

# Research and Application of Chinese Herbs in Aquaculture of China

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## **Abstract:**

In order to draw attention from more and more researchers on Chinese herbs and thus to devote more energy into the study of it. This paper comes out summary and report. It mainly introduces types of Chinese herbs and its advantages over antibiotics and chemicals. In addition, it analyzes the mechanism and active ingredients of Chinese herbs, generalizing the current research and application of Chinese herbs in fishery industry in China. Finally, the essay conducts analysis on its existing problems and application prospects.

**Keywords:** Chinese herbs; aquaculture; application

China possesses abundant plant resources, and Chinese herbs have a wide range of applications from the ancient history. As early as the Southern Song Dynasty in China, records showed that Chinese herbs were used to treat fish disease. In recent years, a variety of disease problems outbreak due to the growing intensification of aquaculture mode, along with lack of technical means and degradation of germplasm resources which resulted in huge losses for aquaculture industry in China. The abuse of antibiotics leads to the drug residues in aquatic products bringing grievous problems on food safety. Because of its peculiarity, Chinese herbs can prevent and cure diseases, thus becoming more and more popular among people and playing an increasingly important role in aquaculture.

## **I. TYPES AND ADVANTAGES OF CHINESE HERBS**

Through thousands of years' researches, Chinese

herbs have accumulated plentiful experience in its efficacy, drug compatibility and drug dosage. In recent decades, Chinese herbs have carried out researches mostly in aquaculture and amassed a lot of experience. Several kinds of Chinese herbs are sorted, one type of which is anti-infection. For example, there are more than 400 kinds of Chinese herbs such as rheum officinale, golden cypress and scutellaria baicalensis having bactericidal and antibacterial effects and above 130 can be antibacterial; the second type is anti-virus. For example, over 50 kinds of Chinese herbs such as resin, saponin and indican possess effects of inactivation or inhibition on virus; the third is anti-parasite like azedarach, verbena and pulsatilla; the last is immune-enhancement. There are over 200 kinds of herbs containing immune-active substances which can increase the immune function of animals. For example, glycoside compound in astragalus and ginseng as well as alkaloid in sophora alopecuroides can both promote antibody production and regulate immune function. In addition, some Chinese herbs can not only promote glucose metabolism of body and synthesis of protein and various enzymes, but also stimulate gonadal development, improve the appetite of aquatic animals, promote its growth and regulate endocrine hormones [1]. Comparing to antibiotics or chemicals, the unique advantages of Chinese herbs are as follow:

### **A. Green Attributes**

Most Chinese herbs are plant-sourced; a small part comes from animals and minerals whose advantages include easy-accessible raw material, abundant resources and low costs. Chinese herbs

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leave no residue in aquatic animal body after metabolism and excreta have no pollution. Chinese herbs belong to green medicine material, compared with antibiotics and chemicals.

#### **B. High Production Efficiency**

Through years of development, the production and application of Chinese herbs are gradually improving. Processing and preparation of Chinese herbs mainly employ technologies including ultrafiltration membrane, ultrafine grinding and ultrafiltration membrane separation [4-6]. Dosage forms such as powder and water aqua are used for oral administration of aquatic animals and external use for aquatic water.

#### **C. Diversified active Ingredients**

Chinese herbs contain a variety of active ingredients, the main ingredients to make effects of nutrition of which are: protein, amino acid, vitamin, oil, resin, saccharide, plant pigment, macronutrient and microelement. Also, there are a large number of organic acid, alkaloid, polysaccharide, volatile oil, wax, glycosides, tannins and other unknown substances promoting growth, acting on aquatic animals which are difficult to produce drug resistance that can be used for a long time.

#### **D. Versatile Functions**

The diversification of active ingredients of Chinese herbs determines its complex functions. The comprehensiveness of Chinese herbs for fishery has many functions such as sterilization, anti-virus, anti-parasite, anti-stress, promoting growth, aiding digestion, improving fecundity, enhancing appetite and so on. The functions of many Chinese medicines not only include sterilization but also non-specific immune function enhancement, such as Radix, rheum officinale, scutellaria baicalensis, coptis chinensis and etc [6].

## **II. MECHANISM AND ACTIVE INGREDIENTS OF FISHERY CHINESE HERBS**

### **A. Mechanism of Chinese Herbs**

Mechanism of Chinese herbs to prevent and treat disease mainly lies in its complex components, polysaccharide, glycoside, alkaloid and other active

ingredients of which can be antiviral themselves or mobilize body's resistance to disease to enhance cell immunity and thus play a disease-resistance effect. Chinese herbs take effects in the form of unilateral and compound. Many studies have shown that pesticide effects can be enhanced through compatibility of Chinese herbs, thus reducing the dosage and lower production costs. For example, the inhibitory effects of combining andrographis paniculata, folium isatidis, lonicera japonica and rhizoma ligusticum wallichii by the ratio of 2:1:3:2 are more than 20 times of unilateral ingredient[7]; Li (2012) measured the minimum inhibitory and bactericidal concentration from gallnut, pomegranate, rheum officinale, rhizoma polygoni cuspidati, scutellaria baicalensis, coptis chinensis and other 15 kinds of prescriptions, the result of which showed that antibacterial function of gallnut in unilateral ingredient was the strongest, and coptis chinensis is the weakest, while the antibacterial function of 15 components is stronger than that of unilateral ingredient [8]; Zhang (2011) conducted an experiment respectively using 10 kinds of Chinese herbs and 4 kinds of prescriptions on oreochromis niloticus streptococcus iniae, the result of which showed that antibacterial function of combining golden cypress with coptis chinensis, rheum officinale with scutellaria baicalensis was more prominent than unilateral ingredient [9]. The synergy is produced among various Chinese herbs to achieve the purpose of improving efficacy.

