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Research Article

Effect of Probiotics on Growth and Survival of Penaeus vannamei from the Culture Ponds of Ampalam Andhra Pradesh, India

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Abstract

The present work is carried out in commercial shrimp farms located at Ampalam of Srikakulam District, Andhra Pradesh, India, over a period of two consecutive years i.e. 2018-2019. Modified extensive shrimp farms were selected for this research work. The data was recorded from both control and experimental ponds in summer and winter crops. In the present study the growth and survival of the shrimps in all the experimental ponds showed better performance than control ponds in two different crops during the study period. The important point of consideration in the study is that the application of feed probiotics along with the immunostimulant showed significantly better results than the feed probiotics alone given in the feeds to the shrimp. The slow growth rate in the control ponds in the selected study area was due to high pathogenic bacterial loads, delayed moulting and stunted growth.

Keywords: Growth, Survival, P. vannamei.

Introduction

According to studies of Gomez-Gil et al., (2000) probiotic bacteria can able to produce digestive enzymes, vitamins and essential amino acids which are helpful to the growth of the hosts. Another study conducted by Uma et al., (1999) revealed that probiotics can enhance the response of the immune system of the animal and achieve highest percentage of survival. Wang et al., (2005) stated that usages of probiotics in shrimp farming can enhance feed conversion ratio (FCR). Rengpipat et al., (2000) isolated the genus Bacillus from crustacean intestine this genus Bacillus have shown inhibitory activity against different pathogens and also increase body weight and survival rate of larvae and post larvae of P. monodon. Rengpipat et al., (1998); Sugita et al., (1998); Zhou et al., (2009) studied about the survival rate and activities of the digestive enzymes in different larval stages of shrimp at different concentrations of the probiotics. Effect of commercial Bacillus probiotic on digestive enzymes, survival and growth of Fenneropenaeus indicus studied by Ziaei-Nejad et al., (2006). Avakh (2006) studied about the action of isolated Bacillus subtilis from cultured prawn Macrobrachium rosenbergii on growth, survival rate and inhibitory activity against pathogen Aeromonas hydrophila in prawn culture. The purpose of the present study is to assess the role of probiotic Pro-2 along with immunostimulant 1,3 β-Glucan, a commercial brand β-ADVANTAGE to assess the impact on growth and survival of shrimp P. vannamei.

Material and Methods

The present work is carried out in commercial shrimp farms located at Ampalam of Srikakulam District, Andhra Pradesh, India, over a period of two consecutive years i.e 2018-

2019. Modified extensive shrimp farms were selected for this research work. The data was recorded from both control and experimental ponds in summer and winter crops. For studies on growth and survival feeding was followed according to the specifications given by the feed manufacturers in both crops during the study period. The feed used during the study was C.P. branded semi-intensive feed. The stocking density of all the ponds was uniformly followed during the study period in both control and experimental ponds. The stocking density was done uniformly at the rate of 1, 13,000 seeds per hectare pond i.e. 13 pieces/sq.mt. Four check trays were arranged in four corners of the pond. Feeding procedure was monitored according to body weight sampling after check tray observation. The feeding procedure was followed as follows: 25% at 6 am, 20% at 11 am, 30% at 6 pm and 25% at 10 pm. After 15 days of stocking, sampling of shrimp was done weekly during early hours of the day with a cast net and weights are recorded and tabulated. The Survival rate and average body weight (ABW) of the shrimp were estimated and condition of shrimp health was observed.

The body weight and survival rate of the shrimp was estimated by adopting the formula

Average body weight of the shrimp (ABW)

Weight gain = Final weight of the shrimp-Initial weight of the shrimp/ Initial weight of the shrimp X 100

% Survival rate of the shrimp

Survival rate = Number of shrimps survived/ Number of shrimps stocked x 100

Application of feed probiotic

In the present study feed probiotic Pro-2 was applied along with the immunostimulant 1, 3 β-Glucan, a commercial brand β-ADVANTAGE for both summer and winter crops. The feed probiotic applied at the rate of 5g/kg and 10g/kg with 5g/kg immunostimulant in the experimental ponds at two different study areas. The application of feed probiotic and immunostimulant was followed every day for both the seasons i.e. summer and winter during study period i.e. 2018 to 2019.

