been observed in gastric emptying time, rate of absorption, or digestion between skim milk powders dried at low or high temperature.

1. a. Geiger, E., Seventh Annual Protein Conf., Rutgers Univ., 1951; b. Geiger, E., *Fed. Proc.*, 1951, v10, 670.

2. El Rawi, I., Thesis, Univ. So. Calif., 1952.

3. Geiger, E., Pinsky, J. J., PROC. SOC. EXP. BIOL. AND MED., 1956, v91, 107.

4. Dreisbach, L., Nasset, E. S., *J. Nutrition*, 1954, v53, 523.

5. Nasset, E. S., Schwartz, D. L., Weiss, R., *ibid.*, 1955, v56, 183.

6. Geiger, E., El Rawi, I., *Metabolism*, 1952, v6, 145.

7. Junqueira, L. C. U., Rothschild, H. A., Fajer, A., *Exp. Cell Research*, 1957, v12, 338.

Received November 14, 1957. P.S.E.B.M., 1958, v97.

## Different Fractions of Serum Proteins in Normal and Scorbutic Guinea Pigs. (23700)

SACHCHIDANANDA BANERJEE AND KRISHNASUDHA ROHATGI
*Department of Physiology, Presidency College, Calcutta, India*

Electrophoretic patterns of plasma and serum proteins of a few animals have been studied(1,2) by the moving boundary electrophoresis. Greenberg *et al.*(3) observed no significant alteration in the serum proteins patterns of monkeys during early stages of scurvy. An increase in the plasma fibrinogen content has been reported in scorbutic monkeys(4) and guinea pigs(6). The present communication deals with studies on the different fractions of serum proteins in normal and scorbutic guinea pigs by paper electrophoresis as similar studies have not been previously reported.

*Methods.* The selection of guinea pigs and the feeding of the scorbutic diet by the paired feeding technic were the same as described previously(6). On the 30th day of the experiment when the experimental animals developed severe scurvy, food was withdrawn from the cages in the evening and on the next morning both the scorbutic animal and its normal mate were anesthetized with pentobarbital sodium and blood samples withdrawn by cardiac puncture. A small quantity of blood was taken in oxalated tube and the rest allowed to clot for the separation of serum. Total nitrogen and non-protein nitrogen of serum and plasma fibrinogen were determined by methods described previously(7). Serum proteins were separated by paper electrophoresis. 0.02 cc undiluted serum was used and electrophoresis continued for 16 hours with a current of 1.5 mA and 100 volts. The staining of the paper strips, determination of the optimum density curves of the coloured zones by densitometry and calculation of the amounts of different fractions of serum proteins were the same as described previously (7).

*Results.* The results are given in Tables I and II. Six clear components of serum proteins were present in guinea pig serum. Serum albumin, $\alpha_2$ and $\beta_2$-globulin values decreased considerably and significantly, $\alpha_1$-globulins increased significantly and there was no change in $\gamma$-globulin and $\beta_1$-globulin fractions when the guinea pigs developed scurvy. Total protein value of serum decreased, non-protein nitrogen value of serum and fibrinogen value of plasma increased in scorbutic animals.

*Discussion.* The lowered albumin globulin ratio in scorbutic guinea pigs agrees with similar observations reported by others(8). The decreased total plasma protein contents has also been reported in scorbutic monkeys (4). Moore(2) could not observe $\beta$ and $\gamma$ globulins in guinea pig sera by moving boundary electrophoresis. The demonstration of these components by paper electrophoresis indicates the superiority of the method over moving boundary electrophoresis. Fukuda and Shibatani(9) and Fukuda(10) observed

TABLE I. Different Fractions of Serum Proteins in Guinea Pigs (%).