### **B. Active Ingredients for Chinese Herbs to Exert Efficacy**

The reason that Chinese herbs can be able to play the efficacy is that it contains many active ingredients, such as polysaccharides, saponins, alkaloids, volatile oil, tannin, organic acid, flavonoid and etc. Polysaccharide can not only provide energy but also participate in various activities of cells with functions of anti-virus, anti-bacterial and immune regulation which possess significant bioactivity [10]. Polysaccharide is an important active ingredient in Chinese herbs, commonly existing in organisms, including astragalus polysaccharide, lentinan, poria polysaccharide, lycium barbarum polysaccharide,

polyporus polysaccharide and ginseng polysaccharide and so on [11].

Saponin is also an active ingredient in the Chinese herbs whose function of immune enhancement is discovered in fishery researches. Saponin can improve the phagocytosis of the reticuloendothelial system and promote response to the relevant immune cells in order to play the role of immunity. Common Chinese herbs containing saponins are alfalfa, ginseng, pulsatilla, panax, campanulaceae, ophiopogon, sichuan dipsacus and so on.

Alkaloids exist mainly in plants, the generic term of a class of nitrogen-containing alkaline organics in body. Most alkaloids containing complex ring structure, with significant biological activity, are one of the active ingredients of Chinese herbs. Many Chinese herbs exert bacteriostasis through alkaloids like kuh-seng, subprostrate sophora, sculellaria barbata, samara oil, sophora alopecuroides, coptis chinensis, D.Leptopodium Feade, lotus leaf, eggplant, tomato, pheasant parasitism, Tibet sophora moorcroftiana, fritillaria unibiateata and peganum multisectum.

Volatile oil, also known as essential oil, mainly contains three categories of compounds including aliphatic, aromatic and terpene series. It exists only in secretory tissue of plants and takes effects in fishery industry. Chinese herbs containing volatile oil include rhizoma atracylodes, schisandra chinensis, Angelica sinensis, rhizoma acori graminei, tenuifolia, pepper, bighead atracylodes rhizome, radix bupleuri, cordate houttuynia, fingered citron, cassia twig, clove, cinnamon, honeysuckle, cardamun, Chinese arbor-vitae, magnolia flower, cornel, cinnamomum lonoepaniculatum and so on.

Flavonoids are ubiquitous in Chinese herbs which can not only depress blood lipids, blood pressure but also inhibit platelet aggregation taking effects of anti-bacterial, anti-virus, liver-protection and anti-inflammatory for aquatic organisms. Chinese herbs containing flavonoids include mint leaves, ginkgo leaves, epimedium, citrus, okra, buckwheat, onion, licorice, astragalus, hawthorn, pomegranate,

onion, matrine, alfalfa and so on.

### III. THE RESEARCH AND APPLICATION OF CHINESE HERBS IN AQUACULTURE

#### A. *The Research and Application of Chinese Herbs as Feed Additives*

In aquaculture, phagostimulant is needed to be added in the fodder in order to promote the preference of aquatic animals on fodder, increase its appetite, improve fodder utilization, reduce water pollution, and shorten the breeding cycle. Chinese herbs are abundant in lomefloxacin, berberine, borneol, beet lactone, caffeine and etc. which are all the main factors with the attractant monomer. Fodders including allspice, petroselinum crispum, cardamun, white pepper, garlic, onion, mint and cumin all lay attractant foundation for loach and crucian, and there is obvious positive correlation between the attractant effect and concentration [12]. With the development of intensification in aquaculture, all culturists should strive for improving fodder utilization and reducing cultivation costs. The compound Chinese herbs additive composed of pericarpium citri reticulatae, angelica sinensis and liquorice are beneficial to the growth of carps and the reduction of fodder index. The production can be increased to 20% adding folium artemisiae argyi, bitter orange, medicated leaven, purslane, humifuse euphorbia herb and garlic into fodders for turtles and 7% adding dandelion, rhizoma atracylodia fennel into fodders for carps and oreochromis niloticus [13]. A variety of Chinese herbs contain various natural nutrients and bioactive substances which can promote animal metabolism and synthesis of protein and enzyme. With feed additive, fodder index can be lowered, thus promoting growth and weight of aquatic animals.

