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## X-RAYING THE USE OF PLANT BASED IMMUNOSTIMULANTS IN AQUACULTURE.

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### ABSTRACT

Disease occurrence in aquaculture is a major limiting factor in aquaculture. Several drugs, synthetic chemicals and vaccines have been introduced to prevent and control disease occurrence but all have been found to have partial success. Despite the use of antibiotics, the frequency of disease/infection is still high and disturbing. The use of antibiotics and chemotherapeutants in aquatic farms and non-compliance to scientific management practices have resulted in adverse impact on aquacultural production, serious diseases outbreaks, development of drug resistance in microbes, and accumulation of antibiotics residues in finfish and shellfish. Phytotherapy has come to be recognized as a handy and viable alternative to chemotherapy, as it is economical, effective, non-resistance forming, renewable, eco-friendly and farmer-friendly. This paper theoretically assess the several use of medicinal plants as immunostimulants in aquaculture and their importance in combating fin and shellfish diseases, enhancing their productivity, fertility, and stimulating aquatic immune system.

**Keywords:** antibiotics, phytotherapy, alternative, immunostimulants.

### INTRODUCTION

Aquaculture is the fastest growing industry around the world with about 80 million tonnes being produced annually (Kolkovski and Kolkovski, 2011). The increasing demand for fish with increasing human population has led to increased disease resistance of cultured fish. This is not unrelated to high stocking density, water pollution, insecticides from agricultural drainage water and unscientific feeding which enhances the risk of bacterial, fungal and viral diseases in cultured animals (Banerjee & Ray, 2017). Owing to the artificial condition posed by intensive rearing, fish cultured under a controlled environment is more susceptible to disease causing agent than fish in their natural environment.

Disease occurrence in aquaculture is a major limiting factor in aquaculture. Bacteria such as *Pseudomonad*, *Edwardsiella tarda* and *Aeromonad* are the major bacterial fish pathogens which are widely distributed in aquatic organism in nature (Rahman et al., 2009). Bacteria are one of the major cause of fish diseases both in capture or culture fisheries and disease occur when there is interaction between the pathogen (harmful microbes), host (fish) in the fish environment (poor water quality, nutritional disorder etc). Several drugs, synthetic chemicals, vaccines have been introduced to prevent and control disease occurrence but all have been discovered to have partial success. Despite the use of antibiotics, the frequency of disease/infection is still high and disturbing. Alternatively, immunostimulant has been introduced to establish its beneficial role for disease management in aquaculture (Mastan, 2015).

Immunostimulants are heterogenous group of compounds that act non-specifically on the immune system by inducing its activation, either upregulating it or by favouring the activity of one of its component, immunostimulants have shown to improve fish resistance to disease (Sakai, 1999; Baiwa et al., 2012; Meena et al., 2013) and enhance their immune response at times of stress. They comprises of group of biological and synthetic compounds that enhances the non specific defense mechanism of the organism. The use of immunostimulants in aquaculture has opened a new visa in fish health protection (Raman, 2017). It is effective and it can also help increase fish immunopotency.



Natural plants have been discovered to possess therapeutic properties which are beneficial to the fish health. The growing interest in plant as natural and innocuous compound has widely increased worldwide because they are easy to obtain and prepare, and have few side effects on the animal and the environment (Van Hai, 2015). Plant product application in aquaculture for disease control is one of the promising alternatives to antibiotics. The aim of this review is to present current knowledge regarding the environmental and public health issues associated with the use of antibiotics in aquaculture and using plant extracts as alternative to combat different health challenges in aquaculture, stimulate aquatic immune system, and promote the fertility and productivity of aquatic organisms.

### **ANTIBIOTICS; USES AND EFFECTS IN AQUACULTURE**

Antibiotics are used in aquaculture for treatment and prophylaxis (preventive) measures. They are either administered in feed, water, bath or injections. The use of antibiotics in aquaculture may involve a broad environmental application that affect a wide variety of bacteria. Several bacteria species may survive unfavourable conditions or environmental changes resulting in mutation that improve their fitness in the new condition. The antibiotics used are often non-biodegradable and remain in the aquacultural environment for a long period of time. This encourages the growth of bacteria which can survive in the presence of antibiotics. 80% of antibiotics administered are excreted in urine or faeces without complete decomposition (Muziasari et al. 2014). This enables the antibiotic to find its way to the aquatic environment.

