

## Role of immunomodulatory plants in pisciculture

SEEMA GUPTA AND PREETI MISHRA

Department of Zoology and Biotechnology, Government N.P.G. Science College, RAIPUR (C.G.) INDIA

(Received: January, 2011; Accepted : February, 2011)

Gupta, Seema and Mishra, Preeti (2011). Role of immunomodulatory plants in pisciculture: A Review. *Asian J. Bio. Sci.*, **6** (1) : 147-151.

The basic function of immune system is to protect individuals against pathogens which put the immune system in a vital position between a healthy and diseased state of a host. Thus, it plays a crucial role in the defense against infections. Its integrity and effectiveness is important for the treatment of diseases. Therefore, modulation of immune system is to overcome disease that has been attention of many researchers. Immunomodulators are the substance of biological or synthetic in origin that can stimulate, suppress or modulate any of the components of the immune system. Immunostimulants, immunosuppressant and immunoadjuvants are the three groups of immunomodulators. Immunostimulants are likely to serve as promoting agent by enhancing the basic levels of immune responses, immunosuppressant could be used to control the pathological immune response and are active in autoimmune disease where as immunoadjuvants are to increase the effectiveness of vaccine. In traditional medicine, different plant parts and their products are believed to have specific medicinal properties including the ability to stimulate the body's immune mechanism (Craig, 1999). That's why Ayurveda termed "Rasayan" is devoted to enhancement of body resistance (Thatte and Dahanukar, 1997). Sharma (1981) identified list of thirty four plants as 'Rasaynas' in the Ayurvedic system of medicine. Agrawal and Singh (1999) reviewed fourteen indigenous medicinal plants investigated in laboratory on mammalian models for immunomodulatory effect. *Eclipta alba* (Lal *et al.*, 2010) and *Cynodon dactylon* (Santhi and Annapoorani, 2010) were also reported for immunomodulation. A survey of literature shows that people knew about the medicinal importance of plant few centuries back. However, it is only during the past few decades that re-emphasis has been given to their uses on health and treatment of diseases. There is not much information available on the immunomodulatory effect of

medicinal plants on the fishes which forms valuable source of food for mankind.

Fish culture is an age-old practice in India, which is the second largest fish culture producer in the world. Healthy or disease resistant culturable fishes are essential requirement for profitable aquaculture, which is achieved by providing nutritious diet or some natural or chemical substances that improve the general health of the fish or strengthen their immune system. Various synthetic chemicals and antibiotics have been used to prevent or treat fish diseases with partial success. However, the emergence of antibiotic resistant microorganisms is an important obstacle to their extensive uses. Subsequently, the use of botanicals as immunostimulant substances was introduced as a prophylactic measure. Since such uses have so far not shown any of the negative side effects that antibiotics and live vaccines may have on the fish and on the environment, they are attractive way of controlling fish infections (Mulero *et al.*, 1998) and development of resistance against pathogens. Direkbusarakom (2004) reported the major role of herbs and herbal products in aquaculture.

Botanicals have broad spectrum activities and can be extracted in commercial qualities. They are biodegradable and easily reversed in fish subjected to chronic concentrations (Fafioye, 2005). That's why in many parts of our country, plants are used in the traditional fishing system (Kadamban and Balachandram, 2005). Some plants have insecticidal, piscicidal and molluscicidal properties (Singh *et al.*, 2010). Piscicidal plants may be useful in developing eco-friendly methods to eradicate fishes from the aquaculture ponds without using any hazards chemicals. Several plants have toxic effect on weed fishes (Olafayo, 2009). That's why they are used to eradicate the unwanted fishes from the aquaculture ponds. One of the important plant *Azadirachta indica* exhibit strong insecticidal activity used to control predators

of fish and fish fry such as dragon fly larvae and are reported to be less toxic to fish than synthetic insecticide used in fish farming (Dunkel and Ricilards, 1998). Another common widely used plant of India is *Eurphorbia royleana* having high molluscicidal activity that protect the fishes from helminthes parasites and piscicidal activity (Singh and Singh, 2009).

