Evaluation Of Effects Of Some Selected Probiotics On Water Quality Characteristics Of L. Vannamei Culture Ponds

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Abstract: The present study was carried out over a period of 120 days to estimate the major physcico-chemical parameters such as salinity, pH, temperature, dissolved oxygen, total ammonia, alkalinity, hardness and total vibrio counts (TVC). For this study we have selected two shrimp culture ponds of which one is control and other is experimental pond (probiotic treated pond). The commercial brand probiotic (Inve-Pro-W) was used for the entire study period. It is evident from the present results that probiotic treated ponds showed better performance in terms of water quality parameters than control ponds.

Keywords: Water quality parameters, L. vannamei, Probiotics.

1. INTRODUCTION

Aquaculture is one of the rapidly growing sectors in the world. The culture activity of the shrimp has increased enormously throughout the world due to fast growth rate of shrimps, short duration of the culture, and great demand in the export market. Water quality of the shrimp culture ponds play an important role and it is controlled by number of factors, for instance the amount of dissolved oxygen is governed by factors like photosynthesis, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and consumption of oxygen by the organism present in the culture ponds. The role of probiotics in shrimp culture is highly beneficial, economical and eco-friendly. In aquaculture industry the usage of probiotics, brought very good change in application procedures. There are different kinds of probiotics used for the shrimp culture, these probiotics are playing vital role in the health management of shrimps and also in the water quality management. These probiotics are classified into many types, but three of them are very important in shrimp culture. These are water probiotics, soil probiotics and gut probiotics. The water quality parameters such as salinity, pH, temperature, dissolved oxygen, total ammonia, alkalinity, hardness and total vibrio counts (TVC). were studied during the year 2018 in L. vannamei culture ponds at Ananthavaram. Despite most of the shrimp farming in India shifted from P. monodon to L. vannamei culture systems, therefore very limited information is available on physico-chemical parameters of the water in L. vannamei culture systems. In recent years in the evolution of the aquaculture probiotics, the single probiotic developed by many companies in the commercial production for water application in the culture ponds. There are different strains used in the probiotics depending on the requirement of their mode of action. Nitya Jeevan Kumar et al., [1] gave information about the effect of water probiotic (Pro-W) in L. vannamei culture ponds from Nellore, Andhra Pradesh, India. In the present study we have used Pro-W probiotic in L. vannamei culture ponds.

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2. MATERIALS AND METHODS

The present work is carried out in commercial shrimp farms located at Ananthavaram of Prakasam District, Andhra Pradesh, India, during the year 2018. Modified extensive shrimp farms were selected for this research work. The data was recorded from both control and experimental ponds. For studies on water quality parameters, samples of pond water were collected from control and experimental ponds for 0, 30, 60, 90 and 120 days of culture. For collection of water samples 500 ml capacity polythene bottles were used and stored in ice box and brought to the laboratory within a span of two hours of sampling. Water temperature, pH, and salinity were recorded on field. The temperature was measured by using mercury centigrade thermometer with an accuracy of 0.1^0C. Temperature was expressed as degree Celsius (^{0}C). pH was measured using pH meter (Elico, Make). Water samples were collected from four corners of the culture ponds and readings were recorded. The samples were brought to the laboratory of the Department of the Zoology, Acharya Nagarjuna University, Guntur for further analysis, and standard methods were followed [2]. Pond water levels were maintained at 1-1.2 meter in all the ponds and continuous aeration was provided throughout the culture period. No probioits was used in control ponds but 10-20% water exchange was done once in 15 days upto 90 days of culture and then 70% water exchange was done once a week till harvest. In case of experimental ponds the water is treated with commercial water probiotics Pro-W@30kg/hectare for every 15 days throughout the culture period. A minimum of 5-10% water exchange was done in experimental ponds. Salinity of the pond water was measured using refractometer. For this water collected from four corners of the ponds. Dissolved oxygen was measured by modified Winkler's iodometric method [2]. Alkalinity was measured by following the modified titrimetric method [2]. For the determination of total ammonia spectrophotometric method was followed [2], for this spectrophotometer (Systronic UV-VIS, Spetrometer 108) was used. The concentration of total ammonia was computed based on standard graph and results were expressed as mg/lit. Hardness of the water was estimated by titrimetric method [2].

