CHAPTER V

DISCUSSION

The records of control values of heart rate, respiratory rate and rectal temperature in this experiment are within the range reported by Pandey and Roy (1969a,b). After exposure to heat, cardiorespiratory frequency increased stepwise with an increase in environmental temperature. These results are similar to those of previous studies in buffaloes after sun exposure (Mullick, 1960; Moran, 1973; Tilakaratne *et al*., 1982; Chaiyabutr *et al*., 1983), which show that the buffalo is affected by heat stress having rapid responses in cardiorespiratory frequency. Some physiological responses were observed in buffaloes after a few hours of heat exposure. The animals showed signs of distress, salivation and panting. These signs indicate a part of process of evaporative heat loss for maintenance of body temperature as the ambient temperature rises. Cutaneous evaporative heat loss may not occur in the buffalo, because of thickness and less density of sweat gland of the skin (Hafez *et al*., 1955; Prusty, 1965). For these reasons, it will cause heat accumulation which associates with a higher rectal temperature. Because of these reasons, the buffalo needs to wallow and drink more water under hot environment in order to help its heat dissipation.

The control values of packed cell volume, plasma volume and blood volume are in agreement with those reported by Pandey and Roy (1969 c). Short exposure of buffaloes to heat stress produces haemodilution which causes a tendency to decrease in haematocrit values while a tendency to increase in blood and plasma volumes. The increment of blood and plasma volumes were reported in cattle exposed to a higher temperature (Bianca, 1957) and in buffalo cows (Murti and Mullick, 1961; Garg and Nangia, 1956). The same results of increase in plasma and blood volumes were also found by Sodhi and Singh (1974) in buffalo calves under stress of exercise. It has been suggested that heat acclimatization of animals is associated with increase in the extracellular fluid (Bass and Henschel, 1956; Pandey and Roy, 1968). In this study, fractional excretion of sodium of urine has a tendency to decrease which may cause retention of sodium into circulation. Sodium retention coincide with a decrease of urine volume may cause an increase in plasma volume. Another possibility of the plasma volume expansion during hot weather may have resulted from transferring of more of extravascular fluid into the circulation (Garg and Nangia, 1981). This phenomenon could occur in heat stressed buffalo since blood is of great importance in the dissipation of heat.

The data on total body water, water turnover rate and biological half-life of tritiated water under control period are slightly higher than those reported by other workers for buffaloes (Ranjhan et al., 1982; Ranawana et al., 1982). Prolonged exposure to higher environmental temperature caused the increment of total body water and water turnover rate (Kamal, 1982 a) of camel (Ghosal et al., 1974) and buffalo (Kamal, 1982 b). Beef cattle (Springell, 1968) and buffalo (Ranjhan et al., 1982) had the lower mean half-life of tritiated water in summer than in winter. The lost of water via urine and respiratory vaporization under heat stress caused the increment of body fluid concentration which stimulate the thirst center in hypothalamus (Kamal and Seif, 1969). These resulted in increment of water consumption (Seif et al., 1973) which caused the elevation of total body water of the animal. Buffalo had the higher turnover rate of water than other ruminants (King, 1979), indicating higher water requirement for evaporative cooling (MacFarlane, 1964) in order to have more evaporative heat loss, which is essential for maintenance of body temperature (Ranjhan et al., 1982). For the present study, six hours of heat exposure in control-temperature room might not be severe enough to cause the significant change in total body water but resultant in two-folded increased in water turnover rate and lower mean half-life approximately one-half of tritiated water which are in agreement with those of other workers (Kamal, 1982 a; Ranjhan et al., 1982).

