Astragalus membranaceus (Fisch.) Bge.

26.1 Introduction

Huangqi, Radix Astragali, is the dried root of Astragalus membranaceus Bge. var. mongholicus (Bge.) Hsiao or A. membranaceus (Fisch.) Bge. (Fabaceae). Astragalus root is a very old and well known drug in traditional Chinese medicine. It is officially listed in the Chinese Pharmacopoeia and used mainly as a tonic and for treatment of nephritis and diabetes.

Another entry in the Chinese Pharmacopoeia concerning the Astragalus species is Shayuanzi, Semen Astragali complanati, the dry ripe seed of A. complanatus R. Br. collected in late fall to early winter. It is used as a tonic against polyuria and vertigo.

26.2 Chemical Constituents

The biologically active constituents of Astragalus roots represent two classes of chemical compounds, polysaccharides and saponins.

Fang et al. [1] isolated from the aqueous extract of the roots of A. membranaceus var. mongholicus three polysaccharides, astragalan I, II, and III. These three polysaccharides are homogeneous as judged by glass fiber paper electrophoresis and gel filtration on Sephadex G-150. Astragalan I is composed of D-glucose, D-galactose, and L-arabinose in the molar ratio 1.75:1.63:1. It also contains a trace of pentose. The average molecular weight of astragalan I is 36300. The sugar component of both astragalan II and III is D-glucose. Their average molecular weights are 12300 and 34600, respectively. Astragalan II and III, when treated by peroxidation and Smith degradation, give rise to glycerol in addition to a large amount of erythritol. These results suggest that both astragalan II and III consist mainly of α(1→4) linked glucopyranosyl residues and also contain a small amount of α(1→6) linked glucopyranosyl residues.

Two glucans (AG-1, AG-2) and two heterosaccharides (AH-1, AH-2) were further isolated and purified from a water extract of the roots of A. membranaceus var. mongholicus [2]. By electrophoresis and gel chromatography, these four polysaccharides were shown to be homogeneous. AG-1 was identified as an α-glucan, with a ratio of α(1→4) and α(1→6) linkages of about 5:2. AG-2 was identified as a α(1→4) glucan. AH-1 is an acidic polysaccharide; the component sugars were identified as hexuronic acid (galacturonic acid and glucuronic acid), glucose, rhamnose, and arabinose in a ratio of approximately 1:0.04:0.02:0.01. AH-2 contains glucose and arabinose in a ratio of 1:0.15.

Kitagawa et al. [3] reported on triterpene oligoglycosides present in the roots of Korean A. membranaceus. By enzymatic and chemical degradation, two aglycones
were separated and structurally elucidated. One of the two aglycones was the 9,19-cyclolanostane type triterpene cycloastragenol (26-1), which is the common genuine aglycone of 10 out of 11 glycosidic saponines called astragalosides. The second aglycone was the lanost-9(11)-ene type counterpart astragenol (26-2), which is formed as an artifact secondarily from cycloastragenol.

Cycloastragenol (26-1)  
Astragenol (26-2)

The methanol extract of *Astragalus* roots was partitioned between n-butanol and water. The n-butanol soluble portion contained the total glycosidic constituents, which were further chromatographed on a reversed phase column. Eleven astragalosides and one soyasaponin were obtained. They are: astragaloside I–VIII (26-3–26-10), acetylastragaloside I (26-11), isoastragalosides I (26-12), II (26-13), and soyasaponin I (26-14) [4].

By chemical degradation and $^{13}$C NMR examination, the structure of astragaloside IV was elucidated as 3-$O$-$\beta$-$D$-xylopyranosyl-$6$-$O$-$\beta$-$D$-glucopyranosylcycloastragenol. Astragaloside I, II, acetylastragaloside I, and isoastragaloside I, II are acetyl derivatives of astragaloside IV [4].