The prospects of using plant extracts in the treatment of epizootic ulcerative syndrome and some parasitic diseases like myxobolosis, trichodinosis, gyrodactylosis and argulosis in (Compbell *et al.*, 1998) farmed tropical fresh water fishes have been fruitful and has opened a new approach in disease control and fish health. Use of traditional herbs to control fish diseases has been reviewed by Compbell *et al.* (1998). The infection of *Aeromonas hydrophila* causes severe losses on global fisheries and fish culture. Harikrishnan and Balasundram (2008) examined the antibacterial activity of an aqueous herbal concoction in arresting the *in vitro* growth of *Aeromonas hydrophila* and treat the *A. hydrophila* infected gold fish (*Carrassius auratus*) with aqueous herbal concoction obtained from three plants (Neem, Tulsi, and Turmeric) and examine the good recovery changes. *Terminalia cattappa* is a medicinal plant that promising to prevent fish diseases. Its leaf extract was active against Staphylococcus bacteria and shows antifungal property (Chansue and Assawawongkasem, 2008). It is also claimed as promoting substance for wound healing and affects the hematology of Siamese fighting fish (Chansue, 2003). *T. cattappa* is also affecting the monogenean parasite of *Carrassius auratus* (Chansue and Tanagtrongpiros *et al.*, 2005). Herbs have also been tried in other countries for the control of shrimp and fish diseases, and successful results have been reported in Mexico, Thailand, China, Japan, Turkey etc. Direkbusarakom *et al.* (1998) reported the efficiency of Thai traditional, garlic and onion herbs against fish and shrimps pathogenic bacteria that causes serious problem in aquaculture. *Andrographis paniculata* is a famous medicinal herb for treatment of bacterial infections and is used in China for the treatment of enteritis in fresh water fish (Rath, 1990). *Mamordica charantia* and *Psidium guajava* are the other important herbs for control of fish and shrimp bacterial diseases (Direkbusarakom *et al.*, 1998).

Recently, growing interest has been paid to the immune stimulating function of some herbs in aquaculture. There are many workers who have reported the immunomodulatory effect of different medicinal plants on fishes like *Lycium Chinese* (Kwon *et al.*, 1999),

*Ocimum sanctum* (Logambal *et al.*, 2008), *Azadirachta indica* (Logambal and Michael, 2001), *Tinospora cordifolia* (Sudhakaran *et al.*, 2006), *Eclipta alba* (Chrystibapita *et al.*, 2007), *Viscum album*, *Utricular diocea*, *Zinger officinalis* (Dugenci *et al.*, 2003), *Astragalus radix*, *Scutellaria radix* (Yin *et al.*, 2009), *Achryanthus aspara* (Vasudeva Rao and Chakrabarty, 2004). Nonspecific immunostimulants such as plant extract and natural synthetic preparations are widely used for enhancing the reactivity of defense system against chronic diseases. The specific and non specific defense mechanism were elevated in common carp *Cyprinus carpio* (Swicky, 1989) and in rain bow trout *Oncorhynchus mykiss* (Jenny and Anderson, 1993) by the use of herbal diet. Rao and Chakrabarty (2004) reported the enhanced protease inhibitor levels in *Labeo rohita* when fed with *Achryanthus aspera* mixed diet, thus the host can defend more strongly against invading pathogens.

Chansue *et al.* (2000) and Chrystibapita *et al.* (2007) reported the non-specific immunity such as bacteriolytic activity and leukocyte function was improved by mixture of Chinese herbs and extract of *Eclipta alba* leaf in and Tilapia. The phagocytosis by white blood cells and lysozyme activity in the serum were increased by the use of herbal diet in *Carassius carassius* (Chen *et al.*, 2003) and *Cyprinus carpio* (Jijan, 2002). Robertson *et al.* (1990) showed an increased protection against fish bacterial infection which was correlated with increment in serum lysozyme levels, phagocytic activity and bactericidal activity of head kidney leukocytes in Atlantic salmon (*Salmo salar*). Chinese herbs enhance immune response of carp *Cyprinus carpio* and protection against *Aeromonas hydrophila* (Yin *et al.*, 2009). It is proved by experiments that, in Tilapia the *Astragalus radix* had a positive influence on the immune system by acting as a booster (Yin *et al.*, 2009). Not only the adult, fry and fingerling of fishes were also protected by plant immunomodulators. Neem leaves, garlic and turmeric powder also induced disease resistance in fry of Indian major carp *Catla catla* (Dey and Chandra, 1995).

