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Assessment of water quality in shrimp (*L. vannamei*) grow out ponds in selected villages of S.P.S.R Nellore district of Andhra Pradesh, India during winter crop season

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Abstract
Maintenance of water quality within the optimal levels during the culture period, especially in semi intensive culture condition is very essential. Hence, the present study is aimed at assessing the water quality parameters such as salinity, pH, alkalinity, hardness, nitrite- nitrogen and ammonia in shrimp grow out ponds of different villages that include Kottakoduru, Nidugunta palem, Ramudu palem, Raghvari Palem, Tummalapenta and Koruturu of S.P.S.R Nellore district of Andhra Pradesh, India for a crop period during November 2017 to February 2018. All most all the parameters like pH, salinity, Alkalinity, Total hardness, Calcium and magnesium, TAN and nitrite were studied. The results have shown that all the tested parameters were maintained under optimal conditions that suits for *L.vannamei* farming except Calcium which was reported to be very high than the ideal level.

Keywords: Total ammonia nitrogen, alkalinity, nitrite, semi intensive culture

Introduction
India is the second largest aquaculture nation in the world with 10.79 million tons of production falling next to china [8]. The vast resources in terms of water bodies and species of fish and shellfish in different agro-ecological regions of the country provide for a wide array of culture systems and practices. The shrimp, *Litopenaeus vannamei* is the major contributor to the overall aquaculture production in the country. Due to its growth rate, short culture period and high export value *Litopenaeus vannamei* expanded rapidly across the country [16]. The successful production of shrimp is often limited by physico-chemical factors of the water as it directly influences the productivity of shrimp farm and the ambient water in which shrimp lives has a cumulative effect on growth performance and survival of shrimp with respect to the production[9]. Proper water quality management plays a significant role to prevent the stress on shrimp that can accelerate them to various diseases [19]. Therefore, study of physico-chemical factors is the focal point of much research [10, 1] to prevent diseases and other changes that causes stress to shrimp. Weekly analysis of water quality during grow out period is essential to control these problems through proper applications and treatments. Hence, the present study was aimed to assess the water quality in grow out ponds on weekly basis during the winter in order to take the necessary precautions to protect the crop.

Materials and Methods
Site selection: Six major and successful crop yielding villages from the coastal belt of Nellore district of Andhra Pradesh were selected for this study. The villages include Kottakoduru, Nidugunta palem, Ramudu palem, Raghvari Palem, Tummalapenta and Koruturu.

Collection of water samples: The water samples from the selected villages were collected with the help of mobile lab operated by Matrix sea foods India Limited at the farm gate itself early in the morning hours and the water in a clean glass bottles preferably from the centre of the pond at a depth of 20-30cm below the water surface.

Water quality analysis: The water quality parameters like pH, salinity, Alkalinity, Hardness, Ammonia and others were analysed on the spot of collection without any delay.

pH was measured using digital pH meter (Electronics India), and Salinity with refracto meter (Erma). Alkalinity, hardness, Total ammonia and nitrite were measured using APHA [2] standard protocols.

Results

A total of 2747 pond water samples were collected and analysed for this study during the winter crop season from the selected villages on weekly basis and analysed for the water quality parameters selected (Table-1)

pH, Salinity and Alkalinity

The pH was studied early in the morning at different villages immediately after collection of the sample using a digital pH meter. The results have shown that an average pH of 8.2 was the highest value recorded at Nidugunta palem in 3rd week and a lowest pH of 7.22 was recorded in Raghavari palem in the 4th week (Figure-1). The salinities were studied using a refracto meter. The results have shown that an average salinity of 34 ppt was the highest value recorded at Tummalapenta in 1st and 2nd weeks and a lowest salinity of 9 ppt was recorded in Koruturu in the 16th week (Figure-2). Carbonates were estimated by titration against 0.02 N sulphuric acid using phenolphthalein indicator. The value for the carbonates remains zero for the most of the times in all most all villages. A high carbonate value of 60ppm was reported in 3rd week in Ramudu palem village. Bicarbonate values were obtained by subtracting carbonates from total alkalinity. High bicarbonates were obtained in Koruturu village (351 ppm) in 16th week. This village has reported most of the times a bicarbonate value of more than 300ppm. Minimum bicarbonate value of 94 ppm was seen in 1st week at Raghavari palem. The results for total alkalinities shown that an average alkalinity of 350 ppm was the highest value recorded at Koruturu in 11th and 16th weeks and a lowest 4 ppm Raghavari palem in the 1st week (Figure-3, 4, 5).

