AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 07 July 2023 Article No: 14

The Risk of Using Chemical in Pond Aquaculture

M. Ponmani, P. Padmavathy, V. Rani, D. Manimekalai and S. Manickavasagam
Fisheries College and Research Institute -Thoothukudi, Tamil Nadu Dr. J. Jayalalithaa Fisheries University

SUMMARY

Fertilizers and liming products are the most prevalent materials used in pond aquaculture. Fertilizers release nutrients that can eutrophicate the natural waters since they are very soluble in water. Additionally, fertilizers are caustic and explosive in some cases, so they must be handled carefully to avoid mishaps. Some lime materials are caustic, and if suitable safety measures are not taken, they could be dangerous to the employees. Liming substances have no negative effects on the environment, and neither do liming or inorganic fertilizer substances have any negative effects on the safety of food. Other chemicals like oxidants, disinfectants, osmoregulators, algicides, coagulants, herbicides, and probiotics are occasionally employed in aquaculture. These substances or biological byproducts precipitate or disintegrate quickly. They do not bioaccumulate and do not disturb the ecology of natural waters that receive pond effluents.

INTRODUCTION

Pond aquaculture uses a variety of chemicals and other substances as additives to improve soil and water quality as well as to reduce biological issues such as phytoplankton blooms, aquatic plant infestations, disease vectors, and the overpopulation of wild fish. Sometimes, water used to fill aquaculture ponds, regulate water levels, or exchange water contains heavy metals and pesticides. Aquaculturists frequently overlook the potential effects of chemicals used in pond management on the surrounding environment and the quality of aquatic food products, even though they are typically aware of the risks to humans involved in handling chemicals. The Food and Agriculture Organisation of the United Nations (FAO, 1995) presented a Code of Conduct for Responsible Fisheries in response to growing concerns regarding the potential harm that aquaculture effluents could cause to receiving water bodies, concerns regarding the contamination of aquatic food products with bioaccumulative and potentially hazardous substances, and concerns regarding the risks to humans associated with storing and handling the chemicals used in aquaculture.

Risk assessment:

For the risk assessment Environment, food, and handling dangers were taken into consideration. From no known harm to high potential risk, each substance's level of risk was ranked as follows:

Values	Level of risk	Description
0	No risk	It signifies that there is no evidence to establish that safety problems have ever been related to a chemical
1	Low risk	It has given to compounds for which there is a potential for modest safety hazards based on the features of the compound or from its application in other fields
2	Medium risk	It has assigned to substances for which experience has revealed a moderate level of safety concerns.
3	High risk	It is reserved for drugs known to have caused severe safety problems in the past.

Fertilizer:

Fertilizers are given to ponds to improve plant nutrient concentrations, stimulate phytoplankton development, and ultimately enhance production of fish or crustaceans (Boyd and Tucker, 1998). The most common inorganic fertilizers are nitrogen and phosphorus compounds, however potassium, trace metals, and silicate may be incorporated in some fertilizers. Fertilizers may be administered as individual compounds, or they may be blended to give a mixed fertilizer containing two or more compounds.

Fertilizer	Description
Organic fertilizer	Animal wastes or agricultural by-products which, when put to ponds, may serve as direct sources of food for invertebrate fish food animals and fish, or they may decay slowly to release inorganic nutrients that drive phytoplankton growth.

Nitrogen fertilizer	Nitrogen fertilizers are explosive ingredients, and they must be kept from contact with petroleum products, open fires, or sparks to prevent them from exploding. Nitrogen, phosphorus, and potassium fertilizers can cause skin irritation; therefore, care should be exercised when handling fertilizers.

Limimg material:

Liming materials are added to pond waters and soils to neutralise acidity and increase total alkalinity (Boyd and Tucker, 1998). Increased alkalinity buffers water against significant daily variations in pH prevalent in eutrophic ponds with soft water. Increasing the pH of an acidic bottom sediment boosts the availability of phosphorus provided in fertilizers (Boyd and Scarsbrook, 1974). Some calcium and magnesium from liming materials are absorbed by the pond biota to become normal elements for plants and animals, adsorbed by the soil, or dissolved in the water.