Statistical analysis

One-way ANOVA was carried out to check the effect of days on the growth and survival rate in control and experimental farms of the winter crop and summer crops at Ampalam during the years 2018 to 2019. These analyses were done by using IBM SPSS Version 22.0. Bar graphs were drawn by using mean values and SD of growth and survival rates in MS Excel 2016. All values were represented as Mean ± SD.

Results

It is evident from the present results in summer crop of year 2018 at Ampalam, that the growth in grams of P. vannamei was noticed as 3.89±0.15 at 30 days of culture in control pond and this pond harvested due to white spot disease at 19.8 g on 108th day, whereas in the experimental pond, the growth of 4.80±0.27 was noticed at 30 days of culture. Similarly the

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highest growth in grams was noticed as 25.17±0.53 in experimental pond at 120 days of culture **(Table 1 & 2, Figure 1 & 2).**

Similarly in the winter crop of year 2018 the growth in grams of P. vannamei at 30 days of culture in control pond was observed as 4.01±0.17 and this pond was harvested due to white spot disease at 20.6 g on 104th day. Similarly the growth in grams of 4.23±0.21 was recorded in experimental pond at 30 days of culture. The highest growth in grams of 25.87±0.48 was observed in experimental pond at 120 days of culture **(Table 1 & 2, Figure 1 & 2).**

In summer crop of year 2019, the growth in grams of P. vannamei was noticed as 4.22±0.12 at 30 days of culture in control pond, where as in the experimental pond, the growth of 5.93±0.31 was observed at 30 days of culture. Similarly the highest growth in grams was noticed as 22.84±0.43, 26.46±0.72 in control and experimental pond at 120 days of culture respectively **(Table 1 & 2, Figure 1 & 2).**

Similarly in the winter crop of year 2019 the growth in grams of P. vannamei was noticed as 3.72±0.20 at 30 days of culture in control pond, where as in the experimental pond, the growth of 3.97±0.26 was observed at 30 days of culture. Similarly the highest growth in grams was noticed as 23.21±0.28, 24.89±0.42 in control and experimental pond at 120 days of culture respectively **(Table 1 & 2, Figure 1 & 2).**

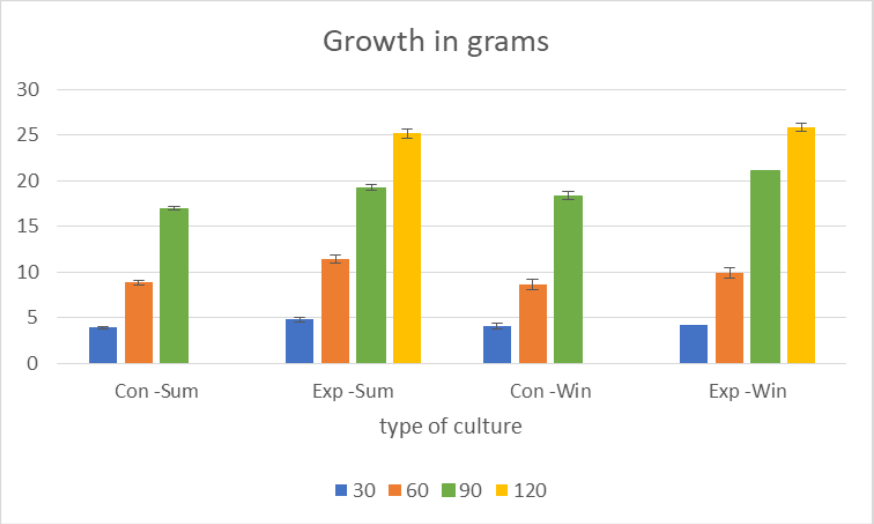

Figure 1. Growth of P. vannamei (in grams) at Ampalam during the year 2018.