Herbal application may also be the practical use in disease management strategy in fish. Mohamad and Abasali (2010) reported the enhancement in immunity and resistance to *A. hydrophila* in common carp (*Cyprinus carpio*) fed with plant extracts supplemented diet. Several immunostimulant plant products significantly influenced the fish/ shrimp larviculture (Citarasu *et al.*, 2003). Sivaram *et al.*, (2004) controlled the vibrio pathogen and improved the immune system of grouper larviculture using herbal methanolic extracts, which suggests that

phytochemical could be an alternative and safe to use in aquaculture. In grouper (*Epinephelus tauvina*) juvenile affected with *Vibrio harveyi* were treated with herbal extracts (*Cynodon dactylon*, *Piper longum*, *Phyllanthus niruri*, *Tridax procumbens* and *Zingiber officinalis*), shows significantly increased the survival, growth and immune responses compared to control group. (Punitha *et al.*, 2008).

Immunomodulator can also act as growth promoter. In India, *Asparagus racemosus* was used in *Labeo rohita* as growth promoter (Kavita and Sharma, 1996). Similarly ethanolic extract of seeds of *Garcinia kola* also act as growth promoter in *Clarias gariepinus* (Dada and Ikuerowo, 2009). The medicinal herb mixture of *Masa medicate fermentata*, *Crataegi fructus*, *Artemisia capillaries* and *Cnidium officinale* is useful to improve growth, fatty acid utilization and stress recovery in the Japanese flounder, *Paralichthys olivaceus* (Cheol *et al.*, 2007). Use of garlic in fish farming has been popular for not only the enhancing activity of nonspecific defense system and conferring protection against diseases but also as a growth promoter in *Oreochromis niloticus* culture (Metwally, 2009). It affects the survival, growth, resistance and quality of *Oreochromis niloticus*. Dietary medicinal plant extract improves the growth, and survival of Tilapia (Uma Devi *et al.*, 2009). Wu *et al.* (2001) reported that weight gain of eels (*Anguilla anguilla*) treated with traditional Chinese medicine increased significantly their resistance to common infectious diseases. Jian and Wu (2004) observed that traditional Chinese medicine had beneficial effects on growth and prevention and treatment of common diseases in *Cyprinus carpio*.

Thus, immunostimulants can be seen as a promising tool in aquaculture as it helps to enhance resistance against diseases in fish. Use of immunostimulants, adjuvants and vaccine carries in fish culture offers a wide range of attractive methods for including and building up protection against diseases.

## LITERATURE CITED

- Agrawal, S.S. and Singh, V.K. (1999).** Immunomodulators: A review of studies on the Indian medicinal plants and synthetic peptides. Part-1 Medicinal Plants. *Proc. Indian Natl. Sci. Acad., B*, **65**:179.
- Campbell, R.E., Lilley, J.H. and Richards, R.H. (1998).** The use of natural products in the treatment of EUS (Epizootic Ulcerative Syndrome). In Kane, A.S. and Poynton, S.L.(Eds), Proceedings of the International Symposium on Aquatic Animal Health, Baltimore, U.S.A., 114.
- Chansue, N. and Assawawongkasem, N. (2008).** The *in vitro* Antibacterial activity and ornamental fish toxicity of the water extract of Indian almond leaves (*Terminalia catappa* Linn. ). *KKU Vet. J.*, **18** (1):36-45.
- Chansue, N. and Tangtrongpiros, J. (2005).** Effect of dried Indian almond leaf (*Terminalia catappa*) on monogenean parasite of gold fish (*Carassius auratus*).Proceeding of the 4th Chulalongkorn University Veterinary Annual Conference. 60 Veterinary Anniversary Building, Chulalongkorn University, Faculty of Veterinary Science, Bangkok, Thailand, February 15, 55-56.
- Chansue, N., Ponpornpisit, A., Endo, M., Sakai, M. and Santoshi, Y. (2000).** Improved immunity of tilapia *Oreochromis niloticus* by C-UPH, a herb medicine. *Fish Pathol.*, **35**: 89-90.
- Chen, X., Wu, Z., Yin, J. and Li, L. (2003).** Effects of four species of herbs on immune function of *Carassius auratus* gibelio. *J. Fish Sci. China*, **10**: 36-40.
- Cheol, J. S., Jeong, G.S., Im, G. S., Lee, S.W. Yoo, J. H. and Takii, K. (2007).** Dietary medicinal herbs improve growth performance, fatty acid utilization and stress recovery of Japanese flounder. *Fisheries Science*, **73** (1):45-48.
- Chrystibapita, D., Divyagneswari, M. and Michael, R.D. (2007).** Oral administration of *Eclipta alba* leaf aqueous extract enhances the non specific responses and disease resistance of *Oreochromis mossambicus*. *Fish & Shellfish Immunol.*, **23**(4): 840-852.
- Citarasu, T., Venket Ramalingam, K., Raja Jeya Sekar, R., Micheal Babu, M. and Marian, M.P. (2003).** Influence of the antibacterial herbs, *Solanum trilobatum*, *Andrographis paniculata* and *Psoralea corylifolia* on the survival, growth and bacterial load of *Penaeus monodon* Post larvae. *Aquac. Int.*, **11**: 583-595.
- Craing, W.J. (1999).** Health promoting properties of common herbs. *American J. Clin. Nutr.*, **70**: 491S-9S.
- Dada, A. A. and Ikuerowo, M. (2009).** Effect of ethanolic extract of *Garcinia kola* seed on growth and hematology of catfish (*Clarias gariepinus*) broodstock. *African J. Agric. Res.*, **4**: 344-347.
- Dey, R. K. and Chandra, S. (1995).** Preliminary studies to raise disease resistant seed (fry) of Indian major carp, *Catla catla* (Ham.) through herbal treatment of spawn. *Fish Chimes*, **14**: 23-25.
- Direkbusarakom, S. (2004).** Application of medicinal herbs to aquaculture in Asia. *Walailak J. Sci. & Tech.*, **1**(1): 7-14.
- Direkbusarakom, S., Ezura, Y., Yoshimizu, M. and Herunsalee, A. (1998).** Efficacy of Thai medicinal plant against fish and shrimp pathogenic bacteria. *Fish Pathol.*, **33**(4): 437-441.