The volumes of ruminal fluid per 100 kg of body weight and its outflow rate under control condition in this experiment are approximately in the range reported for buffalo by Rana and Langar (1980). The data of ruminal fluid volume per 100 kg of body weight of cows were about the same range of those of buffalo (Davis, 1967). The data of ruminal fluid volume of buffalo under heat stress condition have not ever been reported before. In this experiment, acute heat stress has no effect on the change of ruminal fluid volume but causes an increase in the rate of ruminal fluid outflow by approximately 150%. Smith (1959) found the continuous flow of rumen liquor into the abomasum so that it would be possible for digestion and/or absorption in the remainder of the alimentary tract. This can suggest that the increment of the rate of ruminal fluid outflow after heat stress is associated with the increase in absorption of water along the alimentary tract. The increase in absorption of water results in elevation of plasma volume of animals which enhances the mechanism of their heat dissipation.

The concentration of sodium, potassium and chloride of ruminal fluid in this experiment do not change after heat stress which indicates that heat stress has no effect on electrolyte absorption in the rumen.

The normal values for plasma sodium, potassium and chloride concentration in the present experiment are in agreement with those obtained from buffalo cows by Pandey and Roy (1969 c), and Rangachar (1978). Bhutani and Nangia (1975) reported the decrease of blood level of sodium and chloride under stressful condition of water deprivation while the level of potassium did not significantly change. Sodhi and Singh (1974) also found the same results in buffalo calves after stress of exercise. In the present study, plasma concentration of electrolytes after heat stress remain constant indicating that animals have physiological homeostasis in maintaining the plasma level of electrolytes. The parameter which expresses urinary electrolytes excretion in the present study is fractional excretion of electrolytes. The values of urinary creatinine/plasma creatinine ratio after heat stress significantly increased, indicating more excretion of creatinine in urine while the levels of creatinine in plasma are slightly increased. This result shows that reabsorption of water has occurred in the kidney. After heat exposure of buffalo, fractional excretion of sodium and potassium tend to decrease whereas that of chloride significantly decreased. Chaiyabutr <u>et al</u>., (1983).

reported that the results of changes in electrolytes excretion were not caused by changes of filtered load (GFR x plasma electrolyte concentrations) which remained constant during heat exposure. The changes in electrolytes excretion would result from changes of activity of renal tubular cell. There was the evidence suggesting that man exposed to a hot environment lead to an increase in aldosterone and a reduction in sodium loss in urine (Collins et al., 1955). In man the salt normally lost from sweating is more severe than other animals during heat exposure. The decrease in plasma sodium concentration may stimulate aldosterone secretion (Ingram and Mount, 1975). The endocrinologic events, particularly aldosterone and to some extent antidiuretic hormone (ADH) secretion, accompanying heat stress in buffaloes are barely examined. Regulation of the volume and composition of extracellular fluid requires participation of aldosterone as well as ADH. The present result indicates that the fractional excretion of sodium tends to decrease which contrast to the report of Collins and Weiner (1968) in heated sheep in illustrating an increase in sodium loss. The heat stressed buffaloes in this experiment had a tendency to increase plasma levels of aldosterone. The contrast evidence to this experiment is the report of El-Nouty et al., (1980). They reported the decrease in aldosterone during heat exposure in cattle and found a significant reduction in plasma aldosterone levels after 24 hours of heat exposure. Collins and Weiner suggested that the role of aldosterone may be in the long-term adjustments of salt and water balance on exposure to heat. From their suggestions, the short term of heat exposure in the present study (6 hours) and a short half life of aldosterone (8 min) might not cause a significant change in the levels of plasma aldosterone. The results of a tendency to decrease in fractional excretion of electrolytes while plasma aldosterone levels have a tendency to increase will be discussed as follow. These results indicate that aldosterone levels which tend to increase have the effect on urinary electrolyte excretion (Kenyon et al., 1983). Normally, the diet of the ruminants compared with that of man and the dog, is high in potassium and low in sodium contents (Morrison, 1951). Moreover, the main electrolytes loss via kidney and salivary gland in buffalo may be sodium as same as in the sheep (Collins and Weiner, 1968). Thus, the increase in aldosterone secretion during heat exposure of buffalo in this experiment causes the decrement of sodium excretion in urine which contributes to the higher extracellular fluid volume; plasma and blood volume (Seif et al., 1973).