Potential of medical herbal products to be used in aquaculture

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Abstract

In many stages of aquaculture phases, fish are affected by various stress factors such as excessive stock density, poor water conditions, inadequate nutrients, grading and transport effects. These conditions adversely affect fish health and increase the risk of disease. Various chemicals (antibiotics, hormones, chemotherapeutics and vitamins) have been used in fish farming for many years to prevent these negative situations or reduce their effects on aquaculture. However, the damage caused by the chemicals to the environment, fish and and humanity as a result of consumption of fish is undesirable. Therefore, as an alternative to chemicals, studies on the use of spices and medicinal plants in aquaculture have accelerated in recent years. The various compounds of the plants used in these studies have antibacterial, antifungal, antioxidant, antiviral, antiparasitic, immunosuppressive effects. Due to these effects, they can be used as an alternative to synthetic products. This presentation, which examines the properties of herbal products and their benefits to aquaculture, intends to evaluate the use of the said products in the field of aquaculture.

Keywords: Aquaculture, medicinal herbs, diet, phytoadditives, herbal extracts

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Introduction

Aquaculture and rapidly developing industry . This rapid growth process is an increase in bacterial, viral, fungal and parasitic diseases together with some environmental interactions. Infectious diseases, health problems and economic damages caused by these diseases are the leading ones among the most important problems faced in the fish farming enterprises. Various chemicals (antibiotics, hormones, chemotherapeutics and vitamins) are used for many years in aquaculture to prevent or reduce their effects (CITARASU 2010). However, since 1 January 2006, due to the bacterial resistance or threatening effect on human health putting residues in animal by-products, using antibiotics as a feed additive has been banned in the European Union. With this prohibition, the use of plant species as a feed additive has been a good alternative for controlling bacterial diseases, promoting growth performance and reducing mortality by protecting the health of the gastrointestinal microflora (HERMANN et al. 2003; GODA 2008; KESER and BİLAL 2008 and ABDEL-TAWWAB et al. 2010).

1-Herbs as growth promoter

Researches on the aquaculture sector has revealed that medicinal plants are effective on the growth parameters in fishes (RAO et al. 2006; PALACIOS et al. 2006 and ALY et al. 2008). Studies on the fish species of tilapia (*Oreochromis niloticus*) and common carp (*Cyprinus carpio*) revealed that the *Quillaja saponin* plant added to the feed reduced the feed conversion ratio while increasing protein efficiency ratio, apparent lipid utilization, apparent energy utilization and specific growth rate (FRANCIS et al. 2001; FRANCIS et al. 2002a and FRANCIS et al. 2002b). Specific growth rate, apparent lipid utilization and apparent energy utilization of tilapia (*Oreochromis niloticus*) fed with feed containing

ginseng (Panax ginseng) (Ginsana G115) herb supplementation at different ratios were found to increase (GODA 2008). In a different study, it was reported that the extract of thyme (*Origanum heracleoticum L.*) increases weight gain and condition factor in channel catfish (*Ictalurus punctatus*) and provides a good feed conversion ratio (ZHENG et al. 2009). SHALABY et al. (2006) reported that the garlic used in the feed of tilapia (*Oreochromis niloticus*) caused an increase in the specific growth ratio and protein efficiency ratio. It has been reported that the use of red clover in the feed of tilapia (*Oreochromis aereus*), improves the feed conversion ratio, specific growth rate, protein efficiency ratio and apparent protein utilization (TURAN 2006). DAKAR et al. (2008) found that basil increased the amount of specific growth ratio and protein efficiency ratio in *Oreochromis niloticus* x *O. aureus*. In another study, a mixture of fenugreek (*Trigonella foenumgraecum L.*), *M. fragrens*, *P. betel*, *P.Carylifolia* and *Camheria sp*. was added at a ratio of 1% to the feed of *Labeo rohita* and the amount of protein efficiency ratio increased significantly while the feed conversion ratio did not change (PAUL et al. 2004). In a study by AHMAD and TAWWAB (2011), it was determined that the specific growth ratio, protein efficiency ratio, apparent protein utilization and apparent energy utilization of tilapia (*Oreochromis niloticus*) fish fed with cumin-containing feeds were increased. There are side effects of medicinal plants or spices as well as their several positive effects. Side effects of herbal sources can becaused by their contents of toxic components and by their overdose use. However, there are no problems arising from proper dosage and use (AHMAD et al. 2006). The preliminary determination of the effects of herbal sources to be used in fish farming will ensure that the aquacultural activities are carried out in a healthy manner and that the economic losses that may be caused by disease and developmental disorders can be eliminated in advance.