Hardness

The total hardness were studied by titration with 0.02M EDTA. The results have shown that an average hardness 7137 ppm was the highest value recorded at Kottakoduru in 14th week and a lowest hardness of 1908 ppm at Koruturu the 14th week (An average calcium levels of 773 ppm was the highest value recorded at Kottakoduru in 7th week and a lowest calcium (Ca^{+2}) concentrations of 134 ppm were reported in Koruturu the 16th week and average magnesium (Mg^{+2}) level of 1442 ppm was the highest value recorded at Tummala penta in 2nd week and a lowest magnesium concentration 299 ppm were reported in Raghavari palem in the 9th week (Figure-6, 7, 8).

TAN and Nitrite

TAN value reported was found to be 0.56 ppm in Tummapenta in the 5th week is the highest and that of minimum values were recorded was 0.01ppm in 13th week at Nidugunta palem. The average NO_2 value reported was found to be 0.21 ppm in Kottakoduru in the 3rd week and that of minimum values were recorded was 0.00 ppm in almost all weeks in all the villages except 0.04 ppm in 5th week at Raghavari Palem and 0.02 ppm in 1st week at Tummalapenta respectively (Figure-9, 10).

Table 1: Number of samples analysed at different time intervals in different selected villages

Week ↓	Nidugunta palem	Koruturu	Raghavari palem	Tummala penta	Ramudu palem	Kotta koduru
1st	23	31	23	23	50	19
2nd	17	17	21	33	34	19
3rd	17	19	23	23	28	16
4th	20	21	22	22	26	24
5th	15	28	19	24	27	24
6th	18	18	16	24	27	28
7th	18	19	22	39	27	19
8th	34	22	24	42	25	24
9th	18	16	22	40	31	20
10th	23	27	35	26	46	22
11th	24	29	25	32	40	25
12th	29	30	22	46	36	29
13th	29	26	21	39	86	20
14th	15	33	22	45	59	27
15th	40	36	21	51	61	24
16th	40	34	24	53	70	24
Total	380	406	362	562	673	364

