

# ACID-BASE BALANCE IN WHOLE BLOOD AND ERYTHROCYTES OF HEALTHY DOGS

A. A. Safarova, M. L. Garfunkel',  
and I. L. Vinogradova

UDC 612.121-019:636.7

Normal values of the acid-base balance (pH, tension and total content of carbon dioxide, standard and actual bicarbonate, base deficit, and buffer bases) are given for whole venous and arterial blood and for erythrocytes of intact dogs.

\* \* \*

There are reports in the literature of determination of pH [7], total content and tension of carbon dioxide [2, 6], and the alkaline reserve of the blood [5] in intact dogs. However, the study of separate indices cannot give a complete picture of the state of the acid-base balance.

Experiments were therefore carried out to determine the normal values of indices of the acid-base balance in erythrocytes and in whole venous and arterial blood of intact animals. The assumption was made that, despite a constant interchange of ions between plasma and erythrocytes in accordance with the laws of Donnan equilibrium, the acid-base balance in the erythrocytes may differ from that in whole blood [1].

Investigations of the acid-base balance in erythrocytes have been undertaken only in man [3]. Incomplete information of indices of the acid-base balance are given in the published reports of these investigations [3, 4], because only erythrocytes in arterial blood were studied. Destruction of the erythrocytes to obtain a hemolysate was carried out under aerobic conditions, thus preventing the workers from determining pH directly in the erythrocytes. The analysis itself also was very time consuming, leading to technical errors.

## EXPERIMENTAL METHOD AND RESULTS

Parallel investigations were made of the acid-base balance in the erythrocytes and in whole venous and arterial blood of 40 intact, unanesthetized dogs. Blood samples were taken from the femoral vein and artery into syringes containing heparin under mineral oil. The state of the acid-base balance was determined immediately after removal of the blood samples by means of an Astrup apparatus (Radiometer).

To investigate the erythrocytes, the blood sample under oil was centrifuged for 20 min at 3000 rpm, the plasma and the upper layer of cells were removed, and the erythrocytes remaining under oil in the centrifuge tube were frozen in liquid nitrogen ( $-197^{\circ}$ ). They were then thawed by placing the tube under a stream of hot water. Rapid freezing and thawing led to complete hemolysis of the erythrocytes. The hemolysate was investigated in the Astrup apparatus. Comparison of the results of tests (Table 1) of whole venous and arterial blood showed that whole venous blood is more acid than arterial, and the tension and total concentration of carbon dioxide in arterial blood are slightly lower than in venous blood.

---

Department of Posttransfusion Complications and Hemodialysis and Pathophysiological Laboratory, Central Institute of Hematology and Blood Transfusion, Ministry of Health of the USSR. (Presented by Academician of the Academy of Medical Sciences of the USSR N. A. Fedorov.) Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 68, No. 10, pp. 28-30, October, 1969. Original article submitted March 19, 1969.

©1970 Consultants Bureau, a division of Plenum Publishing Corporation, 227 West 17th Street, New York, N. Y. 10011. All rights reserved. This article cannot be reproduced for any purpose whatsoever without permission of the publisher. A copy of this article is available from the publisher for \$15.00.

TABLE 1. Indices of Acid-Base Balance of Whole Venous and Arterial Blood and Erythrocytes ( $M \pm t$ )

Index of acid-base balance	Whole blood		P	Erythrocytes		P
	venous blood	arterial blood		venous blood	arterial blood	
Actual pH	$7,3 \pm 0,01$	$7,347 \pm 0,01$	$< 0,005$	$7,144 \pm 0,029$	$7,025 \pm 0,016$	$< 0,05$
Carbon dioxide tension (in mm Hg)	$49,9 \pm 1,6$	$38,4 \pm 1,7$	$< 0,05$	$49,9 \pm 2,7$	$37,0 \pm 1,53$	$< 0,05$
Standard bicarbonate (in meq/liter)	$21,46 \pm 0,86$	$19,15 \pm 0,5$	$> 0,05$	$14,5 \pm 2,3$	$15,1 \pm 1,18$	$> 0,05$
Total carbon dioxide concentration (in meq/liter)	$23,8 \pm 0,01$	$19,4 \pm 0,73$	$< 0,05$	$18,3 \pm 1,4$	$15,4 \pm 1,2$	$0,05$
Actual bicarbonate (in meq/liter)	$22,43 \pm 0,91$	$18,4 \pm 0,96$	$< 0,05$	$17,1 \pm 1,36$	$14,6 \pm 1,2$	$> 0,05$
Base excess (in meq/liter)	$-6,19 \pm 0,71$	$-4,72 \pm 0,91$	$> 0,05$	$-16,9 \pm 3,9$	$-16,6 \pm 1,7$	$> 0,05$
Buffer bases (in meq/liter)	$44,4 \pm 2,6$	$45,8 \pm 1,8$	$> 0,05$	$45,8 \pm 0,9$	$46,8 \pm 2,4$	$> 0,05$

Comparison of the indices of acid-base balance in erythrocytes and whole blood showed that the pH is lower in erythrocytes of both venous and arterial blood than in the corresponding whole blood (Table 1).

The carbon dioxide tension in erythrocytes is the same as in whole blood, while the carbon dioxide concentration in erythrocytes is lower than in whole blood. Comparative analysis of the indices of acid-base balance in erythrocytes of arterial and venous blood revealed that the pH of erythrocytes of venous blood is slightly lower than that of erythrocytes of arterial blood. This acidification of the medium in erythrocytes of venous blood is evidently due to their high carbon dioxide tension, for there are no significant differences in the remaining indices.

#### LITERATURE CITED

1. S. Ya. Kaplanskii, Acid-Base Balance in the Body and Its Regulation [in Russian], Moscow-Leningrad (1940).
2. I. Todorov, Clinical Laboratory Investigations in Pediatrics [in Russian], Sofia (1963).
3. U. Gleichmann et al., Pflüg. Arch. Ges. Physiol., 283, 43 (1965).
4. P. Hilpert, R. G. Fleischmann, D. Kempe, et al., Am. J. Physiol., 205, 337 (1963).
5. R. W. Masters, Clin. Chem., 8, 91 (1962).
6. T. E. O'Mara and W. R. Faulkner, Am. J. Clin. Path., 31, 34 (1959).
7. N. K. Thomaso, Scand. J. Clin. Lab. Invest., 15, 45 (1963).