SERUM ELECTROLYTES UNDER DIFFERENT AMBIENT TEMPERATURES

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Male albino rats of average body weight 110—120 gm were used in the experiment. Control group of rats were maintained at room temperature (27°–28°C) and the experimental groups were exposed to high ambient temperatures (40°, 42° and 44°C) for different durations of time. $Na+$, $K+$, and $Cl-$ concentrations in serum and the packed cell volume (PCV) percentage was determined in each case. It was found that the concentration of serum $Na+$ and $Cl-$ increased markedly with high ambient temperature and increased duration of exposure. Serum $K+$ concentration increased slightly and the PCV percentage showed marked increase in the heat treated groups.

Cells contain sodium, potassium and chloride ions and exchange of the ions between cells and extracellular fluids depends upon the various diseases and stress conditions[1]. Some workers[2] maintained that haemoconcentration or haemodilution are the two main factors for body electrolyte changes whereas other[3] showed this to be due to hypo or hyper activity of glands influenced by the temperature change. Barbour[4] group made extensive studies of the effects of hyperthermic stress and showed that the haemodilution was one of the earliest responses of the body fluids with increased plasma and blood volume with little change in composition. Horstman[5] *et. al.* exposed a few male subjects to a very hot temperature (48°C for 7 hours) and found decreased in blood volume and plasma volume with dehydration. Many workers[6—9] observed increase in serum sodium and chloride concentration in hot environments while others[10] reported a low sodium value and a stable chloride concentration. Various workers[11—12] noticed an increase in serum potassium level in hyperthermic conditions whereas decrease in serum potassium concentration have also been reported[13—15]. The aim of the current investigation is to ascertain how variation in ambient temperature disturbs the body electrolyte balance.

MATERIALS AND METHODS

Male albino rats (Sprague Dawley strain) of body weight 110-120 gm, taken from the leboratory stock, were used. All rats were provided with standard diet[16] and water *ad. libitum*. Food and water were with-held since morning of the experiment. The control group of animals were maintained at room temperature (27°-28°C). The experimental rats were exposed to high ambient temperatures (40°, 42° and 44° C) with a constant relative humidity (*RH*) of 48-50% and wind speed of 0.3 m/sec for different durations of time. For each high ambient temperature, different groups of rats were taken and were exposed for 1 hr, 2 hrs and 3 hrs respectively. Fresh rats were taken each time to avoid chances of adaptation. Blood samples were drawn by heart puncture under light ether anaesthesia and collected under liquid paraffin. Sodium and potassium of the serum were determined by standard flame photometric method[17]. Serum chloride was determined by the method of king and Bain[18]. Packed cell volume percentage was determined by using a special mixture[19] of ammonium oxalate (3 parts) and potassium oxalate (2 parts), as an anticoagulant, as it causes no change in red cell volume. Blood was drawn in haematocrit tubes containing the dry anticoagulant and was centrifuged at 1500 r. p. m. for 30 minutes.

RESULTS AND DISCUSSIONS

The results of sodium, potassium and chloride concentration in serum and PCV% at different ambient temperatures are shown in the figures[1—4]. It was found that serum sodium concentration was increased by 0.6%, 2·2% and 4.2% at 40°C and 3.0%. 4·7% and 7.0% at 42°C and the increase at 44°C was 6.0%

8·2% and 10·3% respectively after 1 hr 2 hrs, and 3 hrs of exposure. The results were statistically significant (Fig. 1). Serum potassium concentration was also increased to a small extent after the various heat exposures but in all the cases, the increases were statistically non-significant (Fig. 2). Rise in serum chloride concentrations by 2·5%, 5% and 8% at 40°C and 5·3%, 8% and 10·2% at 42°C and 7%, 9·5% and 12% at 44°C were noted after exposing for 1 hr, 2 hrs and 3 hrs respectively. The results were statistically significant (Fig. 3). Increase in PCV% by 11% and 16% at 40°C and 17% and 23% at 42°C and 22% and 26% at 44°C after exposure for 1 hr and 2 hrs respectively was observed. The results were statistically significant (Fig. 4). Results in the Figures 1 and 3 show that there have been a linear rise in serum sodium and chloride concentration with the rise in ambient temperature but serum potassium (Fig. 2) showed only a marginal non-significant rise.