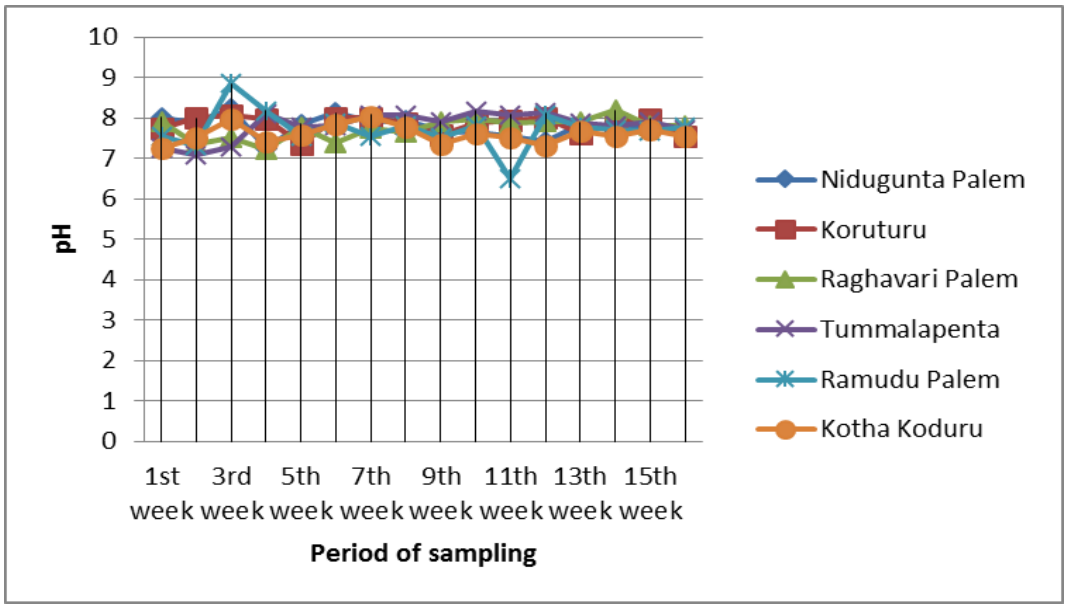

Fig 1: Comparison of pH in the selected villages of Nellore district during the culture period

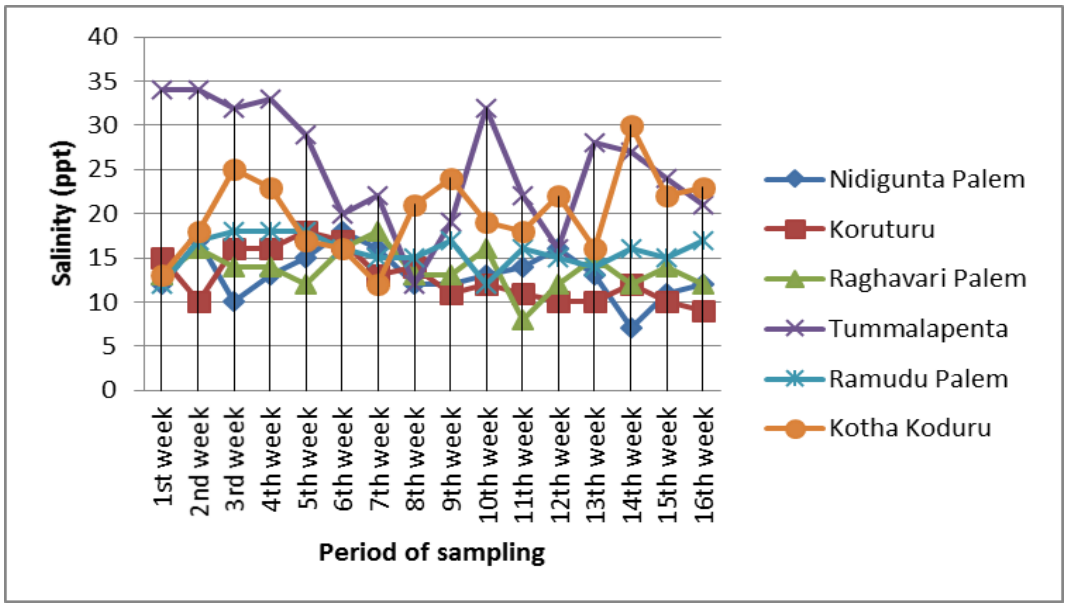

Fig 2: Comparison of Salinity in the selected villages of Nellore district during the culture period

