



## Research status of pharmacological action of cordyceps cicadae

DUAN Qiong-hui, LI Yong\*, ZHENG Yi, Qing Feng, Wang Lu

Jiangsu Agri-animal Husbandry Vocational College, China

Corresponding Authors: **LI Yong**,

Associate professor, Jiangsu Agri-animal Husbandry Vocational College, China

### Abstract:

To exploit and utilize the resources of cordyceps cicadae and lay a theoretical foundation for related products, this paper briefly reviews the research progress of cordyceps cicadae's pharmacological effects in recent years, indicating that cordyceps cicadae has many pharmacological activities, such as protecting kidney, anti-convulsion, anti-oxidation, anti-tumor, antibiosis, analgesic and so on, and can be used as one of the main substitutes of *Cordyceps sinensis*.

**Key words:** cordyceps cicadae; *Cordyceps sinensis*; pharmacological action; development and utilization

### 1. Introduction

Cordyceps is a kind of fungi parasitic on insects, a few fungi and plants, and because *Cordyceps sinensis* has important medicinal value and economic value, it has been widely concerned by the world. The broad sense of Cordyceps includes not only important medicinal fungi such as *Cordyceps sinensis* and cordyceps cicadae, but also includes some pest biocontrol fungi such as anamorphic *Metarhizium anisopliae* and *Beauveria bassiana* which have been proved to be the fruiting bodies of Cordyceps (teleomorphs). The earliest record of *Cordyceps sinensis* in China is the record of silkworm larva in *Sheng Nong's herbal classic*, which has a history of about 2000 years. The second record is the processing method of cordyceps cicadae recorded in *Lei's Treatise on Preparing Drugs* in the fifth century AD. Cordyceps cicadae is a kind of medicinal cordyceps. It is an insect-fungus complex formed by the Clavicipitaceae fungus parasitic on cicada nymphs [1-2].

*Cordyceps sinensis* has greatly promoted the vigorous development of the Cordyceps industry. Because of the particularity of its growing environment, the market is often in short supply. Therefore, it has become a primary problem to find a substitute for *Cordyceps sinensis*. Cordyceps cicadae has the effects of anti-fatigue and improving sleep, together with historical records, and after years of clinical verification, it has become one of the main substitutes for *Cordyceps sinensis*. By consulting the published literature of Cordyceps cicadae, this paper summarized the current pharmacological action of the Cordyceps cicadae in detail, so as to provide reference for further development and industrialization of the Cordyceps cicadae.

### 2. Main function

#### 2.1 Protect the kidneys

Xie Wei and other researchers examined the effect of Cordyceps cicadae mycelium on chronic renal failure in rat model. The results showed that the mycelium of Cordyceps cicadae could significantly inhibit the increase of blood urea nitrogen and creatinine levels in rats with chronic renal failure, suggesting that it could effectively delay the process of chronic renal failure in rats, and could replace the mycelium of Cordyceps in clinical treatment of chronic renal failure [3].

Peng Xiuxiu<sup>[4]</sup> studied the effect of N<sup>6</sup>-(2-hydroxyethyl)-adenosine (HEA) on renal ischemia-reperfusion injury in mice by establishing a model of renal ischemia-reperfusion injury in mice. The results showed that HEA could alleviate renal ischemia-reperfusion injury, ameliorate renal histomorphological changes, significantly reduce renal cell apoptosis induced by ischemia-reperfusion in mice, and reveal the chemical nature and mechanism of the Anti-renal failure effect of *Cordyceps cicadae*. However, HEA binding receptors and related signaling pathways need further study.

## 2.2 Anticonvulsion

Zhu Bichun used the bioassay-guided method to study the effects of different samples isolated from cultured *Cordyceps Cicadae* on pentylenetetrazole-induced convulsion in mice. Hematoxylin-eosin staining and immunohistochemical staining were used to further explore the anti-convulsion mechanism of the components. The results showed that all the four components had anticonvulsant activity, and the component HEA could significantly prolong the survival time and reduce the mortality of convulsive mice. HEA, a functional component of *Cordyceps cicadae*, has anticonvulsant effect, and the mechanism may be playing an anticonvulsant role by activating adenosine A1 receptors<sup>[5]</sup>.

## 2.3 Antioxidative effect

Fengyin designed experiments to extract polysaccharides from *Cordyceps cicadae* by hot water extraction and different-concentration ethanol fractional precipitation. The antioxidant activity of Polysaccharides from *Cordyceps cicadae* was studied. The results showed that both 50% and 80% alcohol-precipitated polysaccharides had strong radical scavenging activity, and had certain reducing power and total antioxidant capacity. The antioxidant activity of Polysaccharides from *Cordyceps cicadae* showed that the polysaccharides from *Cordyceps cicadae* had good antioxidant activity and could be used as a natural antioxidant<sup>[6]</sup>. The antioxidant activity of 50% alcohol-precipitated polysaccharides from *Cordyceps cicadae* was stronger than that of 80% alcohol-precipitated polysaccharides from *Cordyceps cicadae*. Some studies also showed that the polysaccharides extracted from *Cordyceps cicadae* by water extraction and ethanol precipitation and by protein removal through Sevage method had higher DPPH radical activity<sup>[7]</sup>.