Liming material	Description
Burnt and hydrated lime	They are highly caustic compounds, therefore, they should be handled cautiously. Contact with the eyes might possibly cause blindness, and severe irritations can develop from skin contact. If employed extensively, these compounds increase water pH up to 10 or higher and induce toxicity in aquatic plants and animals.
Agricultural lime stone	It is safer to use, typically cheaper, and considered to be the most effective liming material for ponds under normal circumstances.

Oxidants:

Oxidising chemicals are employed for regulating phytoplankton, eliminating disease organisms, or oxidising bottom soils. Potassium permanganate has been reported to oxidise organic and inorganic molecules and kill bacteria, thereby lowering the rate of oxygen consumption by chemical and biological processes. In water, permanganate quickly oxidises labile organic matter and other reduced compounds and is changed to comparatively non-toxic manganese dioxide, which precipitates out. Potassium permanganate is harmful to phytoplankton and will limit the production of dissolved oxygen through photosynthesis. Potassium permanganate is very explosive when in direct contact with organic compounds, and it can cause irritation to the skin. There is a possible concern about spills into water since potassium permanganate can cause catastrophic mortality in aquatic life.

Oxidants	Description
Peroxides and chlorine compounds	They are powerful oxidizing agents, and they are strong irritants when excessively concentrated
Calcium hypochloride	It is sometimes applied to ponds to oxidize organic materials and reduce the biological oxygen demand

Coagulants:

In order to remove turbidity from pond waters, coagulants are used to flocculate suspended clay particles and cause them to precipitate. Gypsum, or calcium sulphate, dissolves in water to raise the levels of both calcium and sulphate. Small amounts of calcium and sulphate can be taken by plants and animals to become regular biological components. Applications of aluminium sulphate and ferric chloride result in the rapid precipitation of aluminium and ferric iron oxides. Nevertheless, the hydrolysis of iron and aluminium causes these two molecules to react strongly in an acidic manner with water. The risk of spills should be kept to a minimum because of their significant propensity to produce acid. Both ferric chloride and aluminium sulphate should be handled carefully since they might cause skin irritation.

Osmoregulators:

These compounds are added to water to raise calcium or salt levels.Some culture species can increase concentration and enhance osmoregulation conditions (Boyd and Tucker, 1998). They are straightforward salts

that disintegrate in water and have little impact on how aquatic animal products are made. The two most widely used osmoregulators are calcium sulphate and sodium chloride.

Algicides and herbicides:

Ponds are treated with herbicides and algicides to lessen the growth of invasive aquatic vegetation. According to Tucker and Robinson (1990), excessive phytoplankton can cause persistently low dissolved oxygen levels at night, and blue-green algae are the cause of fish and crustacean off-flavours. Larger aquatic plants develop dense groups that obstruct harvesting and feeding. Aquatic environments use a variety of herbicides to manage weeds, but only a small number of them have been approved for use in aquaculture ponds in the USA (Federal Joint Subcommittee on Aquaculture, 1994). Their usage is rarely justified in aquaculture due to their high cost and inferior efficacy to mechanical and biological control approaches. There have been numerous algicides employed in ponds, but four stand out: copper sulphate, chelated copper compounds, simazine, and potassium ricinoleate

Piscicides:

The most popular piscicides are lime, potassium permanganate, rotenone, teaseed cake, and fertilizer with ammonium. These substances, which are used to eradicate fish, come in a wide range of concentrations. Sometimes the entire pond capacity is treated. However, treatment is typically restricted to water puddles that remain at the bottom of ponds after harvest. Before the fish and prawns are replenished for the following harvest, the chemicals are broken down by natural processes. Piscicides are not regarded as posing any risks to food safety.