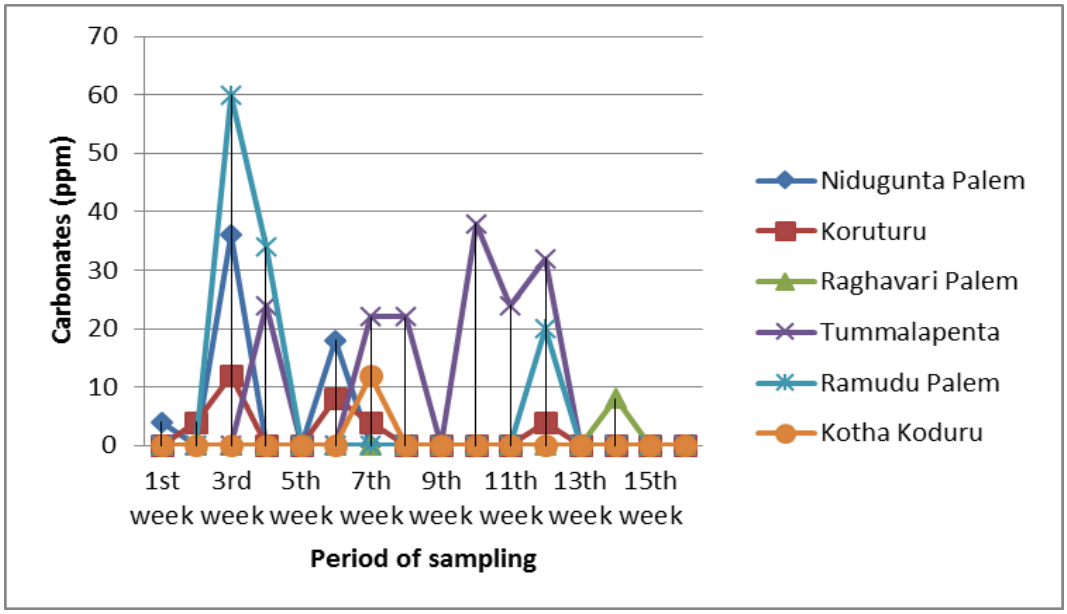

Fig 3: Comparison of carbonates in the selected villages of Nellore district during the culture period

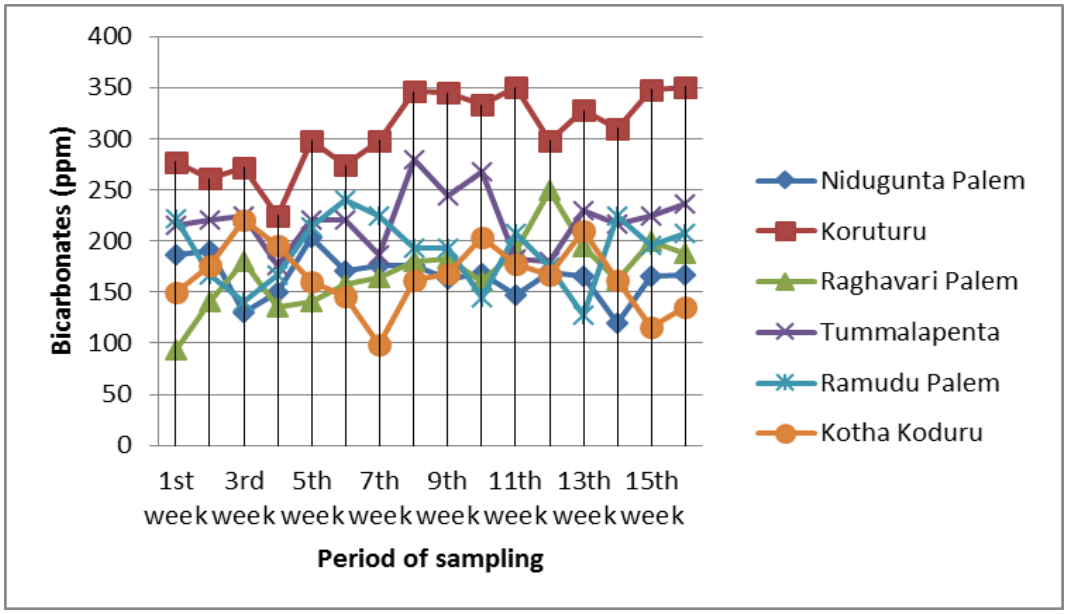

Fig 4: Comparison of Bicarbonates in the selected villages of Nellore district during the culture period