## 2.4 Antitumor activity

Xie Fei and others studied the antitumor activity of wild *Cordyceps cicadae* polysaccharides in vitro and in vivo, and investigated the inhibitory effect of different doses of wild *Cordyceps cicadae* polysaccharides on HeLa cells in vitro. The antitumor activity of wild *Cordyceps cicadae* polysaccharides in vivo and in vitro was tested in transplanted S180 tumor-bearing mice. The results showed that wild *Cordyceps cicadae* polysaccharides had obvious antitumor activity in vitro and in vivo, and the reason may be related to the enhancement of immune regulation and antioxidant activity<sup>[8]</sup>.

## 2.5 Antiseptic effect

Xu Hongjuan isolated and purified the antifungal active constituents from *Cordyceps cicadae* and identified their structures preliminarily. The results showed that it was feasible to use macroporous adsorptive resins for preliminary isolation of antifungal active constituents from *Cordyceps cicadae*. The main antifungal active constituents were identified by structural analysis in 70% ethanol eluent. The results showed that the antifungal active constituent of *Cordyceps cicadae* was myriocin. The minimum inhibitory concentration of myriocin on fungi was 0.02 mg/mL, which provided a basis for further study of *Cordyceps cicadae* and preparation of myriocin needed in pharmaceutical industry<sup>[9]</sup>. *Cordyceps cicadae* polysaccharides from Maoshan area have good antibacterial effect on *Escherichia coli* (G-), *Bacillus subtilis* (G+) and *Alternaria* fungi, and the mechanism of its antibacterial action remains to be further studied.

## 2.6 Analgesic effect

Zhu Weijian and others confirmed that the analgesic active substance in *Cordyceps cicadae* was HEA and it may play an analgesic role by activating adenosine A1R, downregulating A2AR and regulating a series of

pain-related genes to exert its analgesic effect<sup>[10]</sup>. This study confirmed that *Cordyceps cicadae* has anti-inflammatory and analgesic effects, and is expected to provide new ideas for clinical treatment of gout.

## 2.7 Other effects

The results of swimming test, hypoxia tolerance test, heat tolerance test and life span test of *Drosophila* showed that the decoction of *Cordyceps cicadae* had anti-stress and anti-fatigue effects, and could significantly prolong swimming time, survival time under normal pressure and hypoxia and survival time under high temperature. The high dosage group of *Cordyceps cicadae* decoction could significantly prolong the life span of male *Drosophila*, indicating that *Cordyceps cicadae* decoction had certain anti-aging effect<sup>[11]</sup>. Song Jiemin and others studied the effect of *Cordyceps cicadae* on hematopoietic function and its acute toxicity experiment. The results showed that *Cordyceps cicadae* had obvious anti-hemorrhagic anemia and anti-phenylhydrazine hydrochloride anemia effects. The experiment indicated that *Cordyceps cicadae* could promote hematopoietic function and no toxic effects were found.<sup>[12]</sup>

Some scholars have studied the effect of *Cordyceps cicadae* crude polysaccharides on antibody level of Newcastle disease. It shows that adding a certain dose of *Cordyceps cicadae* polysaccharides can effectively improve the immune effect of Newcastle disease vaccine<sup>[13]</sup>. Liu Suzhen and others studied the waste media of *Cordyceps cicadae* after artificial culture, and detected the effects of waste media with different levels of *Cordyceps cicadae* on the broiler serum immune factors, such as IL-2、IFN- $\gamma$ , and growth rate. The effect of *Cordyceps cicadae* waste media, as a kind of feed additive promoting chicken weight and immunity, was preliminarily explored and evaluated. The results showed that the medium of *Cordyceps cicadae* also has certain nutritional and pharmacodynamic functions. It can enhance the immune ability of animals without or with little medication, improve the survival rate and reduce the cost. It has significant effect of disease resistance and growth promotion, and can be developed into a new feed additive<sup>[14]</sup>.

## 3. Conclusion

Numerous experimental studies have shown that *Cordyceps cicadae* has immune regulation, anti-tumor, anti-aging, anti-oxidative stress, hypoglycemic, nourishing and strengthening pharmacological activities, and has the similar tonic effect with *Cordyceps sinensis*. Overexploitation of *Cordyceps sinensis* resources in the short term has caused grassland degradation, forage yield and quality decline, ecological environment deterioration and so on. It has been put on the agenda to find new *Cordyceps sinensis* resources, such as *Cordyceps Cicadae* and *Cordyceps militaris*, and to develop new health care products with the same efficacy. *Cordyceps militaris* has been approved as a new resource food by the Ministry of Health announcement No. 3 of 2009, and can be cultured artificially with bio-fermentation technology, which greatly alleviates the resources of *Cordyceps militaris*, promotes the development of related *Cordyceps* industry, and helps to promote the in-depth research and development of related products of *Cordyceps Cicadae*.

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