It is well documented that fish pathogens and other aquatic bacteria such as *Vibrio salmonicida*, *Aeromonas salmonicida*, *Citrobacter freundii*, *Aeromonas hydrophila*, *Flavobacterium psychrophilum* and *Pseudomonas fluorescens* have developed resistance as a consequence of exposure to antibacterial agents (Sorum, 2006). The aquatic environment can be a source of drug resistance bacteria that can be directly transmitted and cause infections in humans (Pham et al., 2015; Liyanage and Manage, 2015). The occurrence of different antibiotics resistance pathogen species e.g Salmonella in some water body may be attributed to contamination from either agricultural, human or animal environment. The spread to human can be through direct contact with water or aquatic organisms, through drinking water, through handling or consumption of aquaculture products (Suzuki et al., 2008).

Antibiotics resistance poses a great risk on human health due to the fact that it increases the frequency of treatment failure and increase the severity of infection, as a result of this resistance which may result in the prolonged duration of illness. It also increases the frequency of bloodstream infections and increase hospitalization (Kruse and Sorum, 1994). This antibacterial agent may cause disturbance to the micro flora of human intestinal tract exposing the human health to great hazard.

### **PLANT EXTRACT USE; AN ALTERNATIVE**

The use of antibiotics and chemotherapeutants in aquatic farms and non-compliance to scientific management practices have resulted in adverse impact on aquacultural production, serious diseases outbreaks, development of drug resistance in microbes, and accumulation of antibiotics residues in finfish and shellfish. This has resulted in the need by aquaculturists as well as aquatic animal health management professionals to find a befitting replacement in place of antibiotics and chemotherapy. Phytotherapy has come to be recognized as a handy and viable alternative to chemotherapy, as it is economical, effective, non-resistance forming, renewable, eco-friendly and farmer-friendly. Although the use of medicinal plants is known to humanity since the dawn of human civilization for the treatment and control of human and animal diseases (Raman, 2017) but its importance to combate finfish and shellfish diseases, enhance productivity and fertility, and stimulate their immune system has been realized just but recently.

### **Plants Extracts as Treatment for Diseases**

Fishes suffer many environmental, nutritional and stress-related diseases as they are cold- blooded animals. Therefore, controlling disease is a major task in aquaculture. Immediate detection and identification of fish pathogens in an aquacultural farm is crucial for successful disease control. Plant extracts have been used in many ways such as garden fresh, dried, powdered, juices, or extracted (in various solvents like water, alcohol, acetone, ether, etc), or essential oils. The herbal medicines are applied either as decoctions (individual) or concoctions



(mixed) or in combination with other drugs for effective fish health management (Harikrishnan, 2003). The medicinal plant, *Azadirachta indica*, commonly known as 'Neem' has been widely used in India. This is why the people of India regard neem tree as "village pharmacy" and "healer of all ailments". Also, the United Nations has declared Neem as the "Tree of the 21st Century" due to its medicinal and pesticidal effects. Chinese fish farmers have also been reported to have taken lead in treatment of finfish and shellfish diseases using herbal remedies. Below are lists of various Chinese herbal therapies used by fish farmers to control diseases on aquafarm with resultant good results.

- ❖ *Euphorbia australis* @ 500 g dry herb or 2.5 kg fresh herb for 100 kg fish daily for 3 consecutive days to treat enteritis; (Evans et al., 1989) or
- ❖ *Acalypha australis*-500g dry herb or 2 kg fresh herb per 100 kg fish daily for 3 consecutive days (Purohit and Mathur, 1999).

Bacterial gill rot of carp and other fishes has been successfully controlled by the use of following herbal medicines:

- ❖ Add dry powder of Chinese tallow tree (*Sapium sebiferum*) leaves to pond water to a concentration of 6.25 ppm; (Vaidyaratnam, 1995)
- ❖ Das et al. (1999) recommended 10 ppm of aquaneem for pond application in culture system for control of bacterial diseases of fish such as haemorrhagic septicaemia, fin rot and tail rot, bacterial gill disease and dropsy like conditions.
- ❖ Rosemary and fenugreek increase disease resistance against *S. agalactiae*, *S. iniae*, and *A. hydrophila* in fingerlings of *Oreochromis* sp. (Abutbul et al., 2004; Zilberg et al., 2010) and *O. niloticus* (Mostafa et al., 2009).
- ❖ Dey and Chandra (1995) reported successful control of Epizootic Ulcerative Syndrome (EUS) in fish by applying turmeric and lime in affected fish ponds at 5 - 7 days intervals.