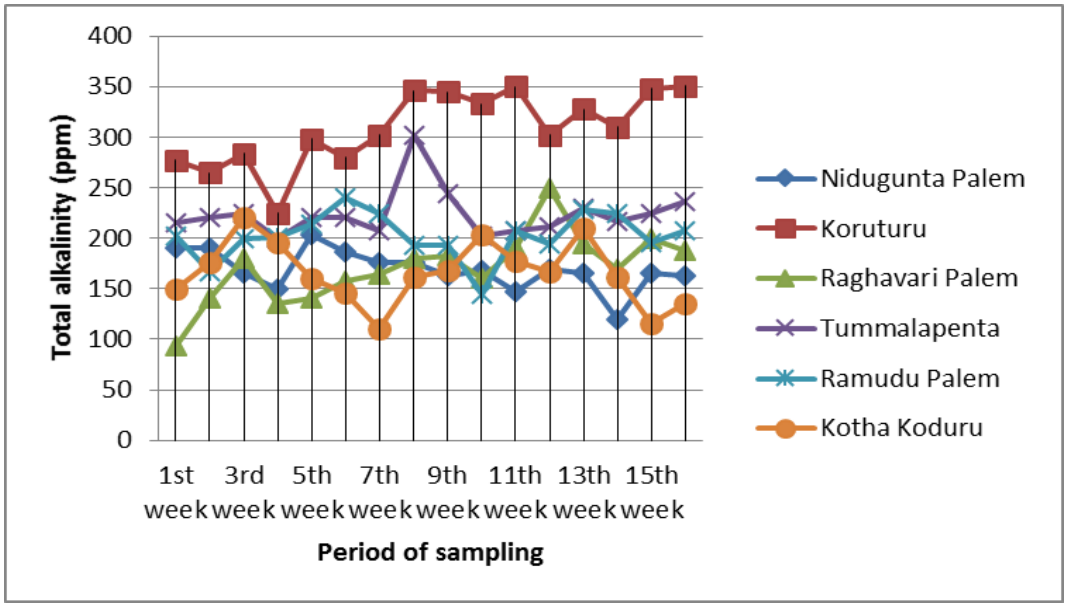

Fig 5: Comparison of total alkalinity in the selected villages of Nellore district during the culture period

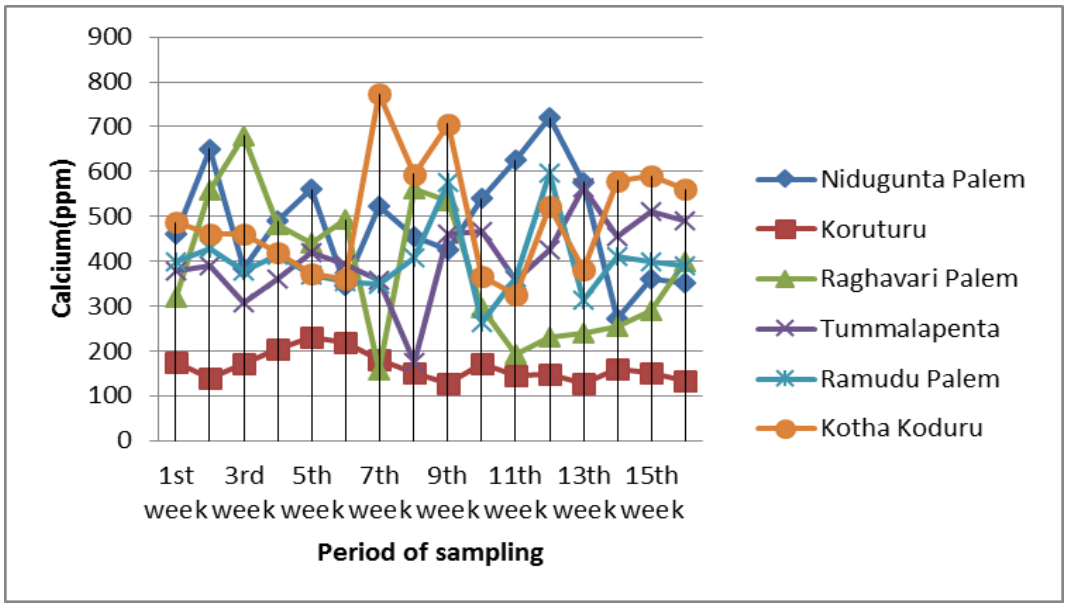

Fig 6: Comparison of total Calcium (Ca^{+2}) in the selected villages of Nellore district during the culture period