2.1 Microbial Analysis

For studies on microbial analysis water samples were collected following the method described by Dalmin et al., [3].

For this water samples were collected in 100ml sterilized PVC bottles just below the water surface. Necessary precautionary measures were taken to minimize the contamination through handling. Each water sample is serially diluted 10^{-6} using sterile distilled water as a blank which was prepared by sterilized seawater in an autoclave at 15 lbs and 121^0C for 15 minutes. Total vibrio counts were determined following the procedure of Dalmin et al., [3]. For this TCBS agar medium was used. For isolation of vibrios spread plate method was used to inoculate bacteria into agar petri plates and incubated for 20-24 hours. Total Vibrio Count (TVC) was expressed as colony forming units/ml (cfu/ml).

3. RESULTS

It is evident from the present results of summer crop of 2018 at Ananthavaram, water salinity in ppt was recorded at different time intervals of culture in control pond and experimental pond were ranged from 28.55±2.8 to 30.60±3.2 and 29.56±1.5 to 32.65±3.2 respectively. Mean values of pH recorded at different time intervals of culture in control and experimental ponds were ranged from 7.5±1.2 to 8.5±1.7 and 7.3±1.9 to 8.7±1.5 respectively. Similarly mean values of temperature in (^{0}C) ranged from 30.25±1.2 to 31.65±2.3^{0}C and 30.40±1.7 to 31.80±1.9^{0}C were recorded for control and experimental ponds respectively. Mean values of dissolved oxygen concentrations were recorded from culture ponds and it was ranged from 5.93±1.35 to 7.74±1.82 and 5.81±1.58 to 7.52±1.35 mg/lit for both control and experimental ponds respectively. It has been observed that values of dissolved oxygen levels in experimental ponds significantly higher than control ponds. Similarly mean values for total ammonia was varied from 0.09±0.02 to 0.25±0.01 and 0.05±0.01 to 0.18±0.02 mg/lit for both control and experimental ponds respectively. Hardness ranged from 881±12.58 mg/lit to 1189±5.32 and 794±10.32 to 1165±4.45 mg/lit respectively. Total alkalinity values found to be varied from 184±3.41 to 206±1.31 and 179±4.27 to 214±2.17 mg/lit for both control and experimental ponds respectively. Similarly mean values of total vibrio counts (TVC) in pond water varied from 0.48 x 10^2±0.10 to 1.21x10^2±0.11 cfu/ml and 0.42x 10^2±0.15 to 0.98x 10^2±0.11 cfu/ml for both control and experimental ponds respectively. Similarly the results of water quality parameters of the shrimp farms in the winter crop of 2018 at Ananthavaram salinity ranged from 30.50±1.5 to 32.85±3.4 and 30.65±5.2 to 32.85±3.5 ppt for both control and experimental ponds respectively. pH varied from 7.8±1.5 to 8.9±3.1 and 7.5±1.9 to 8.9±2.5 respectively. In the same way temperature varied from 27.72±1.5 to 30.70±1.5 and 28.50±1.9 to 30.70±1.5 for both control and experimental ponds respectively. Dissolved oxygen content found to be varied from 5.56±2.32 to 7.93±1.41 mg/lit and 5.42±2.23 to 7.81±1.45 mg/lit for both and control ponds respectively. Similarly mean values of total ammonia varied from 0.11±0.02 to 0.23±0.01 mg/lit and 0.08±0.03 to 0.19±0.02 mg/lit for both control and experimental ponds respectively. Values of hardness ranged from 932±3.53 to 1279±3.21 mg/lit and 765±4.31 to 1169±4.23 mg/lit for both control and experimental ponds respectively. Similarly total alkalinity varied from 162±3.25 to 211±4.16 mg/lit and 139±1.68 to 197±5.23 mg/lit for both control and experimental ponds respectively. Mean values of total vibrio counts were also varied from 0.57x10^2±0.11 to 1.43x10^2±0.25 cfu/ml and 0.36x10^2±0.09 to 0.85x10^2±0.17 cfu/ml for both control and experimental ponds respectively (Figures 1-8).