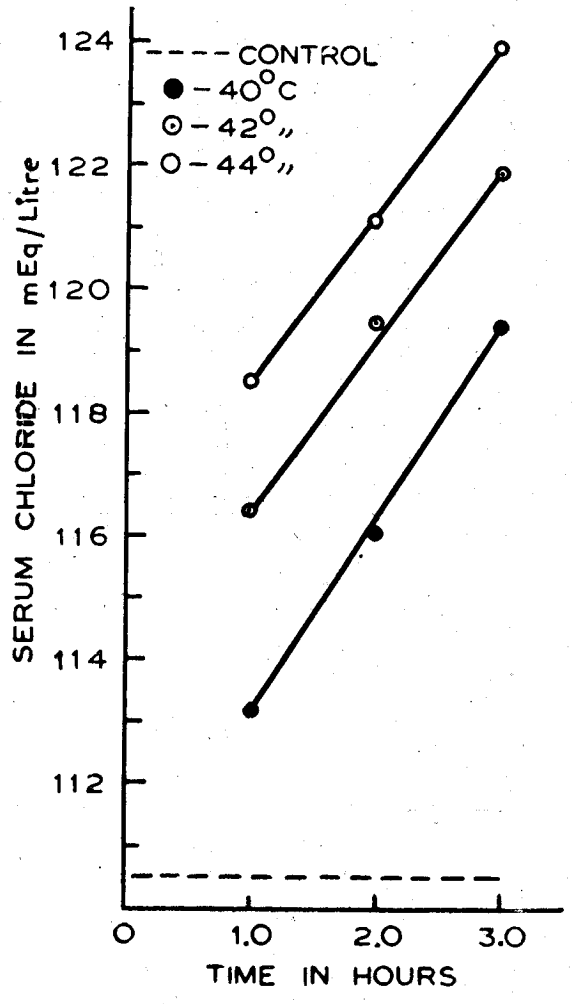

Fig. 1—Changes in serum sodium concentration due to changes in time rate in hot ambient temperatures (40°, 42° & 44°C).

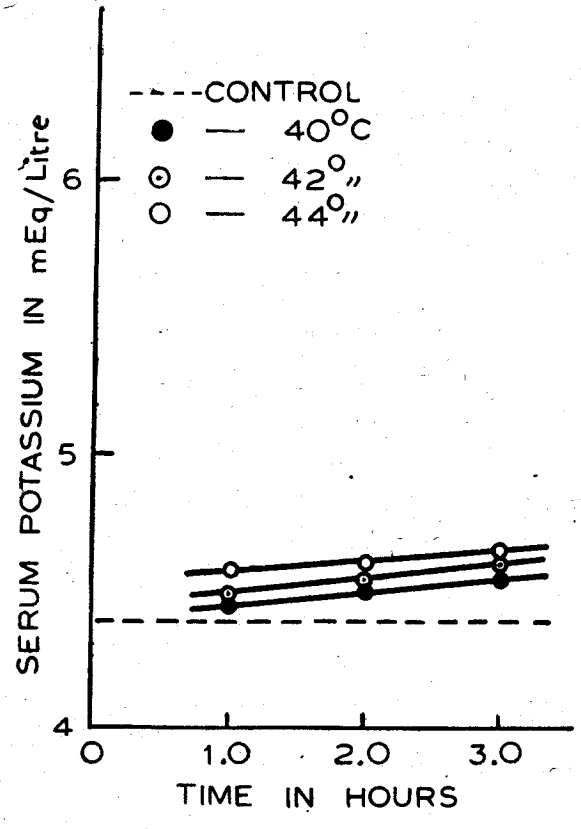

Fig. 2—Changes in serum potassium concentration due to changes in time rate in hot ambient temperatures (40°, 42° & 44°C).