#### **Plant Extracts as Immunostimulants**

Herbal products have the potential to be used as stimulants for the immune system in aquatic organisms. They have been utilised as supplements to chemopreventive agents, antibiotics and adjuvants in vaccines in several fishes (Yilmaz et al., 2018). 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*) (Thangaviji et al., 2012). Also, the use of extract obtained from herbal immunoadjuvant *Asparagus racemosus* had a strong immunological influence against White Spot Syndrome Virus (WSSV) infection in *Penaeus monodon* (Kumaran et al., 2010). 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). Papaya leaf meal has also been reported to contain an enzyme namely papain which increases the protein digestion, food conversion ratio, specific growth rate and weight gain in the 16%unsoaked papaya meal diet fed to *P.monodon* post larvae.(Kurva and Dash, 2013). Jayathirtha and Mishra, 2004 reported that leaves extract of *Ocimum sanctum* affected both specific and non-specific immune responses and disease resistance against *Aeromonas hydrophila*. It stimulated both antibody response and neutrophil activity. A large proportion of vitamin C, which has also been identified as an immunostimulant has been discovered in Amla fruit pulp (Kurva and Dash, 2013). Biomedical research has revealed that neem possesses anti-human immunodeficiency virus, anti-tumor and antimicrobial activities. Azadirachtin, a triterpenoid derived from *A. indica*, enhanced respiratory burst activities, the leukocyte count and the primary and secondary antibody response against Sheep Red Blood Cell (SRBC) in tilapia (Logambal and Michael, 2001; Rao and Chakrabarti, 2005).

#### **Plants Extracts as Pro Fertility Agents**

The use of medicinal plants as fertility enhancer in aquaculture has been receiving great attention of lately due to the shift in focus from synthetic drugs to natural herbs. Several biological studies have supported the claim that medicinal plants are rich in anti oxidants, which increase fertility either directly or indirectly. Pro-fertility properties of several natural herbs have been researched into in Nigeria and their efficacies have been ascertained. Some of



these plants include *Kigelia africana* (Adeparusi et al., 2010), *Bryophyllum pinnatum* (Alimi et al., 2018), *Garcinia kola* (Dada and Ajilore, 2009), *Sesamum indicum* and *Croton zambesicus* (Dada and Adeparusi, 2012), *Tetracarpidium conophorum* (Adekunle and Aguda, 2015) and *Desmodium adscendens* (Oke et al., 2019).

Tilapia have been known to be prolific breeders and this has really limit their rearing for commercial production. The use of phytotherapy in replacement of several methods such as hybridization, genetic manipulation and hormonal sex reversal in producing all male tilapia fish for culture is a novel idea gaining momentum. Studies have shown that water temperature and herbal extracts can influence gonadal sex differentiation process (Baroiller et al., 2009; Bairwa et al., 2013; Fuentes-Silva et al., 2013), thereby creating alternative means of producing monosex fish population, particularly in tilapia culture. Omitoyin et al., (2013) induce sex reversal in *Oreochromis niloticus* using a plant extract *Tribulus terrestris* which can either be added to culture water or administered orally. Considering the growing concerns for food security, finding an effective sex control alternative in fish that is non-hazardous to consumer and environment friendly remains a lingering challenge for aquaculture. Thus, it is a great quest discovering natural plants that keeps the viability of the sex reversal method as well as eliminate the skepticisms on synthetic hormonal treatments associated with monosex Tilapia production.

## CONCLUSION

Natural plant products are widely available and distributed throughout the world. Several researches have revealed their use as growth promoters, probiotics, immunostimulants, profertility agents and phytoestrogenic hormone capable of inducing sex reversal in aquacultural production. Thus, the need to bring about synergy between the great researchers and the local fish farmers by creating strong awareness that will lead to the utilization of these herbal extracts that are readily available, cheap and safe, both to the aquatic organisms and the environment, as well as the final consumer. Also, authorities should encourage fish feed industries to use herbal feed additives to chemical additives in order to eliminate the skepticism associated with their use on a long term basis.

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