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Sugar Alcohols Display Nonosmotic Roles in Regulating Morphogenesis and Metabolism in Plants that do not Produce Polyols as Primary Photosynthetic Products

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Summary

Sugar alcohols are frequent supplements to media of cultures from plant species that do not produce polyols as primary photosynthetic products. They comprise one of the major medium constituents and thereby contribute substantially to the medium osmotic potential. It is generally believed that plants that do not have a native pathway for sugar alcohol biosynthesis are also deficient in pathways to assimilate them. Therefore, polyol-media addenda are generally considered to be metabolically inert, and *in vitro* poloyol-dependent phenomena are defined predominantly as mere osmotic (stress) effects. The article shows that this concept does not provide satisfactory explanations for experimental results described in the literature.

Sugar alcohols commonly penetrate cells, accumulate, can be translocated and, whenever stringently tested, have always been found to be metabolized to various degrees. Heterotrophic cultures, such as those of tobacco, maize, rice, citrus and chicory, can adjust their metabolism from consumption of saccharides to that of polyols as carbon-energy source when the medium is sucrose-deficient or when exogenous saccharides are depleted to a level lower that a threshold concentration. In these, as well as in other cultures (i.e. of barley, tobacco, or tomato), sugar alcohols stimulate specific molecular and physiological responses that do not belong to primary carbon metabolism. These responses are dependent on chemical stimuli rather than being mediated by nonspecific, physical, osmotic signals in the medium. One conclusion of this review is that it would be wise to assume that sugar alcohols may be metabolized until shown other-wise. Further, it is suggested that polyols are perceived by cells as chemical signals. This hypothesis is compatible with the emerging conception of sugar (hexoses) as signals in plants, distinctly separate from their possible metabolic and osmotic roles. At very high concentrations provided *in vitro*, sugar alcolols can probably in some cases be perceived as chemical stress agents, while in other instances they possibly act as protectants against unidentified detrimental medium constituents. In view of the multiple ways of polyol action, administration of these compounds as means of water stress simulation can lead to misinterpretations of experimental results.

Key words: Carbohydrates, chemical stress, metabolic contol, polyol, sugar alcohol, osmotic stress, signial, tissue culture