Aquaculture - Disinfectants, Sanitisers and Feed Supplements

Control of water quality is the key factor for a successful culture of aquatic animals like fish, prawns and shrimp. An open water system with sufficient good water quality may ensure successful aquaculture. However, if proper quality or sufficient quantity of water is not available, purification of water by eliminating polluting substances including toxic metabolites and growth-inhibiting substances which originate mainly from fish or shrimp excretion and excessive feed is necessary. Under these lower water quality conditions there are chances for the occurrence of mortalities by diseases due to viral, bacterial, protozoal and fungal pathogens. High populations of aquatic animals can be kept healthy under successful semi-closed and closed systems by maintaining proper sanitisation. The increased demand for water quality and quantity in shrimp and fish culture has resulted in a growing interest in using water sanitisers and disinfectants.

Agents (substances that destroy harmful germs) which are applied externally on man, animals, water or inanimate objects to check the microbial population are grouped in the category – of disinfectants and sanitisers. These terms are usually applied to the agents useful in destroying pathogens in the aquaculture pond water and hence improve the water quality. The improved water quality will provide healthy ecological conditions, ultimately promotes the survival and growth of the fish, prawn and shrimp in aquaculture ponds. It has been proved that whenever there is minimum stress on aquaculture organisms, there will be automatically increased weight gain by improved feed intake. Hence, as these disinfectants and sanitisers ultimately giving good FCR by improving the feed intake these chemical agents can be brought under feed supplements.

Properties of Disinfectants and Sanitisers:

1. Wide spectrum of antibacterial activity.
2. Lack of irritation.
3. Low toxicity.
4. High Penetrability.
5. Activity in the presence of Pus and necrotic tissue.
6. Non-interference with normal healing processes.
7. Cost effective.
8. Non-corrosiveness & non-staining ability.
9. Higher degree of stability.
10. The ability to penetrate the crevices, cavities and films of organic matter and maintain the lethal concentration of the agent so that a cidal effect can be obtained in the presence of organic matter such

as soil and faecal material.

Disinfectants may be classified as follows:

1. Oxidizing Agents : Halogens, peroxides, Potassium Permanganate
2. Reducing Agents: Formaldehyde
3. Detergents : Quaternary ammonium compounds

OXIDIZING AGENTS

They are divided into those which cause oxidation without releasing oxygen gas "The Halogens (chlorine, Iodine, bromine) and Potassium Permanganates" and those which release gaseous oxygen "The Peroxides".

Oxidizing agents are used for controlling phytoplankton, killing disease organisms (virus, bacteria, protozoa, fungus etc.) or oxidizing bottom soils. Potassium permanganate has been claimed to oxidize organic and inorganic substances and kill bacteria, thereby reducing the rate of oxygen consumption by chemical and biological processes. Some diseases are also treated by the application of potassium permanganate to shrimp/prawn/fish in holding tanks or in ponds. In water, permanganate quickly oxidizes labile organic matter and other reduced substances and is transformed into relatively non-toxic manganese dioxide, which precipitates out. Potassium permanganate is toxic to phytoplankton and will reduce the over blooms.

The germicidal effect of iodine and bromine is based on its concentration. It is commonly used to disinfect nauplei and larvae in hatcheries and also culture farms. Iodine and bromine are thought to be degraded by natural processes in water and should not pose a threat to the environment.

Peroxides and chlorine compounds are powerful oxidizing agents and they are strong irritants when highly concentrated. Calcium peroxide is applied to ponds to oxidize organic matter and reduce the biological oxygen demand. Treatment of pond water with chloramines is an effective means of destroying disease organisms. Chloramines possibly have advantages over chlorine gas and calcium hypochlorite for use in water containing ammonia and organic matter in appreciable concentrations. Chloramines contain chlorine and ammonia in various proportions (NH_2 Cl, NH Cl_2, NCl_3). The advantage of chloramines is that

it is already combined with ammonia and will not form halogenated organic compounds. Its disinfecting power is as good as that of chlorine, provided there is longer contact time. There is no evidence that any of these compounds other than chlorine compounds leave harmful residues in the water or accumulate in the tissues of aquatic organisms, so no food hazard is associated with them. Although chlorine compounds have been reported to form residual compounds that are suspected carcinogens, they have a long history of safe and beneficial use in the disinfection of drinking water. Therefore, the use of chlorine compounds in aquaculture does not pose a significant food safety risk, but there is some possibility of environmental contamination by reaction products of chlorine in effluents.

