An Example of Active Transport of Water Through Plants

The existence of active transport of water through plants has long been debated. LEVITT[1–3], in a series of papers, has maintained that such a possibility does not exist. Others[4,5] take the view that under certain conditions active transport of water does take place. In the authors' opinion the diversity of views is mainly the result of the absence of any uniform and precise definition of the term active transport. SPANNER[6], by providing a physical meaning to the term active transport, has considerably clarified the situation. Making use of the thermodynamic theory of irreversible processes, the linear phenomenological relations for transport of water and salts across cell membranes can be written thus:

$$J_v = L_{pp}\,\Delta\,P + L_{pd}\,\Delta\,\Pi \quad (1)$$

and

$$J_s = L_{dp}\,\Delta\,P + L_{dd}\,\Delta\,\Pi, \quad (2)$$

where J_v stands for the total volume flow and J_s stands for solute flow. $\Delta\,P$ and $\Delta\,\Pi$ are the hydrostatic and osmotic pressure differences across the membrane, L_{pp}, L_{dp}, L_{pd} and L_{dd} are the phenomenological constants. From equation (1) it is clear that the flow J_v is the result of a sum of 2 terms viz. $L_{pp}\,\Delta\,P$ and $L_{pd}\,\Delta\,\Pi$, the former representing flow of water due to hydrostatic pressure difference and the latter the flux of water due to difference in solute concentration. Similarly, in equation (2) the term $L_{dp}\,\Delta\,P$ and $L_{dd}\,\Delta\,\Pi$ represent the solute flux due to differences in hydrostatic pressure and salt concentration respectively.

On account of Onsager's reciprocity relations, we have

$$L_{dp} = L_{pd} \quad (3)$$

Because of equality (3), in equations (1) and (2) we are left with 3 phenomenological constants viz. L_{pp}, L_{dd} and $L_{dp} = L_{pd}$. SPANNER[6] asserts that only those transport processes must be considered as active where the cross coefficients (e.g. L_{dp} or L_{pd}) are important. In physical terms the transport of a species must be considered active only when the driving force is other than the usual chemical or electrochemical potential gradient of the species. Such a definition would exclude the use of such ambiguous terms like 'pumping system', etc. (LEVITT[3]).

Data of one of the authors[7] are presented in the Table to support the contention that active transport of water in plants is possible and may be important under certain conditions.

During the period of these experiments, the moisture % in the placenta remained practically constant at 95%. It is obvious from the data that during the period 25–35 days there is a reduction in the water content and an increase in the osmotic pressure of seeds. At all times the osmotic pressure of seeds remained higher than that of the placental juice. Considering moisture content as a function of moisture potential, it is clear that there is a net water flux against the water and osmotic pressure gradients, suggesting a driving force other than those for the transport of water from seeds. There appears no alternative to the conclusion that a process such as the one described above, where transport of water takes place due to a force (metabolic in this instance) other than water potential must fall under the category of active transport.

Zusammenfassung. Am Beispiel des Wassertransports aus Samen der Tomate wird das Vorkommen eines aktiven Wassertransportmechanismus in Pflanzen nachgewiesen.

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Water content and osmotic pressure of seeds and placental juice of tomatoes associated with development

Seed age days	Water content/seed[a] mg	Osmotic pressure[b] Seeds	Placental juice
25	14.2 (82.1)	11.79	8.22
30	7.8 (69.0)	14.36	8.18
35	5.9 (61.4)	19.98	7.88

[a] Each value represents a mean of seeds from 10 fruits. Figures in parenthesis give the moisture % in seeds. [b] Values are means of biological triplicates.

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5 J. J. OERTLI, Physiologia Pl. *20*, 814 (1967).
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7 Y. P. ABROL, Ph.D. thesis, University of Chicago, USA (1963).

TERMINOLOGIA

Difficulties in Vitamin B_6 Nomenclature

Vitamin B_6 is of appreciable interest in a wide variety of fields. Unfortunately, however, the name vitamin B_6 has disadvantages. For one thing, a term of the form 'vitamin such-and-such' is not suitable for all purposes. Now that a good deal is known concerning the chemical natures and biochemical functions of vitamins, authors are generally careful to avoid an expression like vitamin B_1 when thiamine will do at least as well. Furthermore, a two-word expression will not fit into certain contexts as comfortably as a single word. Such a term as hypothiaminosis presents no linguistic problems; but the structurally parallel term 'hypovitamin B_6-osis' can hardly be viewed with complete seriousness, and even the structure of the less embarrassing term 'B_6 hypovitaminosis' leaves something to be desired.

In 1939, 2 groups of investigators[1,2] identified vitamin B_6 as 3-hydroxy-2-methyl-4, 5-pyridinedimethanol. That same year, GYÖRGY and ECKHARDT[3] proposed the name