Influence of galactoglucomannan oligosaccharides on cell elongation in primary and lateral roots of intact mung bean plants

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ABSTRACT

Galactoglucomannan oligosaccharides (GGMOs) influence elongation growth of plants. The aim of this work was to determine the effect of GGMOs and their modified form (GGMOs-g – GGMOs with reduced galactose content) on root elongation growth accompanied by variations in elongation or division of rhizodermal and primary cortical cells. GGMOs alone as GGMOs+IBA stimulated primary and lateral root elongation growth compared with the control and IBA, respectively. This effect of GGMOs was accompanied by rhizodermal cells elongation and primary cortical cells division. On the other hand GGMOs-g alone or in the presence of IBA inhibited root elongation growth compared with GGMOs and GGMOs+IBA, respectively. The activity of these oligosaccharides in root cells elongation and division is obviously determined by the oligosaccharides structure.

KEYWORDS: elongation growth, galactoglucomannan oligosaccharides, lateral roots, primary cortical cells, primary root, rhizodermal cells.

INTRODUCTIONS

Oligosaccharides isolated from cell wall polysaccharides have been identified to control various plant processes which are under the regulation of growth hormones (Etzler 1998). It was found that galactoglucomannan oligosaccharides (GGMOs) prepared from the galactoglucomannan inhibit the 2,4-D-, IAA-, as well as GA_3-induced elongation growth of pea stem segments at very low concentrations and this effect is dependent on their chemical structure (Auxtová et al. 1995, Kollárová et al. 2006). Induction and elongation growth of adventitious roots in mung bean hypocotyl cuttings and of lateral roots in *Karwinskia* adventitious root cuttings were dependent on GGMOs concentration and interaction with certain type of auxin (Kollárová et al. 2005, 2007).

However, the impact of GGMOs on the elongation of root cells has not been studied yet. The aim of this work was to determine the effect of GGMOs and their modified form (GGMOs-g – GGMOs with reduced galactose content) on the elongation growth of roots accompanied by elongation or division of rhizodermal and primary cortical cells.

METHODS

GGMOs were derived from spruce galactoglucomannan (Capek et al. 2000). Partially degalactosylated oligomers to 47% – GGMOs-g were prepared by treatment of GGMOs with purified α-galactosidase (EC 3.2.1.22) (Bilisics et al. 2004). Uniform seedlings of mung bean

(*Vigna radiata* (L.) Wilczek) were transferred to hydroponic Hoagland solution containing GGMOs or GGMOs-g (10^{-8} M) alone and/or in combination with IBA (10^{-6} M). Plants were grown 7 days in a growth chamber at 27 ± 1 °C, 60 – 70% relative humidity, under 12 hours photoperiod at irradiance of 80 μmol m^{-2} s^{-1} in sterile conditions. The length of primary and lateral roots was determined after the treatment. For light microscopy the whole-mount procedure was used and the samples were stained with toluidine blue (Lux et al. 2005). The length of rhizodermal and primary cortical cells was determined by Lucia analysis system. The data were analyzed using statistical program ANOVA.

RESULTS AND DISCUSSIONS

GGMOs alone stimulated seminal and lateral root elongation growth in comparison with the control. This stimulation of both types of roots was accompanied by the elongation of rhizodermal cells. On the other hand GGMOs-g inhibited seminal root elongation as well as rhizodermal cells length compared with GGMOs, but their effect on lateral root elongation resembled that of GGMOs.

IBA inhibited primary and lateral root elongation compared with the control. This inhibition of both types of roots was accompanied by the reduction of rhizodermal cell length. GGMOs+IBA stimulated primary and lateral root elongation as well as rhizodermal cells elongation compared with IBA, however GGMOs-g+IBA inhibited this processes in comparison with GGMOs+IBA.

GGMOs as GGMOs-g in the presence or absence of IBA were without any effect on the length of primary cortical cells in primary and lateral roots compared with IBA and control, respectively. From results it follows that the root elongation is apparently caused by the increase of the primary cortical cells number.

Stimulation of primary and lateral root elongation by GGMOs in intact mung bean plants is accompanied by rhizodermal cells elongation and primary cortical cells division. The most closely associated effect reported was the cell division in *Zinnia* xylogenic cell cultures stimulated by GGMOs (Beňová-Kákošová et al. 2006). Our experiment confirms the importance of the galactosyl side chain of GGMOs analogically to previous experiments (Kollárová et al. 2006).

This study was supported by the Slovak Grant Agency for Science (No. 2/7048/7) and Agency for the Support of Research and Development (No. APVT-51-013304).

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