XIX. NOTE ON THE PERMEABILITY OF THE RED CORPUSCLES FOR AMINO-ACIDS.

BY SHUZO KOZAWA AND NOBU MIYAMOTO.

From the 2nd medical clinic, Medical College, Osaka.

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In previous publications, one of the authors, S. Kozawa [1914, 1919], has shown that the red corpuscles of man and monkey can take up all the hexoses and pentoses, as well as glucosamine. This was proved by chemical analysis and by means of the hematocrit. In connection with this experiment, the permeability of red corpuscles was also tested for amino-acids by means of the hematocrit, and the following results were obtained on the blood of different animals.

Table I.

Time	Alanine	Glycocoll
I. <i>Red corpuscles of man.</i>		
20 minutes	27.2	27.2
6 hours	28.5	27.5
II. <i>Red corpuscles of dog.</i>		
15 minutes	29.0	—
5 hours	27.5	—
III. <i>Red corpuscles of horse.</i>		
10 minutes	28.2	—
2 hours	29.0	—
IV. <i>Red corpuscles of ox.</i>		
10 minutes	25.5	24.0
5 hours	24.0	23.0

These results seemed to show that the red corpuscles were impermeable for amino-acids. The hematocrit test is, however, not so exact as chemical methods. It has been stated by Constantino [1913], who employed the formol method of estimation, that glycocoll, asparagine and the amino-acids obtained by the hydrolysis of caseinogen penetrated in small amounts into the red corpuscles of ox blood. We, therefore, thought it worth while to reinvestigate the permeability of the corpuscles in man, ox, and goat for amino-acids, employing the method of van Slyke [see Plimmer, 1915] for our estimation. For the removal of blood protein, we employed the method of Rosenberg [1914], using a 2 % solution of mercuric chloride, containing 0.8 % HCl.

EXPERIMENTAL.

The amino-acids used in these experiments were isotonic solutions of glycocoll (2.2 %), and histidine (4.7 %). We first determined the quantities of the amino-acids present in normal defibrinated blood and its constituents, namely, the red corpuscles and serum. We then added 0.2 g. of each amino-acid (2.2 % glycocoll solution, 9.0 cc.; 4.7 % histidine solution, 4.25 cc.) to each 30 cc. of defibrinated blood. The mixture was then placed for one hour in an incubator at 38°. The red corpuscles and serum were then separated by means of a powerful centrifuge. The red corpuscles separated in this way still contain a small quantity of serum, which is estimated by means of the hematocrit, and allowed for in the formol estimation. After one hour in the incubator, 5 to 10 cc. of the mixture are taken up with a pipette, the proteins are removed, as already indicated, and the nitrogen contents estimated by the van Slyke method. By this method, glycocoll would give rather larger figures than are actually obtained, but this has been allowed for by reducing the results in the ratio of 105 to 100.

Table II.

I. *Experiments on ox blood.*

A. Normal defibrinated blood.

Kind of blood		Volume of amino-nitrogen (corrected) cc.	Amino-nitrogen in 10 cc. mg.
I.	Defibrinated blood 20 cc.	2.40	0.6936
	Red corpuscles 20 cc. ...	2.15	0.6256
	Serum 20 cc. ...	2.80	0.7989
II.	Defibrinated blood 20 cc.	3.23	0.9173
	Red corpuscles 20 cc. ...	2.80	0.7952
	Serum 20 cc. ...	3.18	0.8991
III.	Defibrinated blood 20 cc.	3.80	1.1105
	Red corpuscles 20 cc. ...	3.50	1.0228
	Serum 20 cc. ...	3.20	0.9884

B. Defibrinated blood 30 cc. with 0.2 g. glycocoll or histidine.

Kind of blood		Volume of amino-nitrogen (corrected) cc.	Further cor- rected with hematocrit volume cc.	Amino-nitrogen in 10 cc. mg.
I.	Red corpuscles with glycocoll 10 cc.	6.93	3.135	1.8386
	Serum with glycocoll 10 cc. ...	22.10	—	12.9285
II.	Red corpuscles with histidine 10 cc.	5.04	3.50	1.9687
	Serum with histidine 10 cc. ...	11.20	—	6.3000
III.	Red corpuscles with histidine 10 cc.	5.17	3.88	2.2756
	Serum with histidine 10 cc. ...	10.34	—	6.0644

II. *Experiments on goat's blood.*

A. Normal defibrinated blood.

Kind of blood	Volume of amino-nitrogen (corrected) cc.	Amino-nitrogen in 10 cc. mg.
Red corpuscles 10 cc. ...	2.66	1.5324
Serum 10 cc. ...	1.98	1.1414

B. Defibrinated blood with amino-acid.

Kind of blood	Volume of amino-nitrogen (corrected) cc.	Further cor- rected with hematocrit volume cc.	Amino-nitrogen in 10 cc. mg
I. { Red corpuscles with glycocoll 10 cc.	8.84	5.13	2.9420
{ Serum with glycocoll 10 cc. ...	23.66	—	13.5350
II. { Red corpuscles with histidine 10 cc.	6.60	5.60	3.2284
{ Serum with histidine 10 cc. ...	10.64	—	6.1339

III. *Experiments on human blood.*

A. Normal defibrinated blood.

Kind of blood	Volume of amino-nitrogen (corrected) cc.	Amino-nitrogen in 10 cc. mg.
Blood 5 cc. ...	1.16	1.36996
Red corpuscles 5 cc. ...	1.17	1.39814
Serum 10 cc. ...	2.20	1.31450

B. Defibrinated blood with amino-acid.

Kind of blood	Volume of amino-nitrogen (corrected) cc.	Further cor- rected with hematocrit volume cc.	Amino-nitrogen in 10 cc. mg.
I. { Red corpuscles with glycocoll 10 cc.	10.08	7.10	4.1748
{ Serum with glycocoll 10 cc. ...	21.84	—	12.8184
II. { Red corpuscles with histidine 10 cc.	6.88	5.02	2.9317
{ Serum with histidine 10 cc. ...	14.30	—	8.3512

It is evident from the results of these tables, that the amino-acid content of the red corpuscles undergoes a considerable increase on the addition of amino-acids to the whole blood. In the experiments given, the corresponding content of amino-acids was raised to two or three times the normal amount, and was below the content of the serum. We are thus, by the application of van Slyke's method, able to confirm, on ox, man and goat, the results obtained by Constantino in ox blood by the formol method.

CONCLUSION.

We may conclude that the red corpuscles of ox, man and goat are, to a certain extent, permeable for amino-acids, such as glycocoll and histidine.

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