#### B. *Research and Application of Chinese herbs on the Immune Function of Aquatic Animals*

China has more than 2000 kinds of Chinese herbs with immune function, accounting for over 1/3 in the whole Chinese herbs. Studies have shown that many unilateral and compound Chinese herbs have significant immune effects. Taking an experiment on feeding grass carp with immune enhancer composed

of astragalus membranaceus, garlic, chrysanthemum, hawthorn and isatis root, Li (2012) found that phagocytic activity, LSZ activity, SOD and immune protective rate in the experimental group were all significantly higher than that of the blank group [14]. Wen (2012) feed *litopenaeus vannamei* with additive mainly composed of astragalus and isatis root, the result showing that protease, amylase and alkaline phosphatase increased remarkably [15]. Wang (2008) developed to add compound Chinese herb additive of 1g/Kg, and the immune function of Japanese eel is the best [16]. Zhang (1999) added over 10 kinds of compounds including flos *lonicerae*, fructus *forsythiae* and isatis root and results showed that turtle had no disease like ichthyophthiriasis, red neck disease or haemorrhoids [17].

#### ***C. Research and Application of Prevention and Control of Aquatic animal Disease***

Diseases of aquatic animals include bacterial disease, viral disease, parasitic disease and others. The use of Chinese herbs can effectively prevent and cure these diseases. Chinese herbs can effectively solve common bacterial diseases for fish, shrimp, shellfish, crab and other aquatic animals, eliminating clinic symptoms like ulceration, redness, white spot, enteritis, rotten gills and so on. Effective Chinese herbs to sterilize mainly include *scutellaria*, *coptis chinensis*, gallnut, *andrographis*, *folium*, *houltuynia*, honeysuckle, old *zygomatiscus*, *folium artemisiae argyi*, capillaris, burnet, *sophora*, *schisandra*, garlic, pomegranate, ebony, hematoxylin and so on [18]. Unilateral of Chinese herbs, such as golden cypress, *scutellaria*, *forsythia*, honeysuckle and isatis root have good efficacy of killing the virus; medicines to achieve the effect of killing virus in the form of compound include Shuanghuanglian injection, Jingfang oral liquid, antiviral capsules and others. Parasitic diseases mostly occur in the body surface and gill of fish, crab, shellfish and other aquatic animals, resulting in surface lesion, gill blacking, mucus increasing and internal organ damage. Parasites leave comparatively large harm to aquatic animals including melon worms, trichodina,

dactylogrus and etc, the mortality rate of which is very high. Common herbs to kill parasites are betel nut, *cyrtomium fortunei*, rhubarb, golden cypress, *poria*, *radix stemonae*, *sophora*, *melia azedarach* and *artemisia annua* [19].

Chinese herbs proves effective in the prevention and treatment of fish disease and improvement of the survival rate which is mainly owing to its immune function, as well as its unique function to scavenge and inhabit generation of free radical and increase enzyme activity of the anti-free radical. In conclusion, trace elements contained in Chinese herbs are the important material basis in the prevention and treatment of diseases.

### **IV. CURRENT PROBLEMS AND APPLICATION PROSPECT OF CHINESE HERBS FOR FISHERY**

#### ***A. Current Problems***

Although there are some successful attempts of Chinese herbs for fishery on aquatic animals, many problems should be paid attention on the real realization of promotion and application of aquaculture in aquaculture which can be summarized in three aspects: (1) Chinese herbs exert efficacy usually through its active ingredients. However, due to the picking in different time and geographical areas, active ingredients differ greatly from each other which are difficult to accurately evaluate the efficacy and control its quality. At present there are no strict quality control standards, failing to guarantee the superb and stable production of the stereotypes products. (2) The current use of Chinese herbs still remains in the stage in the original powder and decoction that refined products are quite few. The absorption and digestion effects for aquatic animals on ordinary powder are poor, so the low technology contents constrain its further development. (3) The mechanism research of Chinese herbs mostly employs traditional Chinese medicine theory, while the exploration on mechanism of Chinese herbs needs to be further studied.

#### ***B. Application Prospects of Chinese Herbs for Fishery***

With the upturning of people's living standards, and increasing health consciousness and

environmental awareness, the quality of aquatic products, drug residues and other issues are increasingly concerned. Chinese herbs, as a safe alternative to antibiotics and chemical drugs, have a promising application prospect in the aquaculture industry [20]. Future research and development of Chinese herbs should focus on the following aspects: (1) Efficient extraction and separation of effective medicinal components from Chinese herbs, using modern plant chemistry and instrumental analysis techniques. (2) Take more in-depth study of the mechanism of effective components, combined with medicine, nutrition and drug metabolism, studying its mechanism of improving the body immunity from the aspects of metabolic utilization and immune adjusting mechanism. (3) The development of Chinese herbs related testing standards to strengthen the quality control of Chinese herbs raw materials and finished product, and in-depth study also should be conducted on product safety. (4) Study of ion channels, mechanisms of action, operation rules, transformation processes, drug structures and drug relationships, fully studying the laws of absorption, distribution, transformation and excretion of Chinese herbs in aquatic animals, and laws of the environmental impacts of the drugs, to determine the quantity and duration of residues in aquatic animals to have an in-depth study of safe medication.

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