

## SHORT COMMUNICATION

### **Uptake of potassium by erythrocytes in relation to their glucose consumption**

In 1923 and 1924 BRIGGS *et al.*<sup>1</sup> and HARROP AND BENEDICT<sup>2</sup> found a decrease in serum potassium after administration of insulin to normal or diabetic men. Later it was shown that this effect is due to a displacement of potassium from the extracellular to the intracellular space. Administration of glucose likewise resulted in a decrease of serum potassium<sup>3</sup>.

In 1942 BOYER *et al.*<sup>4</sup> demonstrated that there is a relationship between muscle glycolysis and potassium. That a similar relationship exists in the case of human erythrocytes was confirmed by PRANKERD<sup>5</sup> in 1955.

In 1941 DANOWSKI<sup>6</sup> found that the uptake of potassium by human erythrocytes is related to their glucose consumption.

We became interested in the question whether this potassium uptake by the red cells is an index of their glycolytic activity. Years ago it was demonstrated, that in diabetic red cells glycolysis is lowered<sup>7</sup>; in some other diseases, however, blood glycolysis may be elevated<sup>8</sup>.

The method used in the investigation was as follows: blood from fasting men was collected with heparin (0.05 mg/ml) under liquid paraffin, separated into several parts, also under paraffin, incubated at 37° and periodically gently mixed. The potassium content of the plasma was measured with an interference flame photometer (Kipp, Delft, 1954); the glucose content was determined according to the method of Hagedorn and Jensen. Determinations were carried out after 0, 3, 6 and 26 hours, the first determination being within 10 minutes after withdrawal of the blood.

For 10 normal males we found at zero time a plasma potassium content of  $4.08 \pm 0.05$  mequiv./l and a glucose content of  $93.5 \pm 0.77$  mg/100 ml; the potassium concentrations after 3, 6 and 26 hours were  $3.53 \pm 0.06$ ,  $3.55 \pm 0.06$  and  $6.77 \pm$

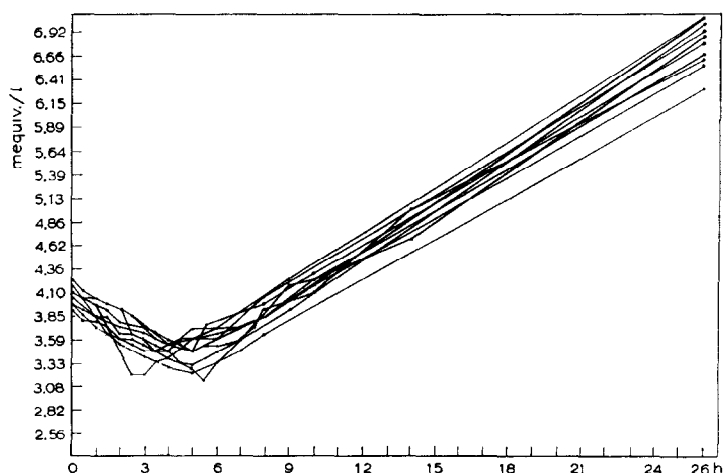


Fig. 1. Potassium content of plasma of 10 normal males.

0.09 mequiv./l (Fig. 1); the glucose had completely disappeared from the plasma after 7-8 hours.

The maximal potassium uptake was 13.4% of the zero values, the corresponding glucose consumption rate was 12.5 mg/h/100 ml blood. In 26 normal individuals, there was a remarkable correlation between the potassium uptake of the red cells and their glucose consumption rate (Fig. 2).

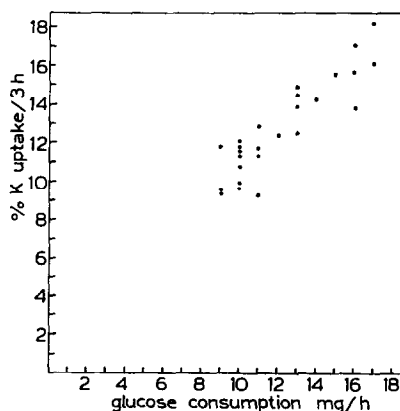


Fig. 2. Relation between the potassium uptake of red cells and their glucose consumption rate.

