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7825 P

Determination of pH of Living Tissue by the Glass Electrode.*

GORDON H. BALL.

From the Department of Biological Sciences, University of California at Los Angeles.

The ordinary bulb type of glass electrode is necessarily limited in its use for determining the hydrogen-ion concentration of *living* tissues to fluids or to cavities in which such an instrument can be placed. For example, the pH of the blood can be determined by actual insertion of the electrode in some of the larger vessels, or the blood stream can be diverted into a chamber surrounding the glass bulb. Other determinations of the pH of living tissue have involved the actual destruction of that tissue, regardless of whether the colorimetric method, or the hydrogen, the quinhydrone, or the glass electrode was used. We have employed a spear type of capillary glass electrode which can be inserted directly into the tissues; in this series of experiments, into the intestinal wall of the white rat. The vacuum tube amplifying system used was essentially that described by DeEds.[1] The electrodes were drawn of Corning No. .015 glass, and were from 30μ to 100μ in thickness, the capillary wall varying from 10μ to 30μ. They were filled with 1/10 N HCl saturated with quinhydrone, sealed at the tip, and calibrated at the temperature of the tissue just before and immediately after using. The animal was completely insulated, being in contact only with the tip of the glass electrode and with the end of the calomel half cell. The latter was inserted into the peritoneal cavity of the rat, which was kept under ether anesthesia throughout the experiment; a por-

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[1] DeEds, F., *Science*, 1933, **78**, 556.

tion of the intestine was fastened to an upright slab of hard rubber; an incision was made in the wall of the gut and a reading taken at once, care being taken to prevent loss of heat. Readings were taken of both the contents and wall in different parts of the intestine. No difference could be demonstrated between readings taken at the surface of the intestinal mucosa and those obtained by dissecting away the surface layer and inserting the electrode directly into the deeper tissues of the gut wall. The galvanometer readings were exceedingly stable during the 2-3 minutes necessary to take an observation, and were not affected by action currents in the animal.

The greatest difficulty was to obtain electrodes which would give reproducible readings; in many cases the electrodes were too inconstant to be calibrated. These changes were spontaneous, and appeared to be independent of the so-called "deviation film" of Kahler and DeEds.[2]

The following readings were taken with electrodes which were sufficiently constant over the period of the experiment to be relied upon. They are intended to illustrate the usability of a new method of determining the hydrogen ion concentration of *living* tissues rath-

TABLE I.
pH of intestine of rat determined by the glass electrode.

Rat Fed Previously hr.	Duodenum Wall	Duodenum Contents	Ileum Wall	Ileum Contents	Cecum Wall	Cecum Contents	Colon Wall	Colon Contents
24	—	—	—	—	—	6.56	—	—
7	—	5.97	6.58	7.44	7.14	6.02	6.39†	—
24	6.36	—	7.44	7.50	7.10	7.51	6.39†	6.49†
24	—	—	—	—	6.10†	6.79	—	—
24	—	—	6.73†	6.69†	7.21	7.23	6.91	7.00
36	6.31	6.54	6.64	8.17	6.79	6.80	—	—
AVERAGE	6.34	6.26	6.85	7.45	6.87	6.82	6.56	6.75
(Live rats only)	—	—	(6.89)	(7.70)	(7.06)	—	(6.91)	(7.00)
Kofoid, McNeil, and Cailleau[3] (Q)	6.93	—	6.98	7.51	7.34	7.13	6.95	7.33
Redman, Willimott and Wokes[4] (Q) (C)	—	5.2	—	6.4	—	6.4	—	6.4
Abrahamson and Miller[5] (C)	—	5.83	—	5.88	—	—	—	—

[2] Kahler, H., and DeEds, F., *J. Am. Chem. Soc.*, 1931, **53**, 2998.

† Rat dead. (C) colorimetric method. (Q) quinhydrone electrode.

[3] Kofoid, C. A., McNeil, E., and Cailleau, R., *Univ. Calif. Publ. Zool.*, 1932, **36**, 347.

[4] Redman, T., Willimott, S. G., and Wokes, F., *Biochem. J.*, 1927, **21**, 589.

[5] Abrahamson, E. M., and Miller, E. G., PROC. SOC. EXP. BIOL. AND MED., 1925, **22**, 438.

er than to present an extensive series of pH determinations. The animal was alive during the course of readings except in those cases marked †; even here it had ceased breathing only 2-3 minutes before. Some results of other workers on hydrogen ion concentration of the digestive tract of the rat are appended for comparison.

7826 C

Tolerance of Fundulus Parvipinnis to Certain Bactericidal Substances.

CLAUDE E. ZOBELL AND NELSON A. WELLS.

From Scripps Institution of Oceanography, University of California, La Jolla, Calif.

The authors have described the bacteriology[1] and the pathology[2] of an infectious dermatitis of the Pacific killifish, *Fundulus parvipinnis*, and other marine fishes which has seriously handicapped the experimental work[3, 4] on these organisms. At certain periods during the last 3 or 4 years literally thousands of *Fundulus* have died of the disease in our laboratories and frequently important experiments have been terminated before results of value could be obtained. While the disease is known to occur in nature, probably the fishes are rendered more susceptible to infection by injuries sustained in the collecting nets and by subsequent handling. The elimination of those fishes which are visibly injured, the segregation of the infected, the disinfection of the tanks by chlorination, and the application of other ordinary precautions have been of little or no avail in controlling the epidemics. A hyperthermic treatment consisting of the gradual acclimatization of the fishes to water heated to 32°C. to 35°C. has been of prophylactic as well as of therapeutic value, but this procedure is slow and expensive. Therefore, it is desirable to find a more expedient method for the control of this and similar diseases.

Certain infectious diseases of fresh-water fishes[5] have been controlled by bathing the fish in solutions of selective germicides. With

[1] Wells, N. A., and ZoBell, C. E., *Proc. Nat. Acad. Sci.*, 1934, **20**, 123.

[2] ZoBell, C. E., and Wells, N. A., *J. Infect. Dis.*, 1934, **55**, 299.

[3] Wells, N. A., *Proc. Nat. Acad. Sci.*, 1932, **18**, 580.

[4] Wells, N. A., *Physiol. Zool.*, 1935, **8**, April.

[5] Plehn, M., *Praktikum der Fischkrankheiten*, E. Schweizerbart'sche, Stuttgart, 1924, 179.