Interaction of galactoglucomannan oligosaccharides with auxin and activity timing in seminal root growth

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ABSTRACT

Galactoglucomannan oligosaccharides (GGMOs) control various plant processes and interactions with the environment which are under the regulation of growth hormones. The aim of this work was to prove the interaction of GGMOs with IBA in seminal root elongation growth during 24 hours of mung bean (*Vigna radiata* (L.) Wilczek) seeds germination. The activity of exogenous GGMOs in seminal root elongation was connected with the regulation effect of exogenously applied IBA. The effect of GGMOs was dependent on their timing with IBA application. A significant impact of the concentration of IBA in this process has been demonstrated and GGMOs proved also in this case their antiauxin activity accompanied by changes in cell wall-associated peroxidase activity presumably connecting with restucturalization and changes in physical properties of cell walls.

KEYWORDS: elongation growth, galactoglucomannan oligosaccharides, peroxidase activity, seminal root, timing of action.

INTRODUCTIONS

Oligosaccharides, derivatived from polysaccharides of fungal or plant cell walls, play an important role in various aspects of normal plant growth and development, and in response to external (biotic, abiotic) stress. Different groups of oligosaccharides with biological activity have been identified, e.g. galactoglucomannan oligosaccharides (GGMOs). Galactoglucomannan oligosaccharides inhibit elongation growth of pea and spruce stem segments (Auxtová et al. 1995, Kollárová et al. 2006), and this effect is dependent on their concentration and timing of GGMOs and auxins application. This inhibition of elongation growth induced by GGMOs is related with changes of enzymes activity involved in elongation processes (Lišková et al. 2006). An inverse relation between the growth rate and peroxidase activity has been reported in many plant systems. Peroxidase reduces cell wall extensibility and participates in reactions controlling cell wall rigidification (Passardi et al. 2004).

However, the impact of GGMOs on seed germination and seminal root elongation, their interaction with auxin, dependence on timing of co-action GGMOs and auxin has not been studied yet. Cell wall-associated peroxidase activity in seminal roots after GGMOs and/or IBA treatment was also determined and peroxidase isoenzymes were detected.

METHODS

GGMOs were derived from spruce galactoglucomannan (Capek et al. 2000). Seeds of mung bean (*Vigna radiata* (L.) Wilczek) were treated in destiled water (control) and in solutions containing GGMOs (concentrations range from 10^{-11} M to 10^{-6} M) alone or in combination with IBA (10^{-8} M – stimulating concentration, 10^{-4} M – inhibiting concentration of root elongation). Timing: a) IBA was added after 3 hours of preincubation with GGMOs; b) IBA and GGMOs were added at the beginning of the experiment; c) IBA and GGMOs were added after 3 hours preincubation in water; d) IBA and GGMOs were added at the beginning of the experiment and after 3 hours the seeds were incubated in distilled water. Seeds were germinated in a growth chamber at 26 ± 1 ºC, 70% relative humidity, in the dark. The length of seminal roots was determined after 24 hours of treatment. Percentage of inhibition of IBA-induced elongation growth was calculated according to McDougall and Fry (1988). Peroxidase extraction was performed by modified method of Warneck et al. (1996) and peroxidase activity was determined spectrophotometrically (Frič and Fuchs 1970). The data were analyzed using statistical program ANOVA.

RESULTS AND DISCUSSIONS

GGMOs inhibited seminal root elongation induced by low concentration (10^{-8} M) of IBA. The inhibition was considerably higher after preincubation with GGMOs compared with experiments when IBA and GGMOs were added simultaneously at the beginning of the experiment, or when the seeds were preincubated in distilled water. The most intensive inhibition of elongation has been ascertained at the 10^{-8} M concentration of GGMOs. On the other hand GGMOs stimulated this elongation inhibited by high IBA concentration (10^{-4} M). This stimulation was the most intensive by simultaneous addition of IBA and GGMOs at the beginning of the experiment and subsequent seeds incubation in distilled water. Our results indicate possible competitive antagonism of GGMOs against auxin, alike GGMOs influenced stem segment growth (Kollárová et al. 2006). The root growth inhibition, induced by GGMOs and/or IBA, was accompanied by the increase of cell wall-associated peroxidase activity and by a higher number of izoenzymes. Similarly, changes in the number of izoenzymes during pea root growth inhibition were observed (Kukavica et al. 2007).

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