CARBOHYDRATE FRACTIONATION AND ELONGATION OF LUPIN HYPOCOTYL CELL WALLS

A thesis presented in partial fulfilment

of the requirements for the degree

of Doctor of Philosophy

in Botany at

Massey University

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1974

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ABSTRACT

The relationship between extensibility, growth rate and carbohydrate composition in different sections of lupin hypocotyl has been investigated. Although significant differences in extensibility were found, the carbohydrate composition of elongating and non-elongating regions were similar when delignified tissue was examined. However, it was subsequently found that the delignification removed all of the wall hydroxyproline, most of the arabinose, and much galactose and that all of these were higher in non-elongating than in elongating hypocotyl. The acid conditions of delignification caused about half of the loss of the sugars but did not cause the loss of hydroxyproline.

Extraction of the hypocotyl cell walls with guanidinium thiocyanate and other denaturants, both before and after treatment with dilute acid or sodium methoxide in methanol did not dissolve the hydroxyproline, indicating that compounds containing this amino acid are probably covalently linked to insoluble wall constituents other than through acid labile arabinofuranose-hydroxyproline or ester links alone. 10% KOH extracted most of the wall hydroxyproline and hemicellulose largely as non-dialysable material. The hemicellulose thus extracted may be fractionated into hemicelluloses A and B and the latter into linear 1-4 linked polysaccharides and branched polysaccharides. Most of the hydroxyproline containing polymer is co-precipitated with the linear 1-4 linked hemicellulose-B arabinoxylan.

When cell walls from elongating and non-elongating hypocotyl sections were compared the hemicellulose-B arabinoxylan fraction from the non-elongating wall had a much higher proportion of arabinose, galactose and hydroxyproline than the same polymer from elongating wall.

Extraction of cell walls with 10% KOH at 0°C removed about two thirds of the hemicellulose-B but little hydroxyproline. Subsequent treatment with 10% KOH at room temperature removed most of the hydroxyproline and remaining hemicellulose-B. The hemicellulose-B removed at room temperature showed the greatest increases in arabinose and galactose accompanying cessation of elongation. The polysaccharide extracted at 0°C is mainly xylan while that removed at room temperature contains large amounts of galactose and arabinose. The release of galactose at room temperature was accompanied by destruction of serine and appeared to parallel β-elimination of galactosylserine The kinetics of release of arabinose and galactose at room temperature differed.

The above and other results are discussed particularly in relation to wall structure and a tentative model for the extensin-polysaccharide complex of lupin hypocotyl cell walls is proposed.

ACKNOWLEDGEMENTS

My thanks are due particularly to Drs.R.W.Bailey and E.D.Penny for their supervision encouragement and patience in directing me through this work.

I also wish to thank Mrs Sue Brennan for help in preparation of the manuscript and for some help in the practical work, and Mrs Olive Brigham for spending many sunny afternoons behind the typewriter.

To those who have contributed only through discussion I am also indebted, particularly to Vasil Sarafis who did much to give some idea of a botanical perspective.

For maintaining a broader perspective I am particularly thankful to Liz who reinforced my sense of priorities so that I was able to love life despite the thesis.

TABLE OF ABBREVIATIONS

DP	Plastic compliance (mm^2/Newton)
DE	Elastic compliance (mm^2/Newton)
DT	Total compliance (mm^2/Newton)
GTC	Guanidinium thiocyanate
HO	Hemicellulose extracted from neutral detergent treated walls by 10% KOH at 0^oC
HRT	Hemicellulose extracted from cell walls by 10% KOH at 18-22^oC after prior neutral detergent depectination and removal of HO
H24	Hemicellulose not extracted from the cell walls by 10% KOH at 18-22^oC but removed by 24% KOH
RND	Cell walls extracted with neutral detergent
RO	RND after extraction with 10% KOH at 0^oC
RRT	RO after extraction with 10% KOH at 18-22^oC
R24	RRT after extraction with 24% KOH at room temperature
IAA	Indole-3-acetic acid
ATP	Adenosine triphosphate
ATPase	ATP phosphohydrolase
Glu.	Glucose
Gal.	Galactose
Man.	Mannose
Ara.	Arabinose
Xyl.	Xylose
EtOH	Ethanol
EDTA	Ethylenediamine tetra-acetic acid