functions, either each element acts singly or in combination with the others (Underwood and Suttle, 1999; Van Ryssen, 2000). Hence a number of inorganic elements are essential for the maintenance of normal animal health and optimum productive performance. Those required in gram quantities are referred to as macrominerals (major, or macro elements) and they include calcium, phosphorus, potassium, sodium, chlorine, magnesium and sulphur (Boland 2003). Whereas, those required in milligrams or microgram amounts are referred to as trace minerals (microelements) (Underwood and Suttle 2001). This group includes iron, iodine, zinc, copper, manganese, cobalt, molybdenum and selenium. Occasionally, other beneficial elements include chromium, fluorine, boron, lithium, nickel, silicon, tin, vanadium, etc. (Nielsen, 2000; Underwood and Suttle 2001; Boland 2003). These minerals cannot be synthesised by the body tissues or gastrointestinal microflora of the animal. Thus, they should be adequately present in bio-available form(s) in the nutrition of animals, so as to optimize the production of

the highest quality product, while minimizing any adverse effects on the health and welfare of animals (Harmon, 1998).

Problems with mineral nutrition in animals can occur as deficiencies, excesses and imbalances (Šlosárková et al., 1999; Van Ryssen, 2000; Paulíková et al., 2002). High concentrations of copper, fluorine, manganese, molybdenum and selenium, some of them at toxic levels, occur in certain regions of the world where they result in various production problems in grazing animals (McDowell and Conrad, 1989). Mineral deficiency problems involving these elements, are known to affect livestock health and productivity (Meyer et al., 2000; Boland, 2003).

Iodine is a good example of a trace mineral whose deficiency creates a disease that is easily corrected by resupplying the mineral in the nutrition. This element is used by the thyroid gland for the biosynthesis of thyroid hormones (Thilly et al., 1992). Through these hormones, iodine is involved in controlling the basal metabolism rate (BMR), anaemia, cell growth and maturation, and the development and growth of tissues (Hetzl, 1989). Thus, iodine deficiency can lead to serious adverse effects. These include goitre (hyperplastic thyroid/hypothyroidism), reproductive failure, weak, and/or hairless calves, reduced milk yield, mastitis, abnormal respiration and reduced growth rate (Hidiroglou, 1979; Anke et al., 1993). Toxicity of iodine seldom results from natural diet. However, severe or fatal intoxication (iodism) occurs in calves after prolonged supplementation or using it in drug therapy (Mangkoewidjojo et al., 1980; Paulíková et al., 2002). Iodism in cattle is generally manifested by persistent cough, hyperthermia, naso-ocular discharge, anorexia, abortion, pneumonia, excessive salivation and bone/ tendon deformities (Paulíková et al., 2002).

Iodine deficiency syndromes in humans have been documented as endemic in many parts of Zimbabwe. Proportionally, human goitre of between 25% and 75% has been reported in Zimbabwe (Todd et al., 1989; Mutamba, 1993) rendering this condition to be of public health importance. Methodological problems however, may have led to the overestimation of these proportions in some areas (Mutamba, 1993). Results of qualitative clinical assessment showed high rates of severe total goitre in Mashonaland East and Central and in Masvingo. According to the 1988 national goitre survey (Mutamba, 1993), the least affected province was Matebeleland South. Based on the results from a study carried out in Wedza and Chinamhora, Todd and Bourdeux (1991) hypothesised that the problem of endemic goitre was due to a simple environmental deficiency. Mutamba (1993) and Todd et al., 1989) showed that girls were more affected than boys. Communities studied in these cases were rural, who were mostly small-holder farmers, and therefore whose livelihoods depended a lot on farm produce, including cereals and vegetables as well as on natural, ground water supplies. Dent et al., (1968) noted high consumption levels of brassicaes such as rape and cabbages, which contain goittrin, an iodine inhibitor.

This endemic status of iodine deficiency in human populations closely subsisting on the environment, can therefore be hypothesised to indicate a similar deficiency in animals as they are much, if not more directly dependant on the environment for food and water. While food animals are known to be able to concentrate iodine metabolically, their meat and milk (Hemken, 1980) may either be deficient or contain inadequate iodine for humans. The country's general state of food self-sufficiency at the time, also meant that there was generally limited access to exotic iodine-rich foods. This could however have changed as there began to be increases in

importation of low priced sea fish since 1993, in addition to a policy of iodisation of all household salt marketed in the country. Supplementation of iodine to the human population is not likely to influence the levels of iodine in livestock significantly as the opportunities for spillage are minimal, and sanitation levels have improved substantially with the expansion of public health programs including construction of latrines.

Intake levels of iodine from natural pasture in Zimbabwe are as yet unknown. However, results by Rudert and O'Donovan (1974) showed that star grass (*Cynodon aethiopicus*) pastures that contained 0.027ppm iodide by dry weight, were deficient for sheep. Little else is known of the extent and effect of endemic iodine deficiency in animals in Zimbabwe. However, a lack of success for many years with investigations into problems of infertility in range cattle, a large proportion of which would appear to be from non-infectious causes and remain unresolved, could partly be explained by such mineral imbalance problems. Secondly, selenium deficiencies have been reported in the middle and high veld (Ushewokunze-Obatolu, 1988) which suggest that secondary hypothyroidism (Arthur et al., 1988) could potentially occur in these areas. As the patterns of human goitre suggest an endemic, environmentally related iodine deficiency problem, nearly 70% of the national cattle herd and a significant proportion (90%) of the national population of goats, which are mainly in the resource-poor, small-holder communal areas, may be at risk to iodine deficiency. The economic implications on production losses could be considerable. Growing interest among researchers coupled with the national agricultural policy geared at improving production in these areas have created greater focus on mineral nutrition.

The premise of this work was the hypothesis that low environmental iodine levels in the country lead to endemic hypothyroidism that affects productivity particularly in cattle and goats, which are of major national food security importance. Diagnosis of the iodine status in animals could enable farm management take appropriate corrective measures.

The goal of this study was therefore to assess the factors associated with iodine nutrition in livestock. In the process, the patterns of iodine levels in cattle and goats, the factors associated with variations of iodine levels, and the effects of corrective interventions were evaluated. A major prerequisite of this epidemiologic study was investigation of suitability of various routine diagnostic procedures in determining iodine levels in field animals.