LETTERS TO THE EDITOR

[Brief letters to the Editor that make specific scientific reference to papers published previously in The Journal of General Physiology are invited. Receipt of such letters will be acknowledged, and those containing pertinent scientific comments and scientific criticisms will be published.]

The Activity Coefficient of Sodium in Striated Muscle Fibers

Dear Sir:

The statement by Brinley (1968) that for striated muscle fibers from the giant barnacle "... one can calculate an activity coefficient for sarcoplasmic sodium of ca. 0.5-0.6 which is not greatly different from what one might expect from a mixed salt solution having the composition of the sarcoplasm (0.65-0.75)" requires some comment. This calculation was made by dividing the average internal sodium activity (10-14 mmoles/kg H₂O) of fibers analyzed by McLaughlin and Hinke (1966) by the average sodium concentration (21 mmoles/kg H₂O) of fibers analyzed by Brinley (1968) and others. McLaughlin and Hinke (1966) measured the activity of sodium in the sarcoplasm of a barnacle muscle fiber by means of a longitudinally inserted cation-sensitive microelectrode, then analyzed the fiber for its total sodium content. The average concentration of sodium (51-81 mmoles/kg H₂O) in the fibers they used was substantially higher than the concentration of sodium in the fibers used by Brinley, and they deduced an average value for the activity coefficient of about 0.2.

Brinley (1968) was correct in noting that the rinse period in isosmotic sucrose (15 sec) used by McLaughlin and Hinke (1966) was insufficient to remove all the extracellular sodium from the clefts and reticulum of the fiber. He was, however, incorrect in implying that this is the major reason for the difference in the concentration measurements reported by himself and by McLaughlin and Hinke (1966) and hence the major reason for the low activity coefficient deduced by the latter investigators.

It was apparently overlooked that McLaughlin and Hinke (1966), in a second series of experiments, made both concentration and activity measurements on fibers bathed for 45 min in sodium-free sucrose Ringer. This is sufficient time for virtually all the sodium contained in compartments communicating with the bathing solution to have left the fiber (Hinke, 1967; McLaughlin and Hinke, 1968). The ratio of the sodium activity to concentration in these fibers was also found to be about 0.2.

The difference between the sodium content of the fibers utilized in these two laboratories is perhaps best illustrated by a comparison of Fig. 1 of Brinley (1968) and Fig. 2 of McLaughlin and Hinke (1968). These are both "timed rinse" graphs in which the sodium concentration of single fibers is plotted as a function of time in sodium-free sucrose Ringer. After 25 min, the slopes of both curves decreased to low values, but the sodium concentration of the fibers analyzed by Brinley (1968) was...
less than 10 mmoles/kg H₂O whereas the sodium concentration of the fibers analyzed by McLaughlin and Hinke (1968) was 35 mmoles/kg H₂O. The ratio of the activity to the concentration in these latter fibers was again found to be approximately 0.2.

Although the factors responsible for the difference between the sodium content of barnacle muscle fibers analyzed in the two laboratories are not yet known, two points may be stressed. First, the difference is not due merely to sodium contained in a compartment which communicates with the bathing solution. Second, all the measurements of the activity of sodium in striated muscle fibers that have been made to date (see also Lev, 1964; Hinke and McLaughlin, 1967) indicate that the activity coefficient for sarcoplasmic sodium is much lower than the value one might expect from a mixed salt solution having the composition of the sarcoplasm.

Received for publication 19 June 1968.

S. McLaughlin
Department of Anatomy
The University
Dundee, Scotland

REFERENCES


