THE EFFECT OF A POTASSIUM-LOW DIET ON THE SURVIVAL TIME OF ADRENALECTOMIZED RATS

Donald L. Alcott and H. Douglas McEwen
University of South Dakota

It has been shown that, under certain conditions, potassium has toxic effects[1]. These effects are especially marked in adrenalectomized animals. Other investigators[2,3] have shown that the adrenalectomized animal can be maintained by feeding a diet high in sodium and low in potassium content. It occurred to us that the survival time of the adrenalectomized animal might be prolonged by restriction of dietary potassium **without** the administration of excessive amounts of sodium. This hypothesis has been submitted to experimental trial in the experiments reported below.

Procedure

Albino rats of two different strains, Wistar and Wisconsin, were used as experimental animals. Under ether anesthesia, and using the method of lumbar approach, bilateral adrenalectomy was performed. Care was taken to reduce operative shock to a minimum. Following the operation, the rats were placed in individual cages so that daily food and water consumption could be determined.

The potassium-low diet was devised by Heppel[4]. This diet formula was reproduced with the exception of its content of liver extract. Its composition is as follows: sucrose 52, lard 12, casein 26, salt mixture 4, Vitab rice-bran concentrate 3, cod liver oil 2, and wheat germ oil 1. The salt mixture was prepared from C.P. salts and contained adequate amounts of all mineral elements except potassium. For the diet containing potassium fed to the control animals a normal amount of potassium phosphate was added to Heppel's salt mixture.

[1] "Factors affecting the toxicity of potassium." Winkler, A. W.; Hoff, H. E.; Smith, P. K. American Journal of Physiology, 127, 430, 1939.

[2] "Clinical and Chemical observations on adrenalectomized dogs maintained by a diet high in sodium salts and low in potassium salts." Cleghorn, R. A.; Armstrong, C. W. S.; Austen, D. C. Endocrinology, 25, 888, 1939.

[3] "Cortical Insufficiency: Metabolism studies on potassium, sodium, and chloride." Nilson, H. W. American Journal of Physiology, 118, 620, 1937.

[4] "The electrolytes of muscle and liver in potassium depleted rats." Heppel, L. A. American Journal of Physiology, 127, 385, 1939.

Several other details concerning the preparation of the diet deserve mention. To render the casein potassium free, it was extracted with 0.2 per cent acetic acid. This was done in 2,000 cc. cylinders by adding to each cylinder 200 gm. of casein, then filling to the mark with acetic acid. The cylinder was then stoppered and inverted several times with shaking. After the casein had settled out, the supernatant fluid was drawn off by suction and discarded. This process was repeated ten times with fresh portions of acetic acid. Following the washing with acetic acid, the casein was washed three times with 95 per cent ethyl alcohol and then dried over a radiator.

The Vitab was rendered potassium free by mixing 100 cc. with 370 cc. of 70 per cent ethyl alcohol and precipitating the potassium with tartaric acid. After standing overnight in the ice-box the mixture was filtered. The filtrate was evaporated to about its original volume in a vacuum still at a temperature not over 50 degrees Centrigrade. The lard was melted and extracted four times with an equal volume of hot distilled water.

Experimental Results

Before considering the results with adrenalectomized animals some growth curves of unoperated animals on the above potassium-low diet may be of interest. In Figure 1 are shown growth curves for four animals which were placed on the potassium-low diet. The character of the curve is striking. The body weight of the animals was maintained almost constant for a period of 50 days. Food consumption records over this period showed that the animals consumed about half the amount of food normally consumed by the rat. As the curves show, the addition of potassium to the diet at the end of 50 days resulted in an upturn in the growth curve in each case.

The results obtained with the adrenalectomized animals are shown in Figure 2. The body weights given are those at operation. The survival time was estimated as closely as

