



Role of Minerals in Shrimp Culture

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Abstract

Shrimp culture is one of the most profitable business in the aquaculture industry. Minerals are the key mediator that plays a vital role in the physiological process of shrimp. Proper management of minerals and water quality are the most crucial factors that affect the shrimp culture. Calcium and Magnesium are inevitable in shrimp culture. Minerals are available in various forms commercially; the challenge is the suitable selection and application of the right dose of required minerals at right time. The imbalance in mineral concentration leads to osmotic stress which affects the growth and survival of shrimp.

Keywords: Calcium; Magnesium; Minerals; Supplements; Shrimp

Introduction

In India during the year 2020, *Penaeus vannamei* (Whiteleg shrimp) was the top species with the production of 5.8 million tonnes [1]. The production from coastal aquaculture in brackish-water ponds are dominated by Marine shrimps. Shrimps are an important source of foreign exchange in the developing countries like Asia and Latin America. In Tamilnadu, the total marine landing of crustaceans in 2021 was 293 tonnes, in which the penaeid shrimps formed 61.2%. Shrimps and Prawns contribute 16.4% of the value of global exports aquatic products. Shrimp culture is carried out traditionally in coastal or estuarine water with different salinities ranging from 15 to 40 ppt. It is important to maintain a healthy shrimp population in the pond. The water available for culture possess different ionic composition. Minerals play an im-

portant role in the shrimp aquaculture. It is a basic necessity for the growth and metabolism in shrimps. Optimum requirement of various minerals are essential for molting in shrimps. Deficiency in minerals in the pond leads to poor or low growth. It is necessary to supplement the minerals in water to enhance the desired productivity.

Importance of minerals

Minerals play a significant role in the physiological functions to maintain and regulate the blood pH. It also play an important role in maintaining the osmoregulation. Minerals help in catalyzing the biochemical reaction. Minerals provide good resistance towards the disease. Calcium and Magnesium are primary minerals required for new shell formation and molting in shrimps.

The survival, growth and production are influenced by the ratio of Na:K and Ca:Mg in water than salinity. Macro minerals and trace minerals are influential for shrimp aquaculture. The macro minerals include Calcium (Ca), Magnesium (Mg), Phosphorous (P), Potassium (K) and Sodium (Na). The trace minerals involve Zinc (Zn), Copper (Cu), Manganese (Mn), Cobalt (Co) and Iron (Fe).

Uneven ionic ratios in water lead to osmotic stress that has a adverse effect on the growth and survival of shrimp. The preferred Ionic ratios for Na:K and Mg:Ca are 28:1 and 3.4:1. The ratio of Ca:K in seawater is about 1:1 is essential [4].

Supplementation of minerals

Shrimp absorb and excrete minerals directly from surrounding water through gills and body surface [2]. There are two ways to supplement the minerals in shrimp aquaculture. The first is the application of minerals through water and the other is to supplement through diet. Mineral fortification requires huge cost when the culture area is large and the limitation for dietary supplementation is that leaching of water soluble minerals.

When the water contains optimum mineral concentration and proper ionic ratios, there is no need to supplement the minerals in high or low saline waters [5].

Reasons for the loss of minerals

The primary cause of mineral loss is the soil adsorption and seepage loss. Other reasons include the shrimp harvest and draining the pond at harvest.

Inadequacy of minerals

Mineral deficiency in shrimp culture causes deformity in shrimps and thus reduces the survival rate. Mineral deficiency reduces the molting frequency and leads to soft exoskeleton. It also causes slow digestion of food and decreased physiological functions. It also leads to turbidity in high temperature and may lead to mass mortality of shrimps.

How to calculate mineral requirement:

Amount of salt to be added =

Concentration of mineral required in pond (ppm)

:

% of mineral ions in selected salt

Water salinity is multiplied by these factors to calculate the desired minerals level [3].

Ions	Factor
Ca	11.6
Mg	39.1
K	10.7
Na	304.5
Cl	551
So ₄ S	78.3

Table 1

Commonly used salt supplements:

Calcium sulphate (Gypsum), Potassium chloride (Murate of potash), Potassium magnesium sulphate (K-Mag), Potassium sulphate, Hydrated Magnesium sulphate (Epsom).

Concentration of ions in different source water

Ion (ppm)	Seawater	Brackish water	Freshwater
Chlorides	19000	12090	6
Sodium	10500	7745	8
Sulphate	2700	995	16
Magnesium	1350	125	11
Calcium	400	308	42
Potassium	380	75	2
Bicarbonate	142	156	174
Other	86	35	4
Total	34558	21529	263

Table 2

Mineral deficiency symptoms

Calcium and Phosphorous deficiency causes slow growth, deformities and increased mortalities. Magnesium deficiency leads to poor growth and tetany. Reduced growth, feed efficiency and homochronic microcytic anaemia are caused by Iron deficiency. Short body dwarfism results as a Manganese deficiency. Elevated tissue concentrations and hepatopancreas are caused due to Zinc deficiency.

Conclusion

To conclude, Minerals are the key to the shrimp aquaculture as it plays a crucial role in the development process of shrimp. Supplementations of minerals are essential to lead a good productive shrimp culture. There is a need to monitor the mineral concentration regularly and supplement them in case of any deficiency. Bios-

security and disease control are the major areas to be concentrated for the successful shrimp production.

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