- Dugenci, S.K., Arda, N. and Candan, K. (2003). Some medicinal plants as immunostimulant for fish. *J. Ethnopharmacol.*, **88**: 99-106.
- Dunkel, F.V. and Ricilards, D.C. (1998). Effect of an Azadirachtin formulation on six non target aquatic macroinvertebrates. *Environ. Entomol.*, **27**: 667-673.
- Fafioye, O.O. (2005). Plants with piscicidal activities in Southwestern Nigeria. *Turkish J. Fisheries and aquatic Sciences*, **5**: 91-97.
- Harikrishnan, R. and Balasundaram, C. (2008). *In vitro* and *in vivo* studies of the use of some medicinal herbs against the pathogen *Aeromonas hydrophila* in gold fish. *J. Aquatic Animal Health*, **20**: 165-176.
- Jian, J., and Wu, Z. (2004). Influence of traditional Chinese medicine on non specific immunity of Jian carp (*Cyprinus carpio* var. Jian). *Fish Shellfish Immunol.*, **16**: 185-91.
- Kadamban, D. and Balachandran, N. (2005). Role of plants in the traditional fishing system of Pondicherry region. *Plant-Archives*, **5**: 553-556.
- Kavita, K. and Sharma, L. L. (1996). Use of herbs (*Asperagus racemosa* wild) supplemented diet for promoting growth in the fry of *Labeo rohita*. *The Fourth Indian Fishries Forum (Abstract)*, India.
- Kwon, M. G., Kim, Y. C., Shon, Y.C. and Park, S. I. (1999). The dilatory supplementing effect of kugija, *Lysium Chinese*, on immune response of Nile tilapia, *Oreochromis niloticus* to *Edwardsia tarda*. *J. Fish Pathol.*, **1**: 73-81.
- Lal, V.K. Kumar, A., Kumar, P. and Yadav, K.S. (2010). Screening of leaves and roots of *Eclipta alba* for hepatoprotective activity. *Archives Appl. Sci. Res.*, **2**(1): 86-94.
- Logambal, S. M., Venkatalakshmi, S. and Michael, R.D. (2008). Immunostimulatory effect of leaf extract of *Ocimum sanctum* Linn. in *Oreochromis mossambicus* (Peters). *Hydrobiologia*, **430**: 113.
- Logambal, S.M. and Michael, R.D. (2001). Azadirachtin—a immunostimulant for *Oreochromis mossambicus* (Peters). *J. Aqua. Trop.*, **16**: 339.
- Metwally, M.A.A. (2009). Effect of garlic (*Allium sativum*) on some antioxidant activities in tilapia niloticus (*Oreochromis niloticus*). *World J. Fish & Marine Sci.*, **1**(1): 56-64.
- Mohamad, S. and Abasali, H. (2010). Effect of plant extracts supplemented diets on immunity and resistance to *Aeromonas hydrophila* in common carp (*Cyprinus carpio*). *Agricultural J.*, **5**(2): 119-127.
- Mulero, V., Esteban, M.A., Munoz, J. and Mesequer, J. (1998). Dietary intake of levamisole enhances the immune response and disease resistance of the marine teleost, gillhead sea bream (*Sparus aurata* L.). *Fish & Shellfish Immunol.*, **8**: 49-62.