REDUCING AGENT

Formaldehyde solution (or formalin) is a general disinfectant used as a germicide, fungicide or preservative in various industries. Its main mode of action is to form covalent cross-links with functional groups on proteins. In the context of aquaculture, it may be applied to the entire pond volume, but more commonly, treatment is limited to puddles of water in the bottom of ponds. It is also used as a disinfectant in hatcheries. Formaldehyde is thought to be degraded by natural processes before shrimp are stocked for the next crop. No food safety hazard is thought to be associated with the use of formaldehyde solution.

DETERGENTS (CATIONIC DETERGENTS)

Quaternary ammonium compounds (Benzalkonium Chloride) are used in hatcheries and farms to disinfect larvae, tanks, ponds and other equipment. Quaternary ammonium compounds disrupt cell membranes and are most active against gram-negative bacteria. There is no evidence on the possibility that these compounds, their reaction products or their degradation products are bioaccmulative or pose any threat to the environment.

Prevention of viral infections in prawn/shrimp hatcheries may be achieved by prior washing of nauplii or fertilised eggs with formalin and iodine.

a) Nauplii

Collection of nauplii using plankton net	=>	Running seawater for 1-2 minutes	=>	Formalin 400 ppm for 30 seconds to 1 minute	=>
Iodophore 0.1 ppm iodine for 1 minute	=>	Running seawater for 3-5 minutes	=>	Hatchery ponds	

b) Fertilised eggs

Collection of fertilised eggs	=>	Running seawater for 1-2 minutes	=>	Formalin 100 ppm for 1 minute	=>
Iodophore 0.1 ppm iodine for 1 minute	=>	Running seawater for 3-5 minutes	=>	Hatchery ponds	

Disinfection:

Processes	**Indications**
Disinfectants and sanitisers	
Quartenary ammonium compounds (BKC) (Bionex 80)	- Controls Viral, bacterial pathogens. - Sanitation of hands, plastic surfaces etc., - Disinfection of aquaculture pond water.
Bromine (BroSpark)	Germicide, algaecide, herbicide.
Iodine (Idophores) (SparkDin-20)	- Controls bacteria, viruses, protozoa, fungi pathogens and parasites. - Eyed eggs, Gametes during fertilisation. - Hands, smooth surfaces, Nets etc.,

Liming materials: Liming materials are applied to pond waters and soils to neutralize acidity and increase total alkalinity. Increased alkalinity buffers water against drastic daily changes in pH common in eutrophic ponds. Increasing the pH of acidic bottom sediment enhances the availability of phosphorus added to fertilizers. Some calcium and magnesium (PearlSpar-Aqua, GeoMix etc.) materials are absorbed by the pond biota to become normal constituents of plants and animals, adsorbed by the soil or dissolved in the water. The anionic component is either neutralized by hydrogen ions or it reacts with carbon dioxide to form bicarbonate that remains in the water to increase alkalinity. The pond sediments in coastal environments often are acidic and the liming of pond bottoms is done to neutralize acidity and stimulate microbial decomposition of the organic matter accumulated during the crop period. Burnt lime and hydrated lime are strong caustic materials and they should be handled cautiously. Contact with the eyes can possibly cause blinding and severe irritations can result from skin contact. If used excessively, these compounds increase water pH by up to 10 or more and cause toxicity in aquatic plants and animals. The water pH will decrease to acceptable levels within a few days after applications of burnt or hydrated lime and ponds can be stocked. Agricultural limestone or dolomite is safer to use and is considered to be the most effective liming material for ponds under normal circumstances. However, in ponds where severe disease problems were encountered in the previous crop, applications of burnt or hydrated lime to empty pond bottoms may be effective in destroying disease organisms in the soil before the next crop is stocked. None of the liming materials is known to be of any hazard to food safety.