2-Herbs as antibacterial agents

ZILBERG et al. (2010) found that the rosemary plant has resistance to *Streptococcus iniae* and *Streptococcus agalactiae* bacteria in tilapia (*Oreochromis sp.*) fish. Antagonistic activity of the medicinal herbs *Curcuma longa*, *Ocimum sanctum* and *Azadirachta indica* against *A. hydrophila* was found to be effective in goldfish following disease challenge (HARIKRISHNAN and BALASUNDARAM 2008). NYA and AUSTIN (2009) observed the control of *A. hydrophila* infection after feeding with *A. sativum* (0.5 and 1 g/100 g of feed for 14 days) to rainbow trout, *O. mykiss* (Walbaum). AHILAN et al. (2010) observed that the addition of *Phyllanthus niruri* and Aloe vera (*A. Barbadensis*) as herbal additives can positively enhance the growth performance of goldfish (*Carassius auratus*) as well as its resistance to *A. hydrophila* infections. Studies have shown that many plants have antibacterial effects on fish and crustaceans. The antibacterial active principles of the herbals may lyse the cell wall, block the protein synthesis and DNA synthesis, inhibit the enzyme secretions and interfere with the signalling mechanism of quorum sensing pathway.

3- Herbs as antifungal agents

According to HUANG et al. (2015), the use of Magnolia (*Magnolia officinalis*) and Euphorbiaceae (*Euphorbia fischeriana Steud.*) forms strongest antifungal effect against *Saprolegnia sp*. GORMEZ and DILER (2014) analysed the essential oils of the three Lamiaceae species, black tyme (*Thymbra spicata L.*), oregano (*Origanum onites L.*) and savory (*Saturejatymbra L.*) which have chemical composition and antifungal effect against *Saprolegnia parasitica*. The herbal extracts contain the fungal cell wall lysis changing the transmissivity, affecting RNA, the metabolism and protein synthesis leading to death.

4- Herbs as anti-parasitic agents

In the study of CHITMANAT et al. (2005a), it was determined that *Terminalia catappa* caused antiparasitic, antibacterial and antifungal effects in tilapia (*Oreochromis niloticus*). In a different study, it was observed that garlic (*Allium sativum*) and sea almond (*Terminalia catappa*) plants had antiparasitic effect in tilapia (*Oreochromis niloticus*) (CHITMANAT et al. 2005b). According to YAO et al. (2010) the leaves of *Macleaya cordata* in different concentrations against *I. multifiliis*-infected grass carp (*Ctenopharyngodon idella*) decreased the rate of parasites on the fish gills. MADSEN et al. (2000)

showed that trichodinids (*Trichodina jadranica*) in eel fish could be treated by the raw garlic at 200 ppm. EKANEM et al. (2004) demonstrated that the crude extracts of *Carica papaya* (Caricaceae) and *Mucuna pruriens* (Fabaceae) could be used against the protozoan fish parasite *Ichthyophthirius multifiliis*. SUZUKI et al. (2006) found that the raw extract of the green tea (*Camellia sinensis*) had a strong effect for controlling of the flagellate fish parasite *Ichthyobodo necator* in salmon (*Oncorhynchus masou*) and in chum salmon (*Oncorhynchus keta*).

5. Herbs as antioxidant agents

Studies have shown that most compounds with antioxidant properties increase immunity in fish (HARIKRISHNAN et al. 2009; WU et al. 2010 and HARIKRISHNAN et al. 2011). The mechanism of antioxidant substances can be evaluated in two ways: enzymatic and nonenzymatic. Enzymatic mechanism is carried out by enzymes such as superoxide dismutase (SOD), catalase and glutathione peroxidase. Albumin, seruplazin and transferrin proteins contribute to this system by binding iron and copper (MASELLA et al. 2005). Flavonoids from diets (non-enzymatic) reduce ions by forming chelates with metal ions (iron and copper) in a similar manner with his mechanism (MIRA et al. 2002). Blood glucose is one of the most important physiological indicators that show whether fish are stressed. It has been reported that fish have increased glucose during disease periods and under the effect of any source of stres (HEATH 1995). In reviewing the studies on the use of herbal sources in fish, it is observed that the plants including bermuda grass (*Cynodon dactylon*), bael (*Aegle marmelos*), *Withania somnifera* (*Ashwagandha*), ginger (*Zingiber officinale*), mango (*Mangifera indica*) and garlic (*Allium sativum*) reduce blood glucose levels. On the other hand, plants including rhubarb (*Rheum officinale*), mango (*Mangifera indica*) and stinging netle (*Urtica dioica*) increased glucose (IMMANUEL et al. 2009; NYA and AUSTIN 2009; SAHU et al. 2007b; SAHU et al. 2007a; XIE et al. 2008 and AWAD 2010). The amount of superoxide radical was found to be lower in fish fed with feeds including green tea (*Camellia sinensis*) extracts, resulting in an increase in reactive nitrogen production, lysozyme, myeloperoxidase, complement and antiprotease activities (HARIKRISHNAN et al. 2011). It is observed that the total amount of protein, albumin and globulin is generally increased by the use of herbal sources in fish (GODA 2008 and XIE et al. 2008). In one study, however, garlic (*Allium sativum*) reduced total protein when used in a low ratio (SAHU et al. 2007a). In a different study involving mango (*Mangifera indica*) added to feed, it was reported that albumin decreased by 0.5g/100g (SAHU et al. 2007b). In another study, carvacrol, thymol, a combination of carvacrol and thymol and Orego-Stim were added to the fish feed of channel catfish (*Ictalurus punctatus*) and the lysozyme, SOD and catalase ratios were increased in the Orego-Stim added group (ZHENG et al. 2009). The antioxidant effects of plant products come from the phenolic compounds. These products prevent the formation of diseases in fish and crustaceans by preventing the reactions caused by free radicals.

