Cordyceps sinensis (Berk.) Sacc.

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48.1 Introduction

Dongchonxiacao, Cordyceps, is the dry complex composed of the sclerotium of the fungus Cordyceps sinensis (Berk.) Sacc. (Clavicipitaceae) and the larva corpses of insects of the family Hepialidae, on which the fungus is parasitic. It is officially listed in the Chinese Pharmacopoeia and is used as hemostatic, mycolytic, antiasthmatic, and expectorant in the treatment of respiratory diseases and as a tonic.

48.2 Chemical Constituents

The chemical constituents of C. sinensis were first studied by Chatterjee et al. in 1957 [1]. A crystalline substance was isolated and named “cordycepic acid”, and was then identified by Sprecher and Sprinson as D-mannitol [2]. Further studies on the chemical constituents of Cordyceps revealed the presence of a series of known substances, but new structures or compounds with significant pharmacological efficacy were not found. The chemical constituents isolated from C. sinensis were amino acids, steak acid, D-mannitol, mycose, ergosterol, uracil, adenine, adenosine [3,4], palmitic acid, cholesterolpalmitate and 5a-8a-epidioxy-5a-ergosta-6,22 dien-3pß-ol (48-l) [5].

5a-8a-epidioxy-5a-ergosta-6,22dien-3ß-ol (48-1)

Since the production of C. sinensis has not satisfied demand, C. hawkesii was found as a substitute for C. sinensis. Comparison of the chemical constituents between C. hawkesii and C. sinensis based on thin-layer chromatography has shown that amino acid, alkaloid, sterol, and organic acid contents are similar [6,7]. Moreover, Cordyceps can be cultured submerged. Ergosterol, stearic acid, p-mannitol, mycose, uracil, uridine, adenine, adenosine. and 13 amino acids were seperated in both the cultured broth and mycelium of C. sinensis 181.

In addition, C. bamesii [9, 10], C. liangshanensis [11], C. militaris [12], and C. shanxiensis [13] were investigated botanically and chemically. They were all used as substitutes for C. sinensis. The D-mannitol contents in C. bamesii and C. sinensis were 8.7% and 7.8%, respectively, and the ergosterol contents in C. bamesii and C. sinensis were 1.2% and 1-1% respectively. The contents of proteins, total amino acids, and alkaloids in both species were also similar [9]. Cultivation of C. bamesii was also reprorted [14].

From ascocarps of C. sinensis, as water-soluble polysaccharide was isolated and purified by etanol fractionation and gel filtration. D-Galactose and D-mannose in a molar ratio of 1:1 were obtained by acid hydrolysis of purified polysaccharide. Chemical degradation and carbon 13 NMR spectrometic analysis showed that this polysaccharide is a highly branched galacto-mannan with a mannan core and galactosyl oligomer branches [15]. A water-soluble, minor galactomannan containing a small proportion of protein was further isolated from a 5% Na,CO, extract of C. sinensis. It showed a homogeneous pattern in gel filtration and the molecular weight was estimated to be about 23,000. This minor polysaccharide was mainly composed of Do-mannose and D-galactose in a molar ratio of 35 and had a highly branched structure [16].

48.3 Pharmacology

Both natural Cordyceps and cultured mycelia of C. sinensis have significant effects on the immune system of mice. They can increase the size of the spleen, decrease the size of the thymus, and prevent atrophy of spleen and liver and hypertrophy of the thymus in mice induced by cyclophosphamide [17]. The DNA, RNA, and protein contents in the enlarged spleen were significantly increased. The effect of the thymus was abolished by adrenalectomy. The extract increased the incorporation of [^{3}H] thymidine into spleen DNA in vivo and the proliferation of splenocytes in vitro. The active principle was found to be present in the stroma rather than in the lanra [18].

The aqueous extracts of natural Cordyceps and the cultured mycelia of C. sinensis can enhance the production of macrophages and activate the functions of the phagocytic system. They not only enhance the phagocytic activity of the macrophages, but also increase the alkaline phosphatase activity of the macrophages [19]. In addition, serum hemolysin and spenocytic immunohemolytic activities were elevated in mice immune suppressed by hydrocortisone. In normal mice, however, no such regulatory effect on humoral immunity was observed [20].

The polysaccharide of C. sinensis also showed immunostimulating activity in mice. It activated the phagocytic function of the reticuloendothelial system and of macrophages in the abdominal cavity and increased blood serum IgG and plasma corticosterone levels and spleen weight. The polysaccharide also antagonized spleen atrophy and leukocyte decrease induced by cortisone and cyclophosphamide, and the reduction of phagocytic function of macrophages in the abdominal cavity, but did not inhibit the anti-inflammatory function of cortisone [21].

Some results of clinical studies with C. sinensis for treatment of tinnitus [22], chronic nephritis [23,24], arrhythmia [25], and sexual hypofunction [26] were recently reported. For instance, treatment with C. sinensis significantly decreased proteinuria of the patients with chronic nephritis in 24 h. Two patients with hematuria as the major clinical manifestation responded with strongly decreased erythrocyte counts in urine [23].

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