

The Structure of the Polysaccharides Produced by Higher Basidiomycetes *Tremella mesenterica* Ritz.: Fr. and *Inonotus levis* P. Karst.

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Polysaccharides are the best known and most potent mushroom-derived substances, with various positive health effects including immunostimulation, lowering glucose level in blood, anticancer activity, and many others. Biologically active polysaccharides are widespread among higher Basidiomycetes mushrooms, and most of them have unique structures in different species. There is still no clear correlation between biological activity and structural features of the polysaccharides. This situation results in part from poor knowledge of polysaccharide structures. Herein, we present the results from analyzing two polymers of *Tremella mesenterica* and *Inonotus levis*.

Tremella mesenterica (Yellow Brain mushroom) possesses a wide spectrum of medicinal properties, including immunostimulating, protecting against radiation, antidiabetic, anti-inflammatory,

hypcholesterolemic, hepatoprotective, and antiallergic effects. Glucuronoxylomannan (GXM), an extracellular polysaccharide produced by single cell culture of *T. mesenterica*, has a number of beneficial health effects. We developed a new strain of *T. mesenterica*, CBS 101939, which grows in submerged culture and offers superior yields of one-cell biomass rich in exocellular heteropolysaccharide GXM.

NMR and chemical analysis showed that it has a defined structure of repeating unit, which is *O*-acetylated at several points, stoichiometrically at *O*-6 of two mannose residues, and partially at GlcA residue, which is present in non-acetylated or acetylated at positions 3 or 4 forms (see Fig. 1).

These results differ from existing data on the structures of mushroom mannan-based polysaccharides, where mannan backbone was believed to be

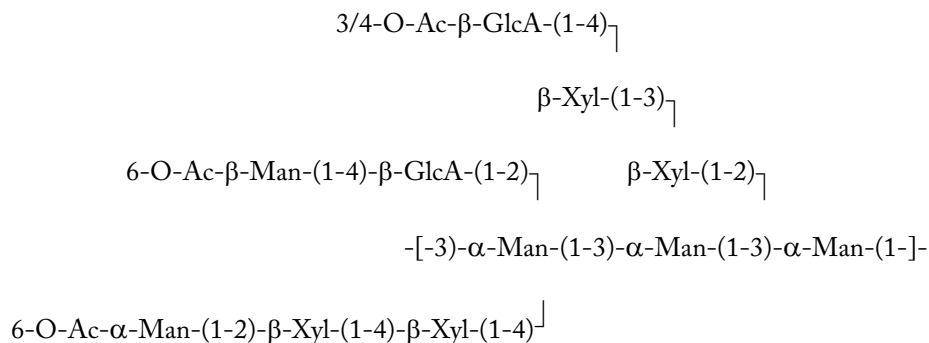


FIGURE 1. Structure of *Tremella mesenterica* polysaccharide.

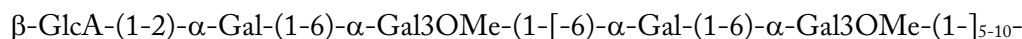


FIGURE 2. Structure of *Inonotus levis* polysaccharide.

randomly glycosylated with xylan chains of different lengths.

Inonotus levis polysaccharide had the structure shown in Figure 2, where terminal glucuronic acid residue is present in about half of the molecules, thus making some of the chains acidic and others neutral. We believe that these short polymeric chains

were originally attached to some protein via serine or threonine residue and were cleaved off due to alkaline conditions of extraction. Another polymer, co-extracted with this galactan, was a branched, phosphorylated mannan with a structure similar to that of the mannan from yeast *Saccharomyces cerevisiae* yeast.

***Cordyceps sinensis* (Berk.) Sacc.: Economy, Ecology, and Ethno-Mycology of Yartsa Gunbu, a Medicinal Fungus Endemic for the Tibetan Plateau**

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Collection, trade, and use of Yartsa Gunbu (dbYar rTswa dGun 'Bu), "summer grass-winter worm" as the *Cordyceps sinensis* (Caterpillar fungus) is known to Tibetans, has a long-standing history in Tibetan medicine and culture. Although ancient local traditions warn that digging of Yartsa would provoke local spirits, its collection dates back centuries. It has been, and is now more than ever, one of the most important sources of income for rural Tibetans, especially nomadic communities, who often derive over 50% of their annual cash income from its collection in spring and early summer.

The 15th century scholar and doctor Zurkhar Nyamnyi Dorje [1439–1475] mentions Yartsa Gunbu in his text "Oral Instructions on a Myriad of Medicines [*sic*]" (Man nGag bYe Ba Ring bSrel). However, according to some Tibetan doctors, it might have been recorded under a different name

in the "four Tantras" (rGyud bZhi) by Yuthok Yontan Gonpo (8th to 11th century). In Tibetan materia medica, *Cordyceps sinensis* is placed in the category of "medicinal essences" (rTsi sMan), which includes several tonics. It is used for general strengthening, boosting the immune system, and virility and is prescribed for kidney and heart problems. It is also used for treatment of hepatitis B. In Tibetan medicine Yartsa is prescribed mostly in compound remedies, which contain a variety of ingredients to balance each other, thus optimizing their efficiency and minimizing side effects.

Field studies in Ganzi Tibetan Autonomous Prefecture, Sichuan (1999–2004), and Nyingchi (Linzhi) prefecture, Tibet AR (2005), analyze collection techniques and trends, local markets and their participants, and the quantity and value of the harvest. Individual specimens are sold by collectors