Various workers[6-9] have shown that the sodium is the main index for electrolyte balance and variable with ambient temperature change and that chloride is more or less stable. In the present case, the finding regarding sodium level is in the similar line as observed by the above references, the findings on chloride level differs substantially. In the present study, a marked increase in chloride level have been noted. The reports on potassium[11-15] are conflicting. In the present investigation, serum potassium showed a slight increase which was statistically non-significant. This shows, as compared to sodium and chloride, that the percentage loss of potassium is substantially high. In the present investigation, high sodium and chloride concentration in serum are obviously due to reduction in the plasma volume as indicated by the higher haematocrit value (Fig. 4). Moreover, it is noted that percentage increase of haematocrit value is much more than that of Na^+ level. In other words, high extent of dehydration is not accompanied by equal increase in Na^+ level. This indicates that there has been active loss of Na^+. This is also true though to a lesser degree for chloride. Serum level of potassium has not practically increased where as level of Na^+ has increased to some extent. Thus the extent of loss of potassium is more drastic in heat stress of

unadapted rats. With access to free drinking water, the level of all these ions in serum will go lower than normal. Replacement of these ions is, therefore, important in case of sudden heat stress. In a tropical country like ours, replacement of the lost potassium should receive great attention. Replacement of sodium and chloride also seem to be needed.

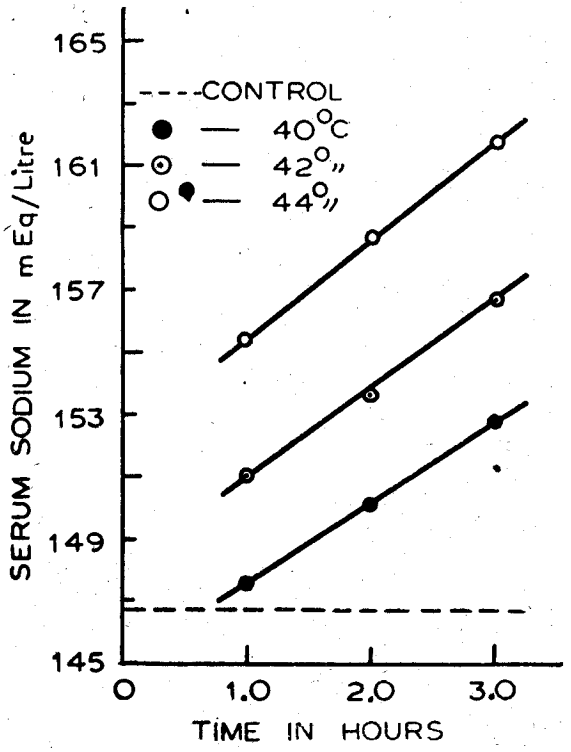

Fig. 3—Changes in serum chloride concentration due to changes in time rate in hot ambient temperatures (40°, 42° & 44°C).

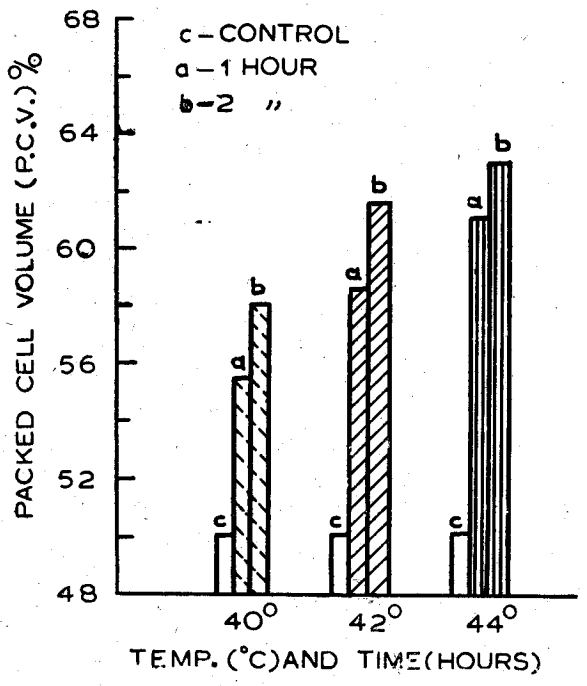

Fig. 4—Changes in PCV% due to changes in time rate in hot ambient temperatures (40°, 42° & 44°C).

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