- Olfayo, M.O. (2009). Haematological characteristics of *Clarias gariepinus* (Burchell, 1822) juveniles exposed to *Derris elliptica* root powder. *AJFAND.*, **9**(3): 921-932.
- Punitha, S. M. J., Babu, M.M., Sivaram, V., Shanker, V.S. Dhas, S. A., Mahesh, T.C., Immanuel, G. and Citarasu, T. (2008). Immunostimulating influence of herbal bioremedicines on nonspecific immunity in grouper *Epinephelus tauvina* juvenile against *Vibrio harveyi* infection. *Aquacult. Int.*, **16**: 511-523.
- Rath, R.K. (1990). Prevention and control of fish diseases by herbal medicine. *Fish health section newsletter*, **3**: 1-4.
- Robertson, B., Rostadt, G., Engstadt, R. and Raa, J. (1990). Enhancement of non specific disease resistance in Atlantic salmon, *Salmo salar* L., by a glucan from *Sacchromyces cerviseae* cell wall. *J. Fish. Dis.*, **13**: 391-400.
- Santhi, R. and Annapoorani, S. (2010). Effect of *Cynodon dactylon* for immunomodulatory activity. *Drug Invention Today*, **2**(2), 112-114.
- Sharma, P.V. (1981). Translation: *Charka Samhita, Chikitsothana*, 1<sup>st</sup> edition, vol. II (Varanasi Chaukhamba Orientalia).
- Singh, S. K., Yadav, R.P. and Singh, A. (2010). Molluscicides from some common medicinal plant of Eastern Uttar Pradesh. *Indian J. Applied Toxicol.*, **30**(1): 1-7.
- Singh, S.K. and Singh, A. (2009). Toxic effect of *Euphorbia pulcherima* plant to fingerlings of *Labeo rohita* (Hamilton) in different culturing conditions. *World J. Fish & Marine Sci.*, **1**(4): 324-329.
- Siwicki, A.K. (1989). Immunostimulating influence of levamisole on non specific immunity in carp (*Cyprinus carpio*). *Dev. Comp. Immunol.*, **13**: 87-89.
- Sudhakaran, D. S., Srirekha, P., Devasree, L. D., Premsingh, S. and Micheal, R. D. (2006). Immunostimulatory effect of *Tinospora cordifolia* leaf extract in *Oreochromis mossambicus*. *Indian J. Exp. Biol.*, **44**: 726-32.
- Thatte, U. M and Dahanukar, S. A. (1997). *Rasayana concept: clues from immunomodulatory therapy in immunomodulation* edited by S. N. Upadhyay (Narosa Publishing House, New Delhi), 141.

- Vasudeva Rao, Y. and Chakrabarti, R. (2004).** Enhanced anti-proteases in *Labeo rohita* fed with diet containing herbal ingredients. *Indian J. Clinical Biochem.*, **19**(2): 132-134.
- Wu, D. F., Lin, S. G., Wang, S. K., Li, J.S. and Huang, Z. I. (2001).** Effect of feed additives made of Chinese herbal medicine on culture of *Anguilla Anguilla*. *J. Fujian. Agricult. Univ.*, **30**: 95-98.
- Yin, G., Ardo, L., Thompson, K. D, Adams, A., Jeney, Z. and Jeney, G. (2009).** Chinese herbs ( *Astragalus radix* and *Ganoderma lucidum*) enhance immune response of carp, *Cyprinus carpio* and protection against *Aeromonas hydrophila*. *Fish & Shell fish Immunology*, **26**: 140-145.

\*\*\*\*\* \*