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BRIEF COMMUNICATION

Changes in cell membrane permeability and lipid content of wheat root cortex cells induced by NaCl

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Abstract

Wheat seedlings were grown hydroponically in absence and presence of 100 mM NaCl for 7 d. Cell membrane permeability to nonelectrolytes and water was determined by the plasmometric method for individual intact cells. NaCl increased membrane permeability to urea, methylurea and ethylurea and decreased permeability to water. Membrane lipid partiality was decreased by NaCl. The effects of NaCl on cell permeability parallel changes in the lipid composition of the plasma membranes induced by NaCl stress suggesting that nonelectrolyte permeability is a useful tool to probe alterations in the lipid matrix of the membrane.

Key words: ethylurea, methylurea, *Triticum aestivum*, urea

Previous work has shown that NaCl alters root plasma membrane lipid composition of wheat cultivar used in the current study (Mansour *et al.* 1994). Mansour *et al.* (1993) report that NaCl changes the membrane permeability of leaf sheath subepidermal cells of wheat lines differing in salt tolerance. It is believed that nonelectrolyte permeators cross the membrane exclusively through its lipid portion (Stadelmann and Lee-Stadelmann 1989). Changes in permeability constants, therefore, indicate alteration in the lipid matrix of the membrane. Thus, a link between lipids of the membrane and nonelectrolyte permeability changes might be expected. This work presented here was designed to test this hypothesis. The aim was to determine the effect of NaCl stress on nonelectrolyte and water permeability of root cortex cells,where plasma membrane lipid changes were reported previously.

Winter wheat (*Triticum aestivum* L. cv. Vivant) was grown hydroponically in controlled environment (for detail see Mansour *et al.* 1994). Nonelectrolyte and water permeability was measured by plasmometric method (Stadelmann and Lee-Stadelmann 1989, Mansour *et al.* 1993). Membrane partiality was calculated from

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the slope of the regression line of the plot $1/K_S$ *vs* $1/P_C$ (Mansour *et al.* 1993). The steeper the slope of the plot $1/K_S$ *vs* $1/P_C$, the higher the membrane lipid partiality.

Addition of 100 mM NaCl to the growth medium for 7 d increased nonelectrolyte permeability and decreased permeability to water of plasma membrane of root cortex cells (Table 1). Membrane partiality decreased with salt treatment (Fig. 1).

NaCl decreased plasma membrane fatty acid unsaturation resulting in straight hydrocarbon chains (Mansour *et al.* 1994). This could explain NaCl induced increase in nonelectrolyte permeability reported in this study as it is proposed that straight hydrocarbon chains facilitates nonelectrolyte permeation (Stadelmann and Lee-Stadelmann 1974). Alteration in relative abundance of membrane phospholipids (particularly phosphatidylcholine and phosphatidylethanolamine) under NaCl stress (Mansour *et al.* 1994) may result in phase separation (Quinn 1984) which could also explain the increased nonelectrolyte permeability.

Table 1. Effects of 100 mM NaCl on urea, methylurea, ethylurea and water permeability of root cortex cells of wheat sensitive cultivar. Each value is the mean ± SD (number of cells is given in bracktes). All differences were significant at 1 % level.

	Permeability constant [$\times 10^{-7}$ cm s^{-1}] urea	methylurea	ethylurea	[$\times 10^{-4}$ cm s^{-1}] water
-NaCl	2.9 ± 0.3 (26)	23.4 ± 1.9 (25)	41.0 ± 2.9 (23)	3.1 ± 0.1 (24)
+NaCl	5.0 ± 0.3 (26)	35.1 ± 2.9 (24)	55.1 ± 5.1 (19)	2.0 ± 0.1 (24)

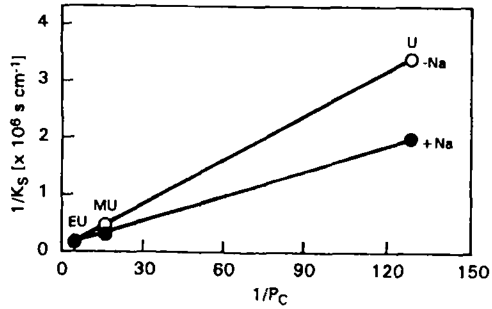

Fig. 1. Permeation resistance ($1/K_s$) of urea (U), methylurea (MU) and ethylurea (EU) as a function of $1/P_c$, where P_c is the partition coefficient of U, MU or EU in octanol/water at 20 °C. Membrane partiality is determined by the slope of the regression line.

Reduced water permeability under NaCl stress may be attributted to an increase in fatty acid saturation induced by NaCl (Kuiper 1975, De Gier *et al.* 1982). The change in the slope of $1/K_S$ *vs* $1/P_C$ plot (Fig. 1) suggested change in the membrane core (Stadelmann and Lee-Stadelmann 1989) which may result from the effect of altered sterol proportions and fatty acid saturation induced by NaCl (Russell 1989).

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