| Guinea pigs | Albumin | Globulins | | | | |
|---|---|---|---|---|---|---|
| | | $\alpha_1$ | $\alpha_2$ | $\beta_1$ | $\beta_2$ | $\gamma$ |
| Normal (10) | 2.82 ± .05* | .42 ± .03 | 1.38 ± .08 | .35 ± .01 | .56 ± .03 | .68 ± .05 |
| Scorbutic (8) | 1.90 ± .08 | .77 ± .03 | 1.19 ± .06 | .31 ± .03 | .43 ± .02 | .69 ± .04 |
| Diff. of means | .92 | .35 | .19 | .04 | .13 | .01 |
| S.E. of diff. | .093 | .04 | .095 | .032 | .033 | .052 |
| $t$ | 9.86 | 8.83 | 2.00 | 1.25 | 3.93 | .19 |

* Mean ± S.E. Figures in parentheses indicate No. of animals.

a decrease in liver protein values in scorbutic guinea pigs. The decrease in the serum albumin and total serum proteins values in scurvy might be due to diminished synthesis of these components by the liver of the scorbutic animal.

Elevation of fibrinogen in scurvy might be due to dysfunction of the liver. Antibodies are mainly contained in the $\gamma$-globulin of plasma proteins(11). $\gamma$-globulin values, however, did not change in scorbutic guinea pigs although it has been stated that Vit. C-nutrition influences the development of immunity in the body(12). A significant increase in the non-protein nitrogen values of serum in scorbutic guinea pigs might be due either to increased tissue catabolism or to its retention by the dysfunction of the kidney. The changes in the different components of plasma proteins in scurvy indicate the interrelations of Vit. C-nutrition and protein metabolism in the body.

*Summary.* Different fractions of plasma proteins were determined by paper electrophoresis in scorbutic and paired-fed normal guinea pigs. Guinea pig serum contained albumin and $\alpha_1$, $\alpha_2$, $\beta_1$, $\beta_2$ and $\gamma$-fractions of globulins. There was a significant decrease in albumin, $\alpha_2$ and $\beta_2$-globulins; considerable increase in $\alpha_1$-globulin and no significant change in $\beta_1$ and $\gamma$-globulins in the serum of scorbutic guinea pigs.

TABLE II. Total Serum Protein, Serum Non-protein Nitrogen and Plasma Fibrinogen Values in Guinea Pigs (%).

| Guinea pig | Serum protein | Serum N.P.N. | Plasma fibrinogen |
|---|---|---|---|
| Normal (10) | 6.2 ± .10 | .06 ± .00 | .31 ± .04 |
| Scorbutic (8) | 5.29 ± .17 | .10 ± .01 | .56 ± .07 |
| Diff. of means | .92 | .04 | .25 |
| S.E. of diff. | .196 | .012 | .077 |
| $t$ | 4.6 | 3.3 | 3.2 |

1. Deutsch, H. F., Goodloe, M. B., *J. Biol. Chem.*, 1945, v161, 1.

2. Moore, D. H., *ibid.*, 1945, v161, 21.

3. Greenberg, L. D., Hoessly, J. P., Brooks, R., Rinehart, J. F., PROC. SOC. EXP. BIOL. AND MED., 1952, v79, 425.

4. Salmon, R. J., May, C. D., *J. Nutrition*, 1952, v46, 515.

5. Ichihara, K., Oku, H., *Vitamins (Japan)*, 1952, v5, 139.

6. Banerjee, S., Deb, C., *J. Biol. Chem.*, 1951, v190, 177.

7. Banerjee, S., Chatterjee, K. P., PROC. SOC. EXP. BIOL. AND MED., 1957, v94, 474.

8. Chalopin, H., *Compt. rend. soc. biol.*, 1955, v149, 265.

9. Fukuda, M., Shibatani, A., *Experimentia*, 1953, v9, 27.

10. Fukuda, M., *Osaka, Diagaku Igahu Zasshi*, 1953, v5, 547.

11. Tiselius, A., Kabat, E. A., *J. Exp. Med.*, 1939, v69, 119.

12. Banerjee, S., *Science and Culture*, 1942, v8, 341.

Received November 14, 1957. P.S.E.B.M., 1958, v97.