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Hypoglycemic Activity of Twenty Plant Mucilages and Three Modified Products*

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Recently, a number of water-soluble components having hypoglycemic activity were isolated from the oriental crude drugs. Among them, the aconitans from the roots of *Aconitum carmichaeli* were clarified as glucans whereas the panaxans and ganoderans from the roots of *Panax ginseng* and the fruit bodies of *Ganoderma lucidum*, respectively, were found to be peptidoglucans. In addition to the above glucans, various heteroglycans were also isolated as active components. In this paper, we would like to discuss the relationship between the structure of polysaccharides and their probable hypoglycemic activity which were already characterized by Tomoda *et al.*

Most of the mucilages obtained from plants belonging to monocotyledoneae are partially acetylated glucomannans. On the other hand, Dioscorea-mucilage B is a partially acetylated mannan-protein complex. All the mucilages obtained from plants belonging to dicotyledoneae are mainly composed of acidic polysaccharides.

Paniculatan, the representative mucilage of a Saxifragaceae plant, has common structural units in its backbone chain to the mucilages isolated from plants in the Malvaceae family, but it possesses very different side chains from those of the latter mucilages. Plantago-mucilage A, the representative mucilage of a Plantaginaceae plant, is a different type of polymer even in component sugars from the other acidic polysaccharides described above.

Most of glucomannans were found to be inactive expect Lilium-A-glucomannan, Lilium-S-glucomannan and Dioscorea-mucilage B which showed weak activity. Among the Lilium-glucomannans, Lilium-A-glucomannan and Lilium-S-glucomannan belong to the same type regarding the location of *O*-acetyl groups.

The majority of the mucilages from the plants in the Malvaceae family exhibited significant hypoglycemic activity on *i.p.* injection to normal mice. Abelmoschus-mucilage M showed especially remarkable activity. This mucilage has the repeating structure (1→4)-[*O*-β-(D-glucopyranosyluronic acid)-(1→3)]-*O*-α-(D-galactopyranosyluronic acid)-1→2)-*O*-α-L-rhamnopyranose in its main part. Althaea-mucilage O, Okra-mucilage R and Hibiscus-mucilage Mo also possess the main chain composed of the same structural unit

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as that in Abelmoschus-mucilage M. They also show remarkable hypoglycemic effect. Most of the mucilages obtained from the plants in the Malvaceae family possess this trisaccharide structural unit in their main part but some of them have (1→2)-linked rhamnosyl rhamnose residues in part of their main chain and have (1→4)-linked galactosyl galactose side chains. These factors may have influence on the hypoglycemic activity.

Okra-mucilage F has no glucuronic acid branches at posiiton 3 of the galacturonic acid in the main chain, but it showed significant activity. So it may be concluded that the presence of glucuronic acid branches in the backbone chain consist of alternating (1→4)-linked α-D-galactopyranosyluronic acid and (1→2)-linked α-L-rhamnopyranose is not essential for the hypoglycemic effect. On the other hand, Althaea-mucilage R had the exceptionally very weak activity among the mucilages obtained from plants in the Malvaceae family. Among them, this is the sole example which possesses the side chains of glucuronic acid-(1→4)-glucuronic acid and of galactosyl-(1→4)-galactosyl-(1→4)-glucose. Therefore the presence of these side chains may inhibit the activity. This mucilage has the highest acetyl content among the plant mucilages of the Malvaceae family. Its deacetylation contributed to the elevation in the activity. So it may be able to point out that the presence of acetyl groups in the mucilage serves as a negative factor for the hypoglycemic activity. The deacetylation product of Plantago-mucilage A also showed the pronounced elevation in the activity.

The deacetylation of partially acetylated glucomannans from plants belonging to monocotyledoneae causes insolubility of the products in water. In contrast to them, the deacetylation of partially acetylated acidic polysaccharides genarally enhances the solubility in water. This fact may be applicable to enhance the activity in the case of Althaea-mucilage R. Whereas Plantago-mucilage A itself is freely soluble in water, so its deacetylation effect may be based on the change of its conformation.

The trisaccharide having the fundamental structural unit of the Malvaceae plant mucilages showed insignificant activity after 7 h of administration, though it has weak activity at 24 h. The acidic polysaccharides having the high activity contain the same common side chains. It may be presumable that both branching and relatively high molecular weight are some factors essential to rise the activity.