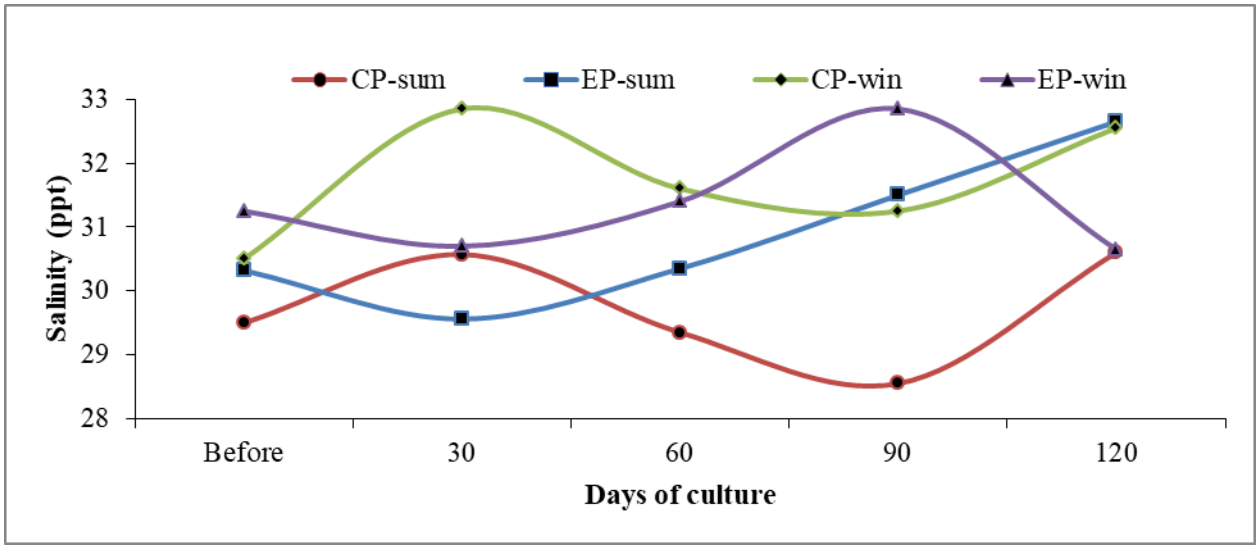

***Figure 1**. Salinity of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

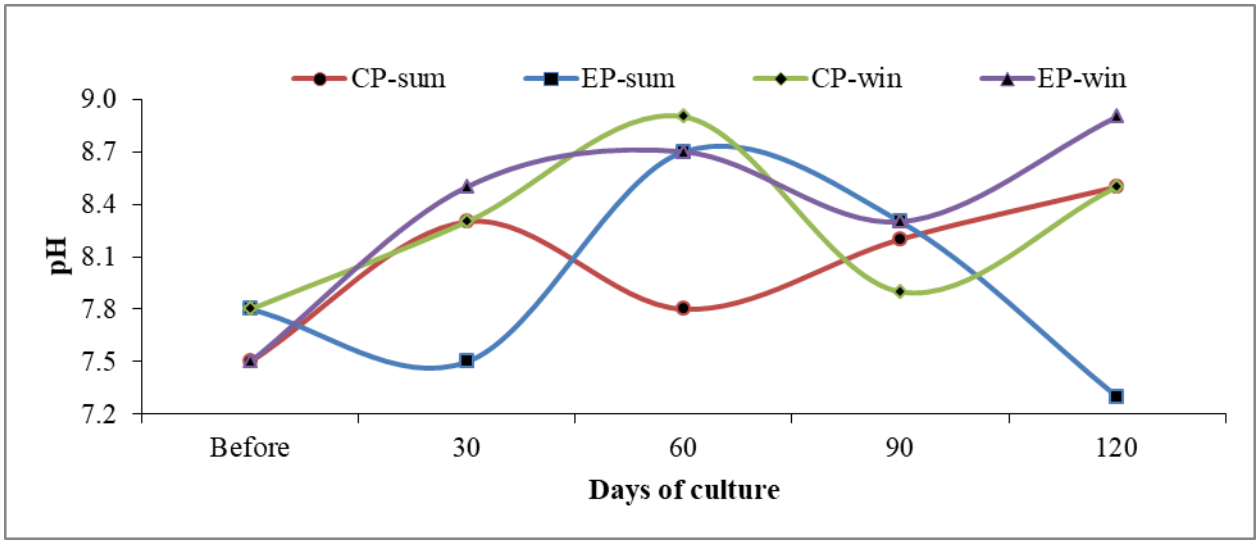

***Figure 2**. pH of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

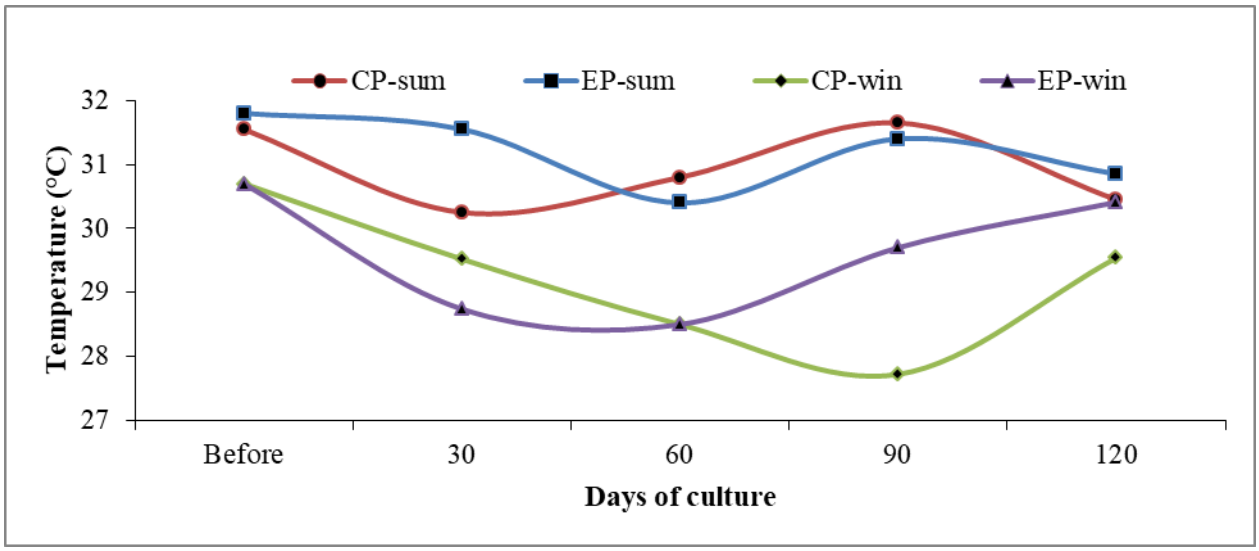

***Figure 3**. Temperature of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

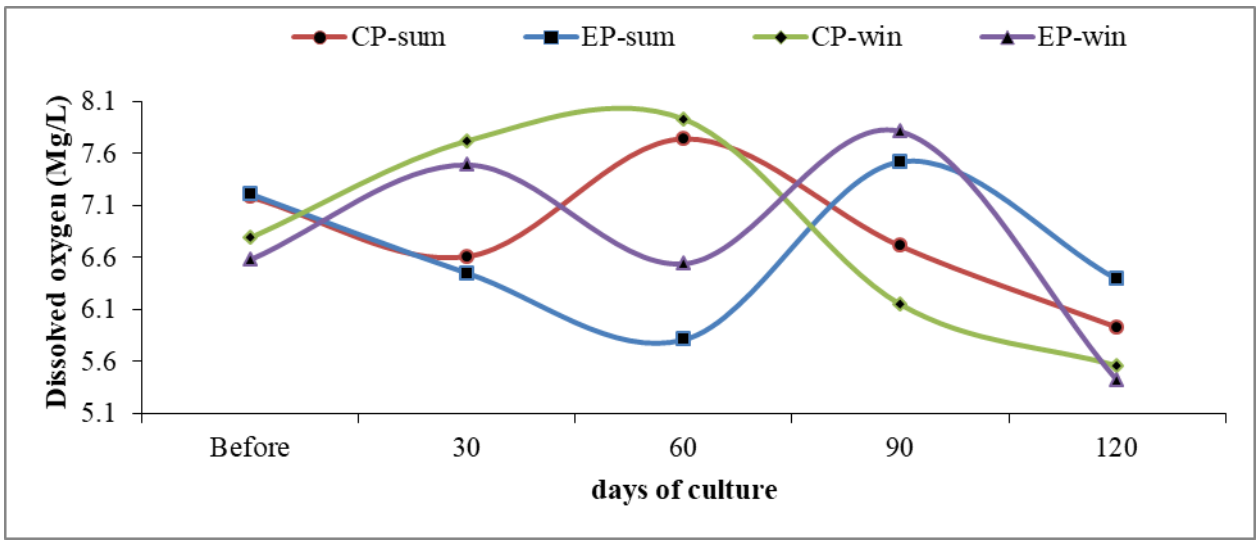

***Figure 4**. Dissolved Oxygen of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

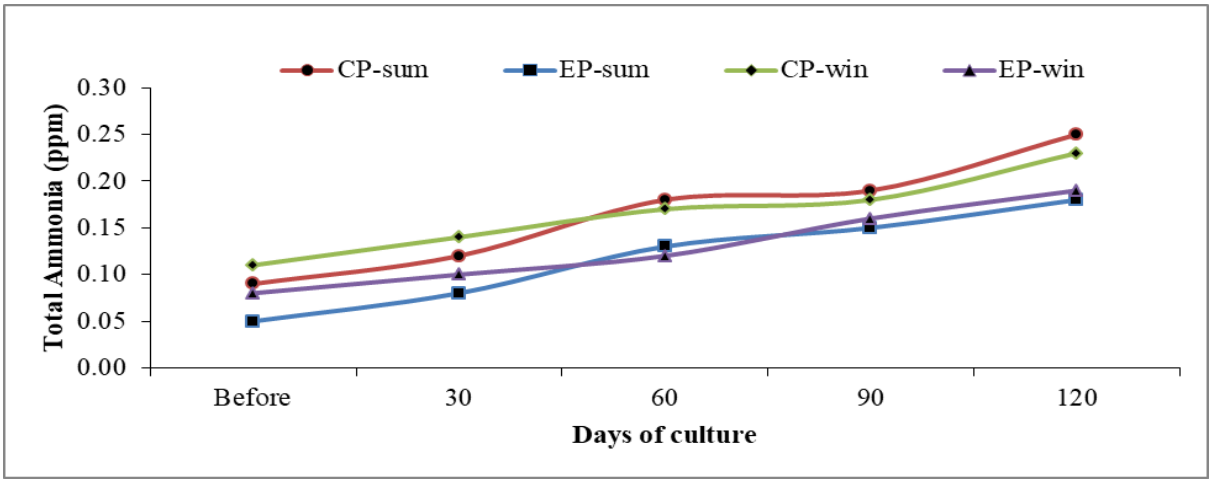

Figure 5. *Total Ammonia of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

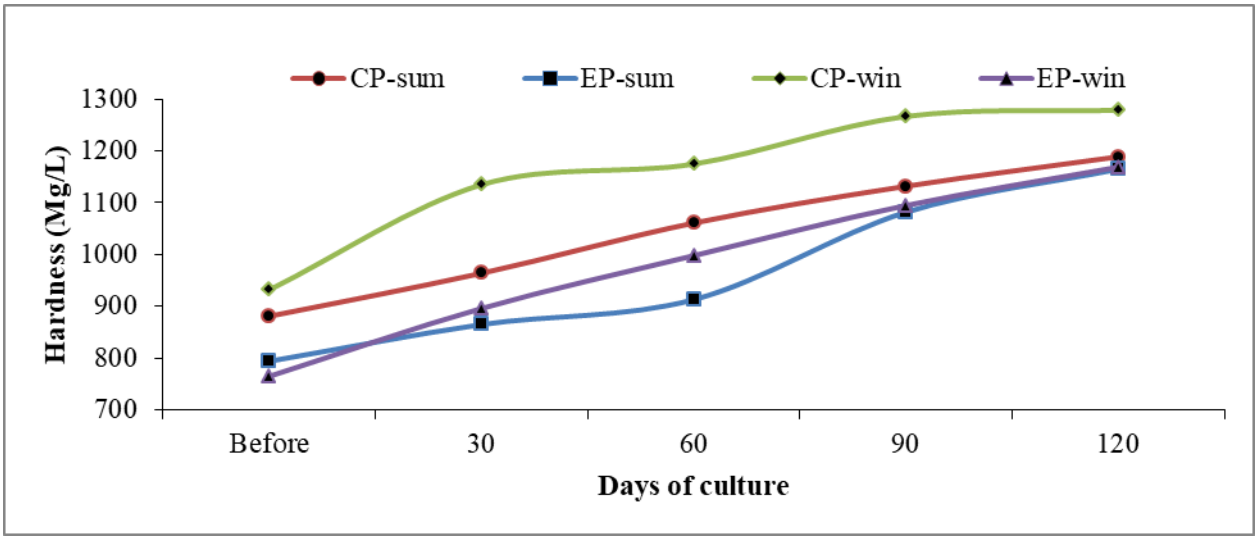

Figure 6*. Hardness of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

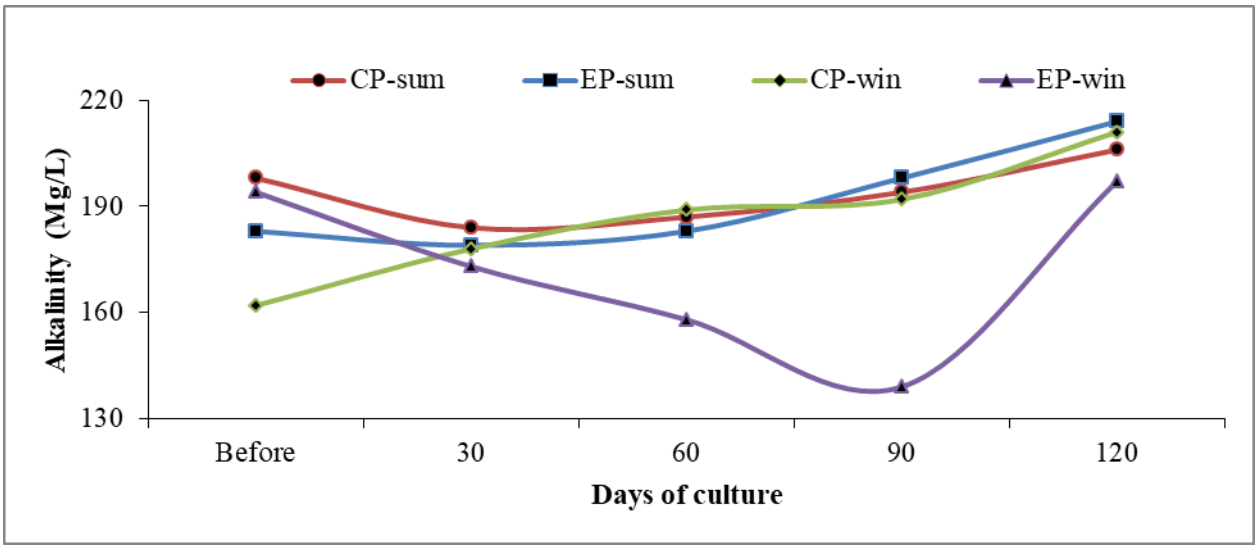

Figure 7*. Alkalinity of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

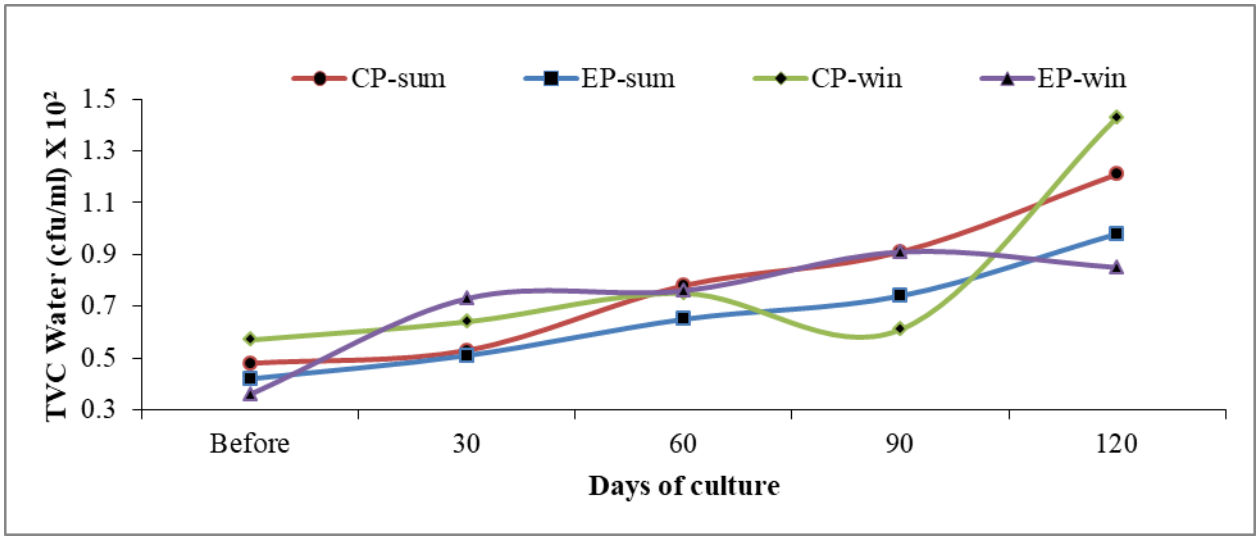

***Figure 8**. TVC of the pond water in control and experimental ponds at Ananthavaram during the summer and winter crops of 2018*

4. DISCUSSION