When the plasma glucose had vanished, the cells began to lose their potassium at an almost linear rate in the first 20 hours.

We also determined the potassium uptake and glucose consumption rate of fasting blood from patients with various diseases (Table I).

TABLE I

Number of patients	Disease	mequiv./K/l plasma				Max. K uptake %	Glucose consumption rate mg/h
		0 h	3 h	6 h	26 h		
9	Insulin hyper-sensitivity	4.20	3.58	3.18	6.50	24.0	20.1
7	Hepatitis inf.	4.40	3.62	3.51	7.64	20.9	17.3
8	Hemolytic anemia	4.00	3.28	3.18	7.66	20.5	17.9
6	Hyperthyreosis	4.60	3.90	3.85	5.58	17.2	16.9
4	Asthma	4.34	3.78	3.62	6.41	17.0	15.9
7	Carcinoma	4.51	4.00	3.85	6.85	15.2	16.0
10	Normal individuals	4.08	3.52	3.53	6.77	13.4	12.5
6	Asthma (attacks)	3.85	3.41	3.41	5.00	11.2	10.3
15	Diabetes mell.	4.30	3.89	3.82	5.25	8.9	7.5
7	Hypocho. anemia	4.37	4.00	3.97	6.47	8.8	9.1
8	Acidotic diabetes mell.	4.35	4.05	4.00	4.61	7.0	6.3
7	Renal insuff.	4.60	4.50	4.34	7.05	5.5	9.2
12	Diseases requiring therapeutic cortison doses	3.85	3.61	3.61	5.25	5.4	6.9
18	Cirrhosis hepatis	3.85	3.61	3.72	5.21	4.0	5.5
5	M. Addisoni	4.21	4.13	4.28	5.21	2.1	4.7
5	Hypokalemia	3.07	3.03	3.19	3.85	0.85	5.6

From this table it can be seen that the red cells can be divided into a group with normal potassium uptake activity as compared with normal cells, a group with a

potassium uptake and glucose consumption rate statistically higher than normal, and a group with a much smaller uptake.

We found from the figures that there was a correlation between the rate of the potassium uptake by human erythrocytes and their glucose consumption rate.

Therefore this potassium uptake test seems to us a valuable method of determining the metabolic activity of the red cells under various conditions.

*Medical Clinic,  
University of Utrecht (The Netherlands)*

A. J. HOUTSMULLER

<sup>1</sup> A. P. BRIGGS, J. KOECHIG, E. A. DOISY AND C. J. WEBER, *J. Biol. Chem.*, 58 (1923) 721.

<sup>2</sup> G. A. HARROP AND E. M. BENEDICT, *J. Biol. Chem.*, 59 (1924) 683.

<sup>3</sup> J. GROEN, A. F. WILLEBRANDS, CHR. E. KAMMINGA AND M. FRENKEL, *Chem. Weekblad*, 14 (1951) 201.

<sup>4</sup> P. D. BOYER, H. A. LARDY AND P. H. PHILLIPS, *J. Biol. Chem.*, 146 (1942) 673.

<sup>5</sup> T. A. J. PRANKERD, *Clin. Sci.*, 14 (1955) 633.

<sup>6</sup> TH. S. DANOWSKI, *J. Biol. Chem.*, 139 (1941) 693.

<sup>7</sup> P. B. VAN STEENIS, *Thesis*, Univ. of Utrecht, 1924.

<sup>8</sup> J. E. ULTMANN, G. A. HYMAN, J. L. HARVEY AND A. R. DENTE, *Blood*, 12 (1957) 1114.

Received January 19th, 1959