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Isolation and characterization of an acidic polysaccharide from *Mesona Blumes* gum

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Abstract

A neutral polysaccharide (NMBG) and an acidic polysaccharide (AMBG) were fractionated from *Mesona Blumes* gum (MBG) with yields of 0.5% and 90% (w/w), respectively. AMBG was composed of Gal, Glc, Man, Xyl, Ara, Rha and GalA with a molar ratio of 2.66:1:0.37:2.29:12.5:5.99:23.5, and NMBG consisted of Gal, Glc, Man, Xyl, Ara, Rha with a molar ratio of 9.9:15.3:4.31:1.48:11.6:1. But there was no GalA in NMBG. Both AMBG and NMBG were homogeneous with Mw of 6566 and 5277, respectively. AMBG could form a viscous solution but NMBG could not. Structure features of the purified AMBG were investigated by a combination of chemical and instrumental analyses, such as periodate oxidation, Smith degradation, GC–MS, ^{13}C and ^{1}H NMR. It was found that AMBG possessed a α-(1 → 4)-galacturonan backbone with some insertions of α-1,2-Rha*p* residues. The branches of arabinogalactan, arabinan, galactan and xylan could be all attached to the backbone via O-4 of Rha*p* residues. In addition, some Rha*p* residues on the backbone terminated with α-L-Ara*f* and some O-6 in galacturonic acid residues could be acetylated and some O-6 in GalA*p* residues could be methyl estered. The molecular structure of AMBG at different concentrations was observed with atomic force microscopy (AFM). AMBG showed a spherical lump at 1 μg/mL, but an irregular shape like worm at 10 μg/mL, which indicated that the viscous property of AMBG might be caused by its strong tendency to aggregate.

Keywords: *Mesona Blumes* gum; Molecular weight; Monosaccharide component; Periodate oxidation; Smith degradation; GC–MS; ^{13}C and ^{1}H NMR; AFM

1. Introduction

Mesona Blumes is a herb from Lamiaceae family originally from South China and wide spread in Southeast Asia. In China, it has been used as a folk medicine for preventing heatstroke, hypertension, diabetes and muscle or joint pain. The unique aroma and health benefits of this herb make it popular to the Chinese. Traditionally the plant is consumed as a herbal tea or as a jelly-type dessert (a mixed gel with non-waxy type starch) (Lai & Lin, 2004).

Mesona Blumes contains an ionic polysaccharide gum, named *Mesona Blumes* gum (MBG). As compared with other commercial gums, MBG forms a low-viscosity solution with pronounced shearing-thinning behaviour (Lai, Tung, & Lin, 2000). Although the structural features of MBG are still unclear, Yang and Huang (1990) reported that the core of the structure was a heteroglycan, containing galactose, glucose, rhamnose, arabinose and uronic acid with a molar ratio of about 2:1:1:1:2. Lai, Liu, and Lin (2003) reported that the neutral sugar composition of crude MBG could be rhamnose, arabinose, galactose, glucose, xylose, mannose, fructose and erythrose at mole fraction of 13.68%, 10.26%, 20.86%, 23.25%, 6.84%, 14.71%, 10.26% and 0.14%, respectively, but the uronic acid content is not reported.

Polysaccharide gums have wide applications because of their rheological properties. Although MBG has a unique rheological property, there is lack of systematic structural analysis. In order to elucidate the relationship between the rheological characteristics of MBG and its structure,

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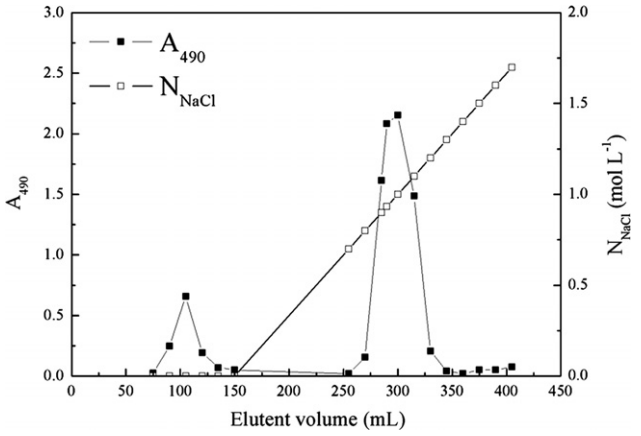

Fig. 1. Elution profile of MBG on DEAE-Sepharose Fast Flow (D2.6 × 50 cm).

this work describes: (a) isolation and purification of MBG; (b) molecular weight determination of MBG by High Performance Gel Permeation Chromatography (HPGPC); (c) structural characterization of MBG by periodate oxidation, Smith degradation, methylation analysis, UV, IR and NMR spectroscopy; and (d) clarification of the monosaccharide component and the bond structure in the MBG.