The physico-chemical factors of the culture pond play an important role on shrimp production and ecosystem of the pond. The pond ecosystem and biota of culture ponds also influence the production performance of the shrimp farm. The maintenance of good water quality is essential for optimum growth and survival of shrimp. According to Samocha et al., [4] salinity tolerance of 2-45 ppt was observed with L. vannaemi culture. An ideal salinity range for P. monodon was 10-35 ppt as recommended by Gunalan et al., [5]. In the present study the pond water salinity was found to be varied from 28.55±2.8 to 32.85±3.5 ppt throughout the study period for both summer and winter crops respectively. The results were correlated with the studies conducted by Ponce-Palafox et al., [6] revealed that L. vannamei had better growth at higher salinity of 20 ppt at temperatures of 25^{0}C and 35^{0}C. Ramanathan et al., [7] gave information about the optimum range of pH is 6.8-8.7 for maximum growth and production in shrimp farming. According to Boyd [8] pH of the pond water should be ranged between 6.5-9.0 is to be considered for good production in shrimp culture. In the present study the pH concentration was found to be varied from 7.3±1.9 to 8.9±3.1 during the study period. Wyban et al., [9] observed that temperature is one of the important factors that influence the growth of marine shrimps. Ramanathan et al., [7] suggested about the temperature range in the culture system of tiger shrimp that, the optimum temperature range of 28-50^{0}C promotes the optimum growth rates in shrimps. In the present investigation the observed temperatures in the study period ranged from 27.72±1.5 to 31.80±1.9^{0}C. These results were correlated with the similar findings observed by Pushparajan and Soundarapandian [10]. According to Molluae [11] oxygen demand can reduce the metabolic activity of shrimp, therefore the growth and molting process will be retarded and eventually