Probiotics:

The most frequent probiotics employed in pond management are extracellular enzyme-rich fermentation products and live, non-pathogenic Bacillus species inocula. Probiotics are said to have a number of potential advantages in aquaculture ponds, including improved organic matter decomposition, decreased nitrogen and phosphorus concentrations, improved algal growth, increased dissolved oxygen availability, decreased blue-green algae, control of ammonia, nitrite, and hydrogen sulphide, decreased disease incidence and greater survival, and improved prawn and fish production. These medications are often administered at doses of 1-2 mg/l^{-1} at 1 or 2 days or longer apart. The ecosystem or the fish or prawn crop shouldnot be harmed by the addition of probiotics to aquaculture ponds. Probiotics are not regarded as posing any risks to food safety.

Insecticides and heavymetals:

Heavy metals, insecticides, and other pesticides can contaminate aquaculture ponds. The compounds may be hazardous to the species used for culture and may contaminate the product that is being harvested (Avault, 1996). The heavy metals lead, mercury, arsenic, beryllium, cadmium, chromium, manganese, silver, and zinc pose the greatest risk of contaminating aquaculture products. Ponds are rarely developed in regions where a high degree of external contamination is expected because aqua culturists are well aware of the potential threat of pollution to the survival of their crops. Therefore, it is probably a rare occurrence for aquaculture products to get accidentally contaminated with pesticides or heavy metals due to pollution.

CONCLUSION

The majority of chemicals used to manage aquaculture provide negligible or no risk to food safety. However, some farmers might treat ponds with bactericides and insecticides, which might bioaccumulate and pose a threat to the safety of food. Accidental pesticide and heavy metal contamination of aquaculture products does not seem to pose a significant problem. Aquaculture chemicals typically donot represent a threat to food, but some of the substances can be hazardous to employees who apply them to ponds, be explosive or combustible, or pollute the environment. Aquaculture ponds should have enriched water, however it's not always wise to dump these waters directly into the environment. Promotion and widespread use of management techniques that can lessen possible issues caused by aquaculture effluents are necessary.

REFERENCES

Avault, J.W. Jr., 1996. Fundamentals of Aquaculture. AVA Publishing, Baton Rouge, LA, pp. 1–889.

Boyd, C.E., 1979. Aluminum sulfate (alum) for precipitating clay turbidity from fish ponds. Trans. Am.Fish. Soc. 108, 305–311.
Boyd, C.E., 1995a. Chemistry and efficacy of amendments used to treat water and soil quality imbalances in shrimp ponds. In: Browdy, C.L., Hopkins, J.S. (Eds.), Proceedings of the Special Session on Shrimp Farming. The World Aquaculture Society, Baton Rouge, LA, pp. 183–189.
Boyd, C.E., 1995b. Potential of sodium nitrate to improve environmental conditions in aquaculture ponds. World Aquac. 26 (2), 38–40.
Boyd, 1999. Codes of practice for responsible shrimp farming. Global Aquaculture Alliance, St. Louis, MO.
Boyd, C.E., Gross, A., 1998. Use of probiotics for improving soil and water quality in aquaculture ponds. In: Flegel, T.W. (Ed.), Advances in Shrimp Biotechnology. Proceedings to the Special Session on Shrimp Biotechnology, 5th Asian Fisheries Forum, 11-14 November 1998, Chiengmai, Thailand.
The National Center for Genetic Engineering and Biotechnology, Bangkok, Thailand, pp. 101–106.
Boyd, C.E., Noor, M.H.M., 1982. Aquashade treatment of channel catfish ponds. North Am. J. Fish. Manag. 2, 193–196.
Boyd, C.E., Scarsbrook, E., 1974. Effects of agricultural limestone on phytoplankton communities of fish ponds. Arch. Hydrobiol. 74, 336–349.
Boyd, C.E., Tucker, C.S., 1998. Pond Aquaculture Water Quality Management. Kluwer, Norwell, MA.
Budavari, S., 1996. The Merck Index. An Encyclopedia of Chemicals and Drugs, 12th edn. Merck &Co., Inc, Whitehouse Station, NJ.
Chamberlain, G., 1988. Rethinking shrimp pond management. Tex. Agric. Ext. Ser. Coast. Aquac. 2, 19.
Duncan, T.O., 1974. A Review of Literature on the Use of Potassium Permanganate (KMnO4) in Fisheries. US Fish Wildlife Service, Report FWS-LR-74-14. pp. 61.