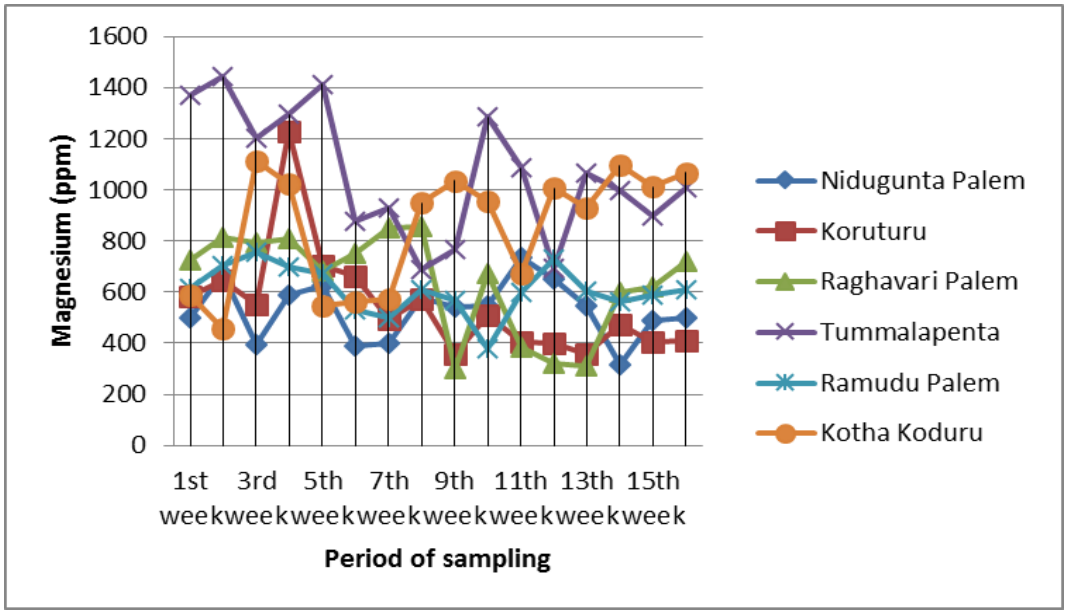

Fig 7: Comparison of total Magnesium (Mg^{+2}) in the selected villages of Nellore district during the culture period

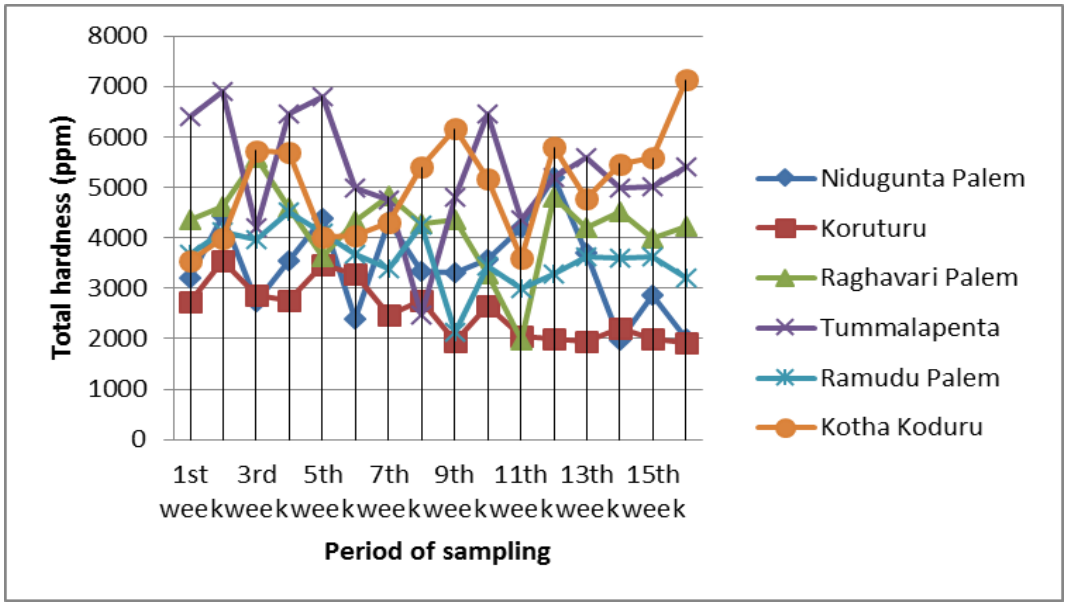

Fig 8: Comparison of total hardness in the selected villages of Nellore district during the culture period