mortality occurs. According to Chen [12] the critical concentration of the dissolved oxygen in shrimp culture pond is 3.7 ppm. In the present findings the recorded average values of dissolved oxygen are greater than 5.4 mg/lit. Jiang et al., [13] observed the safe level of ammonia in L. vannamei culture was of 2.6 mg/lit. In the present investigation the total ammonia concentrations were within the normal limits (0.05 to 0.25 ppm and correlated with similar studies of Boyd and Zimmerman [14]. According to Hutchinson [15] main cause of alkalinity in pond water due to bicarbonates and they are act as chief components at a pH range of 7 to 9. Welch [16] and Yaron [17] stated that alkalinity of aquatic environment is partly depends on water present in it. In the present study the total alkalinity found to be varied from 139±1.68 to 214±2.17 mg/lit for both summer and winter crops respectively. Similarly the total hardness was significantly varied from both control and experimental ponds from 765±4.31 to 1189±5.32 mg/lit. The term Vibriosis is used to refer to all the types of infections caused by the bacteria of the genus Vibrio including bacterial shell disease and black gill disease. Vibriosis is most frequently encountered in culture shrimps and majority of the stressed shrimps have the presence of vibrio species. Since vibrio species are opportunistic pathogens they attack stressed shrimps which leads to mass mortality [18]. The positive bacteria in the probiotics reduced the proliferation of the pathogenic bacteria in all the experimental ponds where the application of probiotics is followed. At the same time due to the probiotic application the toxic gases of the pond bottom were reduced and the oxidation of the organic matter is observed in the culture ponds. The present findings of water quality parameters with the application of probiotics were correlated with the studies of Nitya Jeevan Kumar et al., [1].

5. REFERENCES

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