2. Materials and methods

2.1. Materials

Crude MBG was kindly donated by a Fujian farmer. DEAE Sepharose Fast Flow was bought from Pharmacia Biotech Ltd. (Denmark); D-mannose, D-Galactose,

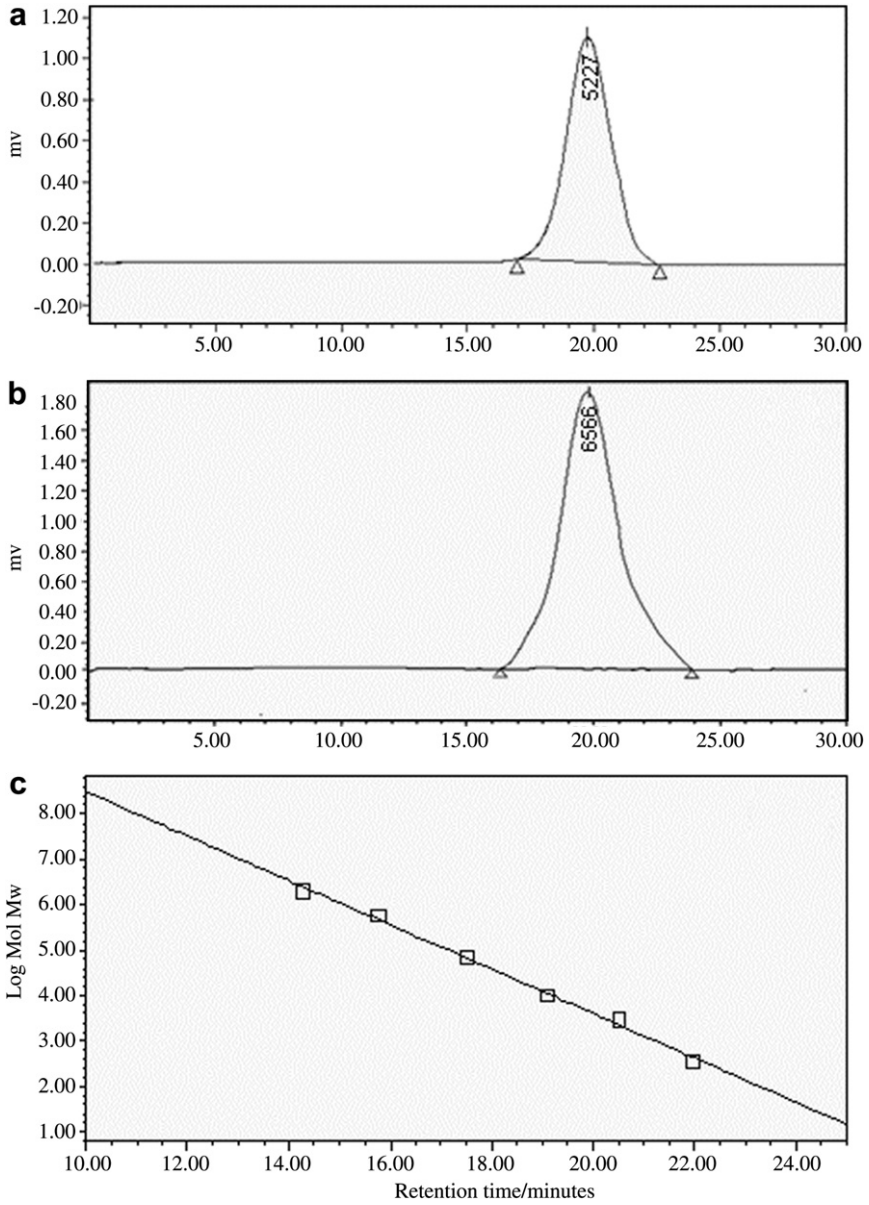

Fig. 2. HPGPC chromatograms on Ultrahydrogel column of (a) NMBG (b) AMBG. (c) Calibration standard curves of lgMw and relative retention time (t) of Dextran T on Ultrahydrogel. The linear fit equation of this standard curve was lg Mw = 13.7 − 0.499t, $R^2 = 0.9974$.