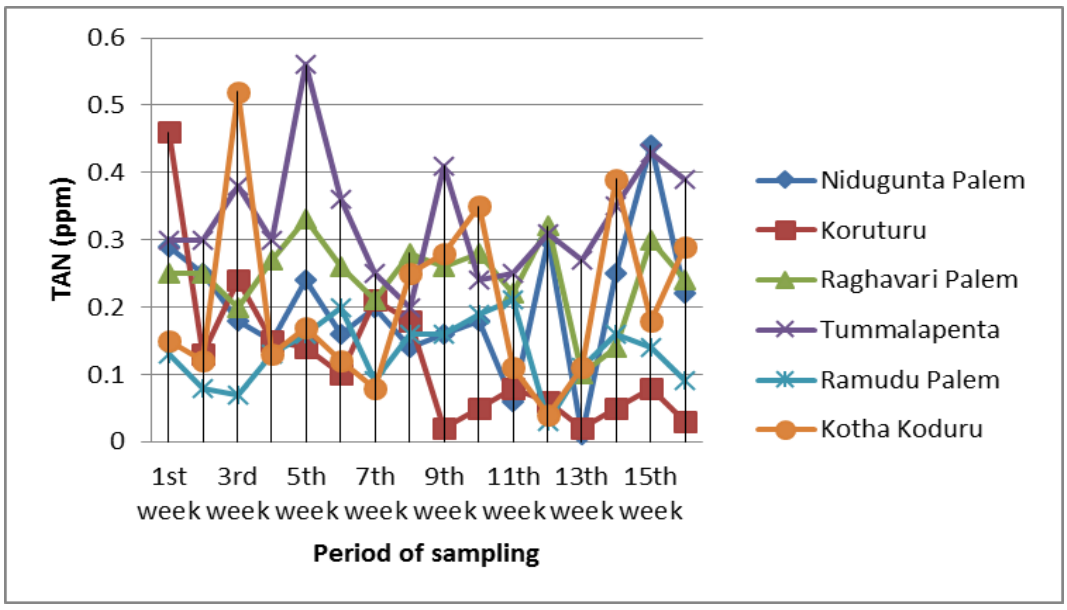

Fig 9: Comparison of total ammonia nitrogen (TAN) in the selected villages of Nellore district during the culture period