Piscicides: The most common piscicides are tea seed powder and potassium permanganate. The tea seed cake contains 5.2–10% saponin, a glucoside that causes hemolysis in organisms. The higher sensitivity of finfish than crustaceans to glucoside has made it an effective piscicide in shrimp ponds. The concentrations of these compounds used for eradicating fish vary widely. The entire pond volume is sometimes treated, but usually, treatment is limited to puddles of water that remain in the bottom of ponds after harvest. These compounds are degraded through natural processes before the fish and shrimp are stocked for the next crop. No food safety hazards are thought to be associated with piscicides.

Water quality enhancers: The group of substances called water quality enhancers comprises products used in attempts to remove ammonia and improve water quality in ponds. The most commonly used are zeolite (UltraSil-Aqua) and probiotics. Zeolite is an aluminosilicate clay of

high cation exchange capacity and is applied to aquaculture ponds. Farmers apply zeolite with the aim to reduce ammonia concentration through ion exchange, providing physical cover over sediments to prevent the leaching of metabolites into the water column, removing suspended solids and improving water colour and algal blooms. These functions are believed to be achieved by either flocculation of suspended solids, ionic exchange and absorption of ammonium ions by zeolite or the prevention of toxic metabolites leaching from pond sediments by covering the sediments with a layer of zeolite. Zeolite will settle to the pond bottom and it does not cause food safety problems or environmental threats.

Probiotics: The common probiotics used in pond management are live bacterial inocula (non-pathogenic organisms) rich in extracellular enzymes (water probiotic - BioRemid-Aqua, Soil probiotic-TerraGard-SP, Spark-PS etc.). Claims about the potential benefits of probiotics in aquaculture ponds include: enhanced decomposition of organic matter; reduction in nitrogen and phosphorus concentrations; better algal growth; greater availability of dissolved oxygen; reduction in blue-green algae; control of ammonia, nitrite and hydrogen sulfide; lower incidence of disease and greater survival and better fish and shrimp production. The addition of probiotics to aquaculture ponds should not result in any damage to the fish and shrimp crop or to the environment. No food safety hazards are thought to result from probiotics.

Immunostimulants: Immunostimulants are used to boost the fish or crustacean immune system. It includes mineral mixture (PowerMin, GeoMix, AzoMax, StarShrimp etc.) for both fish and shrimp/prawn), vitamin C (AscoSol-C) products containing glucan (ImmunoMax-FS), gut-probiotics (UltraZyme-P-FS), extracts of other natural products (TekBlok) and these products are mixed with the feed by binding agent (NutriGel-P-FS). In general, immunostimulants should not cause any hazards to the environment or food safety problems.

Summary: Most substances used to improve water quality, improve health, or stimulate the immune system of fish or crustaceans present little or no risk to the environment or food safety. Aquaculture farmers who use these substances should follow product labels regarding dosage, withdrawal period, proper use, storage, disposal and other constraints including environmental and human safety precautions. Also, careful records should be maintained regarding the use of chemicals in ponds, as suggested by the Hazard Analysis and Critical Control Point (HACCP) method. Some disinfectants, sanitisers and water quality enhancers are necessary for aquaculture and a system for using

them in a safe and publicly acceptable manner must be implemented. In future, as natural fish stocks are getting depleted, it is likely that we will have to rely increasingly on aquaculture for the production of fish and crustaceans for human consumption. Therefore, it is important that the sustainability of this industry is maintained by improved aquaculture practices coupled with the more effective use of scientifically approved disinfectants and sanitisers as feed supplements along with other biological agents in order to improve survival rate and growth, to enhance yield and to minimize production cost.