



## STUDIES ON THE EFFECT OF *STREPTOMYCES* ASSOCIATED WITH SEAWEEDS AS SINGLE CELL PROTEIN ON THE GROWTH OF PRAWN *MACROBRACHIUM ROSENBERGII* AND ANTAGONISM AGAINST PATHOGENS

Sirajudheen, T. K.\* , Dhevendaran, K. and Pramod Kiran, R.B.

Dept. of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala.

\*Corresponding author: sirajaqb@gmail.com

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**Abstract:** The key to successful management of prawn culture operations lies in the manipulation of useful microbes through innovative means such as use of probiotics. This study was targeted to explore the antimicrobial potential of *Streptomyces* against fish pathogens such as *Aeromonas hydrophila* and *Serratia* and their potential to increase the growth and survival of *Macrobrachium rosenbergii* in the laboratory conditions. Six of the highly productive *Streptomyces* isolates of seaweed origin were used for the study. All of them exhibited bright mycelial colouration. All the six strains were tested against two fish pathogens such as *Aeromonas hydrophila* and *Serratia* spp. and found to be powerful antagonistic agents. The three *Streptomyces* strains with the maximum antimicrobial activity were tested in the experimental tank for their effect on the growth and survival rate of prawn under the laboratory conditions. The results revealed more growth and feed conversion efficiency in animals fed with *Streptomyces* strains when compared to control. It was also found optimum range of water quality parameters such as dissolved oxygen, dissolved free carbon dioxide, hardness and total alkalinity in the experimental tanks when compared to control. The study gives a vivid picture of *Streptomyces* as bio-control agent against bacterial diseases and growth promoter in fresh water prawn culture. The commercially important *Streptomyces* should be explored for their potential application in the health management of cultured prawns in the years to come.

**Key words:** Antimicrobial agents, bio-control, growth promoter, freshwater prawn culture

### INTRODUCTION

Knowledge on the nutritional quality and health improving efficiency of feed is essential for a successful aquaculture. The emphasis of disease management in aquaculture has been on prevention, which is likely to be more cost-effective than cure. So far, the conventional approaches, such as the use of disinfectants and antimicrobial drugs, have had limited success in the prevention or cure of aquatic diseases (Subasinghe, 1997). This may lead to less reliance on the use of chemicals such as antimicrobials, disinfectants, and pesticides which largely treat the symptoms of the problem and not the cause (Planas and Cuhna, 1999).

The key to profitable management of prawn culture operations lies in the manipulation of useful microbes through innovative means such as use of single cell proteins. Use of microbes in aquaculture to improve water quality by balancing bacterial population in water and reducing pathogenic microbial load is adopted in many parts of the world (Maeda and Liao, 1994; Zhoujia *et al.*, 1997). There are various ways through which these microbes could act in aquaculture systems. These include competitive exclusion of pathogens, enhancing digestion through the supply of essential enzymes, moderating and promoting the direct uptake of

dissolved organic materials, active promotion of pathogen inhibiting substances and other possible mechanisms (Jory, 1998).

The importance of microbial communities in shrimp aquaculture systems and pond productivity was realized by Maeda and Liao (1992) who first isolated a strain "PM-4" (subsequently identified as *Thalassobacter utilis*) from the rearing water of larval *Penaeus monodon* for use as biocontrol agent. Nogami and Maeda (1992) isolated a bacterial strain which was found to improve the growth of crab *Portunus trituberculatus* larvae and repress the growth of other pathogenic bacteria, especially *Vibrio* species. The present study was targeted to explore the antimicrobial potential of *Streptomyces* against fish pathogens and their ability to improve the growth and survival of *Macrobrachium rosenbergii* in laboratory conditions.

## MATERIALS AND METHODS

### Antimicrobial activity of *Streptomyces* strains

Six strains of *Streptomyces* of seaweed origin were screened for antimicrobial activity by disc method. Pathogenic organisms such as *Aeromonas hydrophila* and *Serratia* sp were used as the test organism. To test the antagonistic property, nutrient broth media inoculated with pathogens were swabbed on to nutrient agar plates. Disc incorporated with butanol extract of *Streptomyces* were placed separately on these media and the zones of inhibition were measured after 24-28 hours.

### Growth Parameters

Three *Streptomyces* strains (AQB4, AQB24 and AQB40) with the maximum antimicrobial activity were tested in the experimental tanks for their effect on the growth and survival rate of *Macrobrachium rosenbergii* under the laboratory conditions. Artificial feed was formulated by using ingredients such as soya bean meal, ground nut oil cake, cholesterol, vitamins, minerals, Soya lecithin, fish meal, and tapioca powder. *Streptomyces* strains were mass cultured in the Glycerol medium, filtered, dried and then

pulverized to incorporate in test feed. The acclimatized prawns reared in glass tanks were fed twice daily (morning and evening) in two equal portions. The morphometric characteristics i.e. body weight and total lengths were recorded to observe their growth performance. From the weekly data obtained during the experimental period, variation in Length, Weight and Food Conversion Ratio (FCR) were determined. The FCR was computed by the following equation:

$$FCR = F / (W_f - W_o), \text{ where}$$

F = weight of food supplied during the experiment

W<sub>o</sub> = live weight of prawns at the beginning of the experiment

W<sub>f</sub> = live weight of prawns at the end of the experiment

All data were subjected to one-way analysis of variance (ANOVA) (Snedecor and Cochran, 1967) in order to derive the mean variations of length, weight and FCR.

### Water quality analysis

The water quality parameters such as temperature, dissolved oxygen (Winkler, 1883), dissolved free carbon dioxide, total alkalinity and total hardness were analyzed weekly by adopting the method of APHA (1998).

