Chapter 1: Introduction..

1. General Introduction

1.1 Background of the study

Aquaculture is farming of different aquatic organisms like molluscs, crustaceans, fish and aquatic plants (Paul, 2014). Particularly in developing countries, fishes are considered as the cheapest and affordable protein source, energy and nutrients. According to report by United Nations, in 2018 the world population had reached to 7.6 billion and likely to be reach upto 8.6 billion by 2030 and around 10 billion by 2050. The growing world population leads to a recurrent problem of hunger and malnutrition. Feeding a global population of around 10 billion people poses a chief challenge. Only aquaculture holds a tremendous potential to seize the surging demand of the nutritious and quality food. According to a report by Lahsen and Iddya, 2014, fishes supplies around 17% of global population protein intake and it also provides 70% of protein in some island and coastal countries. Globally total aquaculture production for food fish was found to be around 80 million tones (MT). The farmed fish production includes 54.1 MT of fin fishes, 7.9 MT of crustaceans and 17.1 MT of molluscs (FAO, 2018). Asia accounts for 80 % of aquaculture production and this industry contributes notably to the economic enhancement of the developing countries. Globally, India ranked second after China for inland fisheries production (Hoque et al., 2018). In 1951, the aquaculture production of India was 0.7 MT which had increased to 10.79 MT in 2016-17 (DAHDF, 2107). West Bengal is the largest fish seed (62%) and freshwater fish (30%) producing state in the country. West Bengal lies between the location of 22° 58' 43.0464" N and 87° 44' 52.0908" E. The annual fish yield of state had increased upto 16 lakh tones in year 2014-15 from 14.4 lakh tones in the year 2011-12 (Handbook of fisheries statistics, 2016). The reason after this increase involves the environment and natural resources of West Bengal. The state West Bengal is having all types of fisheries

resource, huge numbers of river, estuaries, canals, lakes, pond, boars, beels and is also have both fresh and brackish water resources. Also the state is having high diversity in culture species, culture systems & culture techniques etc. West Bengal fisheries sector provides livelihood, nutritional security which contributes towards agricultural exports in the state. In West Bengal, fresh water aquaculture is mainly dominated by IMCs (*Labeo rohita, Labeo catla, Cirrhinus mrigala*), minor carps (*Labeo bata*, *Labeo calbasu*, *Puntius spp*. etc), exotic carps (*Ctenopharyngodo nidella*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*) and other fishes (*Oreochromis spp*., *Clarias batrachus, Heteropneustes fossilis*, *Anabas testudineus*).

Despite of tremendous production potentiality, the fish farmers are experiencing around 26% loss in production due to poor farm management, lack of knowledge and most concerning threat "diseases" (Vineetha and Abraham, 2009; Hoque et al., 2018). In order to achieve the global food demands, intensification and commercialization of aquaculture production is going on, which is finally creating an immense stress on environment and stress in the cultured fish species. This pressure is ultimately leading to outbreak of various kinds of infectious and non infectious diseases. According to Abraham et al., 2010, the major reason for loss occurred in different aquaculture farms of West Bengal are diseases (82%), floods (51%), financial problems (50%), illegal poaching (48%) and fluctuation in market price (30 %). Diseases are the stumbling blocks for both social and economic development. Mondal and Das, 2005 had also reported that in West Bengal freshwater hatcheries, diseases are the third major threat. Diseases occur as result of interaction between host, environment and pathogen (Snieszko, 1974).

Currently, disease conditions are rapidly changing due to globalization, microbial adaptation and increasing pressure of aquaculture production (Subasinghe et al., 2004). In recent day's aquaculture practices, over stocking in pond and providing excess quantity of artificial feed for faster growth of fishes is a common phenomenon. However, the unutilized feeds get deposited at the bottom of the ponds leads to poor quality of water and stress to fishes. This is

ultimately resulting in outbreak of various fish diseases (Faruk et al., 2004). In aquaculture ponds, an infectious disease involves bacterial diseases, viral diseases, parasitic diseases, and fungal infections. In aquatic system, bacterial species can survive irrespective of their host, so bacterial infections are of major concern in the aquaculture practices. Around 13 genera of pathogenic bacteria including gram negative (*Photobacterium, Aeromonas, Francisella, Flavobacterium, Edwardsiella, Tenacibaculum, Vibrio, Pseudomonas, Yersinia* and *Piscirickettsia*) and gram positive (*Lactococcus, Streptococcus* and *Renibacterium*) are most frequently reported in aquaculture fish species (Subasinghe, 2005; Sharma et al., 2012). However, recently *Klebsiella pneumoniae* have found to be a newly emerging fish pathogen responsible for diseases in various fish species. In few years, occurrence of *Klebsiella pneumoniae* infection in different fish species had been reported from various countries like Iraq (Al-Imarah, 2008); Ghana (Takyi et al., 2012); Brazil (Oliveira et al., 2014) and from India (Gopi et al., 2016; Das et al., 2018).

Klebsiella pneumoniae is gram negative, ubiquitous, encapsulated opportunistic bacterial species which can be easily found in different environments like soil effluents, natural water bodies and also on mammalian mucosal surfaces (Piperaki et al., 2017). However, under adverse condition of aqua culture farms like overcrowding, elevated organic content, poor water quality these opportunistic bacteria will lead to disease outbreak (Park et al., 2012). Gopi et al., 2016 have reported *Klebsiella pneumoniae* disease in *Amphiprion nigripes*. There they have found an increased ammonia level in captivity which had helped the bacterium to cause severe infection. As *K. pneumoniae* is zoonotic in nature, so it is having a wider impact over public health. In the present study, sampling was carried out in various freshwater fish farms of West Bengal, India. *Klebsiella pneumoniae* have been isolated from different cultured fresh water fish species like *Labeo rohita, Oreochromis niloticus, Labeo catla, Cirrhinus mrigala, Anabas testudineus and Clarias batrachus*. Nevertheless, *Labeo rohita* was used as a model organism for studying the

pathogenecity of *K. pneumoniae*. The findings will be helpful for developing management strategies against this bacterial disease in the aquaculture system.

Across the globe, there are very scanty reports of *K. pneumoniae* infection in fish species. Most of the reports on *Klebsiella pneumoniae* infections includes microbiological and biochemical identification of the bacterium. The virulent genes responsible for pathogenesis in *K. pneumoniae* responsible for fish infections were not known. Earlier, no report of *K. Pneumoniae* infection in farmed *L. rohita*. Moreover, there were no detailed study on host pathogen interaction on fish immune system and *K. pneumoniae* infection. Understanding these factors will help in therapeutics agent development in the future to fight against this emerging pathogen in aquaculture system. So the present research study was conducted with the following objectives.