6- Herbs as immunostimulants for fish

Phagocytic activity, NBT, myeloperoxidase and serum lysozyme are important parameters that provide information on the non-specific defense mechanisms in fish. In the study conducted by YIN et al. (2006), phagocytic and lysozyme activities were increased when *Astragalus radix* extract was added to the feeds of tilapia (*Oreochromis niloticus*). In another study, resistance to the increase in NBT, lysozyme, phagocytic activities was observed when *Astragalus* and *Lonicera* extracts were added to tilapia (*Oreochromis niloticus*) fish feeds (ARDO et al. 2008). In another study, an increase in the amounts of lysozyme and phagocytic were observed when *Lonicera japonica* and *Ganoderma lucidum* plants were added to tilapia (*Oreochromis niloticus*) fish feeds (YIN et al. 2008). In a study by HARIKRISHNAN et al. (2010), NBT, lysozyme, ACH50, phagocytic activities were increased when a plant extract mixture (*Punica granatum*, *Chrysanthemum cinerariaefolium* and *Zanthoxylum schinifolium*) was added to olive flounder (*Paralichthys olivaceus*) feeds. Herbal products have the potential to be used as supplementary to chemopreventive agents, antibiotics and vaccine in aquaculture fish. In addition, the nutritional properties, biodegradability, safety of herbal immunostimulants and the fact that they don't cause a

harm to human health play an important role in their popularity.

7- Herbs as adjuvants in vaccine

Adjuvants are a significant component for efficiency in most vaccines. THANGAVIJI et al. (2012) found that the use of immunoproteomic *Aeromonas* OMP vaccine obtained from the herbal adjuvant *A. racemosus* extract gives a protection against *A. hydrophila* in ornamental goldfish (*Carassius auratus*). According to KUMARAN et al. (2010), use of anti WSSV IgY obtained from herbal immunoadjuvant *Asparagus racemosus* had a strong immunological influence against WSSV infection in *Penaeus monodon*. In the studies it was seen that, herbals were used as adjuvants in vaccines.

8- Herbs as antiviral agents

Many herbals as home remedies have been used for millennia and some of these herbals have potent anti-viral features. A few of them have been demonstrated to have anti-viral effect against fish viruses involving in tissue culture (DIREKBUSARAKOM et al. 1996a) and some have been asked for their talent against shrimp viruses (DIREKBUSARAKOM et al. 1996b). ERTURK et al. (2000) found out that the crude extracts, got from *Laurus nobilis*, *Aconitum nasutum*, *Hypericum androsaemum*, *Daphne glomerata*, *Nerium oleander*, *Prunus laurocerasus*, *Olea europaea*, *Punica granatum*, *Rhododendron caucasicum* and *Urtica dioica*, controlled the nuclear polyhedrosis virus (NPV) observed in *Spodoptera frugiperda* cell culture. In viral suspension tests, the antiviral effect of essential oils and eucalyptus oil showed a high level of antiviral activity against HSV-1 and HSV-2 (SCHNITZLER et al. 2001). *Allium sativum*, (PARIDA et al. 1997), *Azardirachata indica*, *Melia azedarachta* (RAO et al. 1969) and *Phyllanthus emblica* (PATEL et al. 2000) had an antiviral effect against many kind of animal viruses and plants. In order to test their antiviral effects against WSSV, various traditional Indian medicinal plants such as *Allium sativum*, *Aristolochia indica*, *Azadirachta indica*, *Cassia fistula*, *Curcuma longa*, *Lantana camara*, *Melia azedarach*, *Momordica charantia*, *Ocimum americanum*, *Phyllanthus amarus*, *Psidium guajava* and *Tylophora indica* analysed by BALASUBRAMANIAN et al. (2007). Among extracts of plants differently tested, just five of them (*A. marmelos*, *C. dactylon*, *L. camara*, *M. charantia* and *P. amarus*) had antiviral effect against WSSV. To sum up in the study, herbals have a significant effect as adjuvants in vaccines.

Conclusion

The need for alternative substances has increased due to the fact that use of antibiotic is not wanted in food and bacteria gains resistance to antibiotics. Plants are a good alternative for their various compounds and properties. In addition, they have positive aspects such as been supplied easliy, being cheap and natural contributions. It is seen that, the plants thanks to their components have antibacterial, antifungal, antiviral, antiparasitic affect, as well as they have immunosuppressive, hematological and rehabilitative features, so they could be accepted as an alternative to synthetic products. Studies on the availability of plants in aquaculture have been ongoing. The effects of plants on immunology, biochemistry, hematology, environmental impact, nutritional composition and growth performance are important. Elimination of deficiencies in these areas will make contribution seriously to aquaculture activities and science. This article is presented at the International Conference on Advances in Natural and Applied Sciences (ICANAS 2018) congress.

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