## RESULTS AND DISCUSSION

Among the six isolates, all exhibited maximum antagonistic activity against *Aeromonas hydrophila* and *Serratia* spp., except the strain AQB2. The strain AQB24 showed maximum inhibition zone of 2.7cm against *Aeromonas hydrophila* (Fig. 1 A, B) whereas AQB40 showed maximum inhibition zone 2.5cm against *Serratia* spp (Fig. 1 C, D). Smith and Davey (1993) reported that fluorescent strain pseudomonad bacteria can competitively inhibit the growth of fish pathogen *Aeromonas salmonicida*.

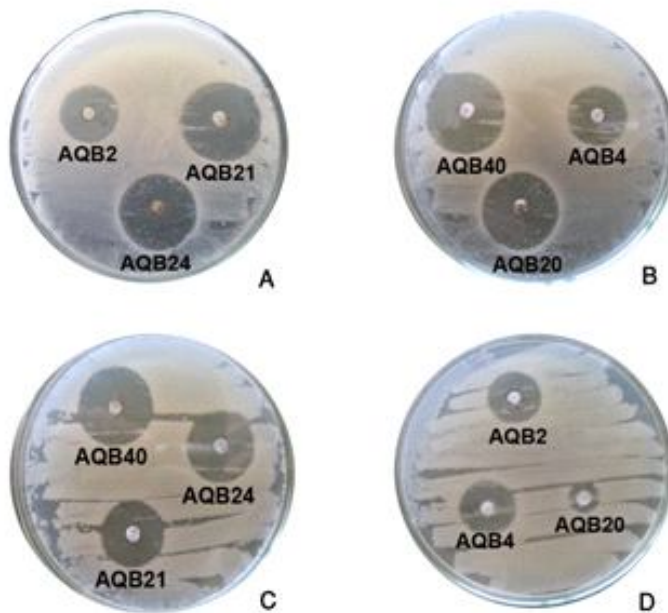
The prawns fed with *Streptomyces* incorporated feed showed a high growth rate when compared to prawns fed with control diets. The prawns fed with *Streptomyces* strain AQB40 showed increase in length, weight and FCR followed by those fed

## Effect of *Streptomyces* associated with seaweeds as single cell protein

with *Streptomyces* strains AQB24 and AQB4 respectively (Table. 1). The ANOVA results also showed variations in growth parameters with significant F values (Table 1). Maeda and Liao (1992) reported the effect of bacterial strains obtained from soil extracts on the growth of prawn larvae of *Penaeus monodon*. Nogami and Maeda (1992) reported that some bacteria could improve the growth of crab *Portunus trituberculatus* larvae and repress the growth of other pathogenic bacteria, especially *Vibrio* species. The water quality parameters were found optimum in the experimental tanks when compared to control. No change was observed in temperature during the experimental period. Dissolved Oxygen content was higher in tank with *Streptomyces* strains AQB40 (7.435 mg/ltr) followed by tanks with AQB24 and AQB4 respectively, but it was comparatively low in control tank (6.49 mg/ltr) (Fig. 2). A low

concentration of dissolved free carbon dioxide were also observed in tank with AQB40 (16.875 mg/ltr) whereas it was comparatively higher in control tank (Fig. 2). The total alkalinity was found low in tank with *Streptomyces* strains AQB40 and AQB24 (10 mg/ltr CaCO<sub>3</sub>) whereas a low value of total hardness was observed in tank with AQB4 (12.75 mg/ltr CaCO<sub>3</sub>) (Fig. 2).

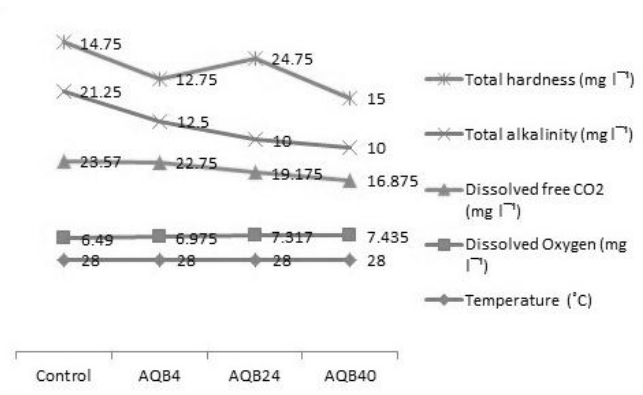
These finding are consistent with the observations of Zhoujia *et al.* (1997) and Sridhar and Paul (2003) that they succeeded in the use of microbes to improve water quality in shrimp culture systems. Dhevendaran and Selvakumar (2007) also demonstrated the utility value of *Streptomyces* as feed additives to ornamental fishes. The present study provide evidence for the usefulness of *Streptomyces* as a bio-control agent against bacterial pathogens as well as growth promoter in fresh water prawn culture .



**Fig. 1.** A, B: Antimicrobial activity of *Streptomyces* against *A. hydrophila*.  
C, D: Antimicrobial activity of *Streptomyces* against *Serratia* sp.

**Table 1.** Effect of *Streptomyces* incorporated feed on the growth and FCR of *Macrobrachium rosenbergii*

Parameters	Mean Variation				ANOVA	
	CTRL	AQB4	AQB24	AQB40	F value	P value
<b>Length (cm)</b>	0.75	1.05	1.825	2.3	7.25695	0.00492
<b>Weight (gm)</b>	0.465	0.87	1.375	2.0625	5.42987	0.01362
<b>FCR</b>	3.58	7.25	10.04	13.23	5.85539	0.02042



**Fig. 2.** Effect *Streptomyces* on water quality parameters of *M. rosenbergii* culture system.

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