Table 1. ANOVA for Growth of P. vannamei (in grams) at Ampalam during the year 2018.

Growth in grams					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	267.622	3	89.207	1.545	.219
Within Groups	2194.030	38	57.738		
Total	2461.652	41			

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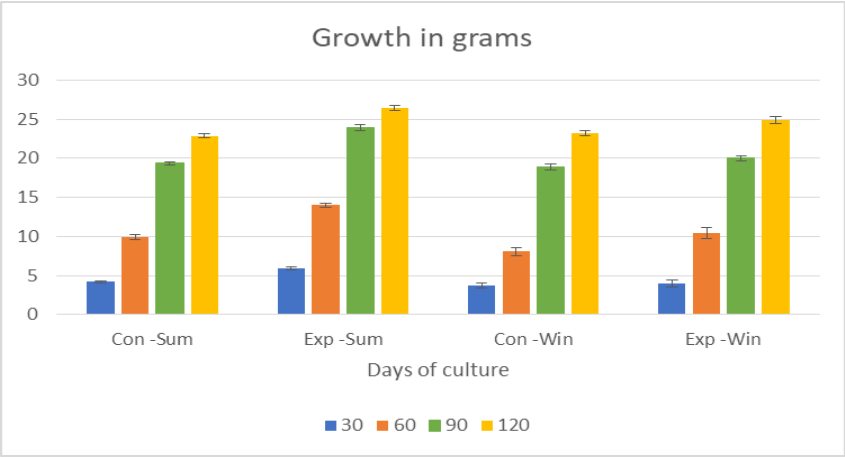

Figure 2. Growth of P. vannamei (in grams) at Ampalam during the year 2019.

Table 2. ANOVA for Growth of P. vannamei (in grams) at Ampalam during the year 2019

Growth in grams					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	118.330	3	39.443	.578	.633
Within Groups	3004.125	44	68.276		
Total	3122.456	47			

Table 3. Percentage survival rate of P. vannamei in the culture ponds at Ampalam during the years 2018 to 2019.

S/N	Station	**2018**				**2019**			
		Summer Crop		Winter Crop		Summer Crop		Winter Crop	
		C.P.	**E.P.**	**C.P.**	**E.P.**	**C.P.**	**E.P.**	**C.P.**	**E.P.**
1	Ampalam	70.04	83.21	73.59	82.54	79.06	84.25	74.39	87.04
Note: C.P. = Control Pond; E.P. = Experimental Pond									

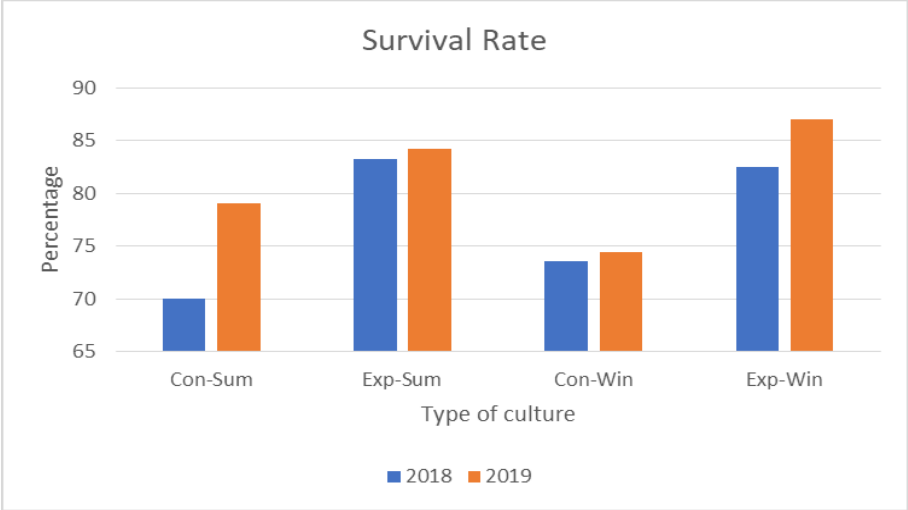

Figure 3. Percentage survival rate of P. vannamei in the culture ponds at Ampalam during the years 2018 to 2019.