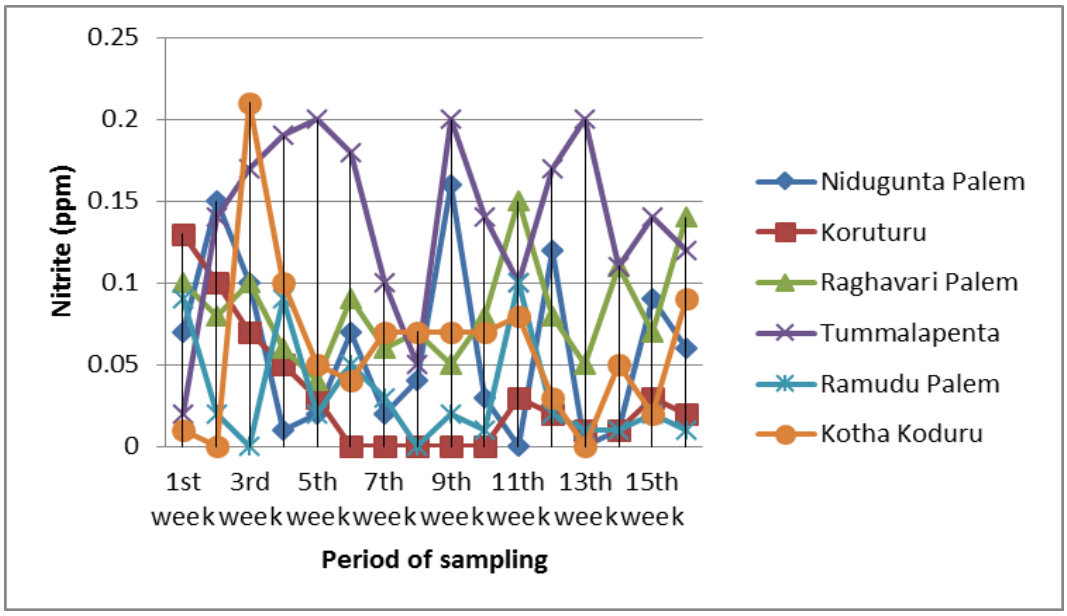

Fig 10: Comparison of total Nitrite (NO_2) in the selected villages of Nellore district during the culture period

Discussion

Shrimp are normally exposed to naturally occurring disease-causing organisms in pond waters. The immune system of healthy shrimp can normally defend against infection. However, once shrimp are exposed to environmental stressors such as poor water quality or nutrition, their immune function is reduced and disease can occur. Since poor water quality is the leading cause of disease, the most important management goal in shrimp production is to maintain a good water quality environment.

The permissible limit of pH in shrimp culture is 7.5 to 8.5 [14] [20]. In the present study the pH values reported were in the permissible range. The culture species, *L. vannamei*, can tolerate salinities of 0.5 to 45 ppt [4, 13] and recent studies suggest that this species can possibly be cultured at salinity below 0.5 ppt [3]. However, most successful shrimp culture appears to have been done at salinities above 2 ppt (Roy *et al*., 2010). In the present study the salinities recorded were well suited for *L. Vannamei* farming.

The calcium and magnesium levels in water are very essential element for *L vannamei*. The magnesium concentration must be at least three times than the calcium concentrations. The calcium and magnesium values should follow the formula that

Calcium (Ca^{+2}) in ppm = Salinity x 11.6

Magnesium (Mg^{+2}) in ppm= Salinity x 39.1 [15]

In the present study magnesium concentration were reported to be under ideal limits where as the calcium levels were reported to be very high. This may lead to mineral depositions on carapace of shrimp and sometimes delayed moulting. Magnesium serves as a cofactor for several enzymes important for the metabolism of proteins, carbohydrates, and lipids [7]. Magnesium is necessary for forming specific enzyme complexes that necessary for osmotic and ionic regulation in acclimation of shrimp to lower salinity water. Magnesium is also necessary for neuromuscular transmission and skeletal tissue metabolism [5].

TAN values reported in the present study were in the ideal limits for shrimp farming [14]. Generally, the high concentration of nitrite is uncommon in aquatic systems [21]. High nitrite concentrations commonly deactivate haemoglobin in the blood crustaceans [12]. However, blood of shrimp does not contain haemoglobin. Therefore, instead of haemoglobin, the oxygen binds to copper at the gills of the shrimp and delivered throughout the body and cause effect on the circulatory and immune system of aquatic organism [18]. For the culture of *L. vannamei*, the optimal levels of nitrite concentration is < 1.0mg/l [6]. The recorded nitrite levels in the present study are within the range of suitability for *L. Vannamei* in the selected areas. Nitrate is an inorganic nitrogen compound formed at end of the nitrification process.

Conclusion

The present study conducted in the selected villages of Nellore district of Andhra Pradesh where *L.vannamei* has been extensively farmed in semi intensive system. All the parameters like pH, Salinity, Alkalinity, Hardness, Calcium and Magnesium, TAN and nitrite were tested on weekly basis during grow out of shrimp in winter crop season. The results have shown that all the tested parameters were in the ideal range suitable for vannamei except the calcium which was found to be abnormally increased. Hence all the farmers can be suggested for the regular application of softeners like EDTA during regular intervals of farming.

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