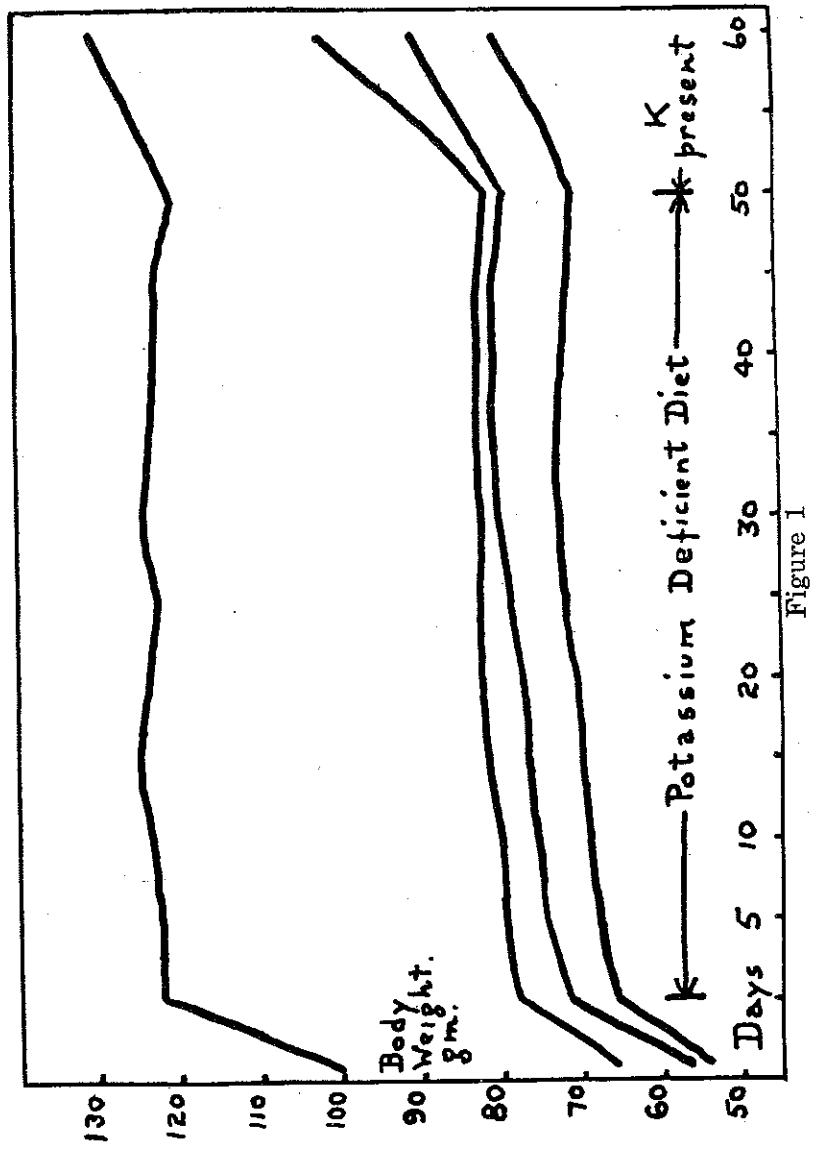

Figure 1

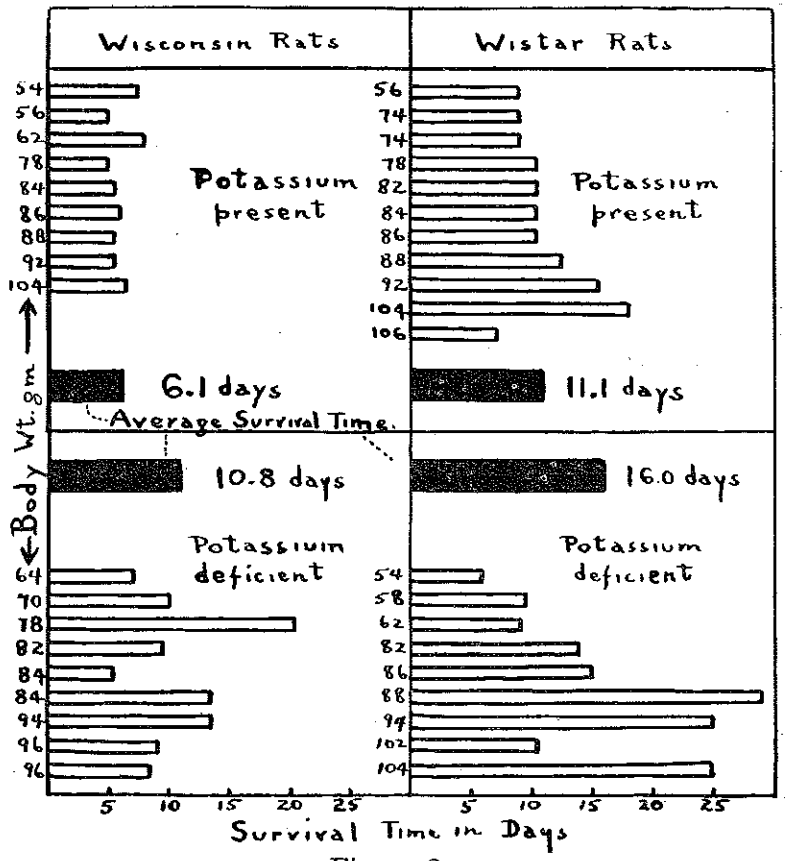

Figure 2

possible for each animal. The weight spread for each of the four groups of animals is approximately the same. To compare the rats on the potassium-low diet with those receiving potassium a simple average was taken including all animals in each group.

Discussion

We are well aware of the fact that the number of animals used in these experiments is insufficient to allow statistical evaluation of the results. Further work, involving a greater number of animals, is in progress. However, the results obtained so far favor our hypothesis that a mere deficiency of

potassium in the diet increases the survival time of the adrenalectomized rat.

Summary

In some preliminary experiments, it has been demonstrated that the survival time of adrenalectomized rats may be increased by excluding potassium from their diet **without** a concomitant increase in sodium. Rats of the Wisconsin strain survived an average of 6.1 days when potassium was present in the diet in normal amounts. This survival time was increased to 10.8 days on the potassium deficient diet. Rats of the Wistar strain survived 11.1 days on the potassium containing diet and 16 days on the potassium deficient diet.