Survival rate

The percentage survival rates of P. vannamei in control and experimental ponds were tabulated and the data was evaluated. It is evident from the present results that, the survival rate of P. vannamei during the year 2018 at Ampalam in summer crop the percentage of 70.04% and 83.21% was observed for both control and experimental ponds respectively. Similarly in the winter crop of 2018 these values were observed as 73.59% and 82.54% for both control and experimental ponds respectively **(Table 3, Figure 3).**

In the same way the survival rate of P. vannamei during the year 2019 at Ampalam in summer crop the percentage of 79.06% and 84.25% was observed for both control and experimental ponds respectively. Similarly in the winter crop of 2019 these values were observed as 74.39% and 87.04% for both control and experimental ponds respectively **(Table 3, Figure 3).**

Discussion

Application of probiotics showed best growth performance and significant increase in digestibility protease in P. vannamei and F. indicus as reported by Gomez and Shen (2008), Liu et al., (2009), Wang (2007) and Ziaei-Nejad et al., (2006) respectively. According to Castex et al., (2008), Gomez and Shen (2008) and Nimrat et al., (2013) protease probiotics can also influence other digestive enzymes present in the shrimp such as amylase, cellulose and trypsin. Since positive results of the application of probiotics on digestive physiology of shrimp, it is considered as desirable feature for the farmed shrimps. According to Lazado and Caipang (2014) the role of gastrointestinal tract microbiota of the host can be divided into two main distinctive functions. First one is related to immunity because, the microbiota is very much essential for the maintenance of the mucosal immunity and act as major defensive barrier against invading pathogens. The second one is related to nutrition because, supply of nutrients and useful enzymes by the microorganisms to the host animal (Nayak, 2010; Lazado et al., 2015).

Probiotics can be modulate the microbiota present in the host, since the gut microbiota is responsible for the success of probiotic applications, whereas probiotics are modulators of the gut microbiota as described by Lazado and Caipang (2014). This phenomenon is very interesting in aquaculture species, where application of probiotics is mainly through diets and gastro-intestinal tract is organ where interaction occurs between host and probiotics is very significant. According to Verschure et al., (2000) there are two main hypothesis on how probiotics influence the microbiota of the host. (1). Determinism, which explains that a well-defined dose responsive relation shrimp is needed. (2). Stochasticism which describes changes favor to the organism which will occur to be in the right place at right time.

According to Janeo and Corre Jr, (2011) when the shrimp fed with probiotic cocktail that contain different Bacillus strains, the dominance of the Bacillus bacteria can be increased, this was observed in the shrimp gut after 2 hours and 24 hours in the hepatopancreas of shrimp. The change of microbial community was observed in P. vannamei when exposed to probiotics of different origins. In this experiment gut probiotic fed group consist of α- and γ-proteobacteria, fusobacteria, sphinobacteria and flavobacteria whereas control group was mainly dominated by α-protobacteria and flavobacteria as reported by Luis-Villasenor et al.,

(2013). In a study made by Li et al., (2007) there was no significant change observed in total bacterial count in P. vannamei fed with Bacilllus licheniformis. Whereas application of probiotics lowered the vibrio counts in gut of shrimp. This remarkable reduction of vibrio count was also noticed in tiger prawn P. monodon fed Synechocystis MCCB and in Marsupenaeus japonicus fed with Bacillus bacteria as reported by Preetha et al., (2007).

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