Summary and Conclusions
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The present investigation has been designed to identify the various endemic diseases and their control measure prevailing in selected cultured shrimps, \textit{L. vannamei} and \textit{P. monodon}. The study has envisaged the prevalence of several endemic diseases and some new emerging diseases in both the selected species.

5.1 Diseases of \textit{L. vannamei}

5.2 White Spot Syndrome (WSSV)

The study has confirmed the out break of white spot disease in exotic species \textit{L. vannamei}. The appearance of white spots on shrimp causing panic to farmers and often resort to emergency harvest and to save whatever they can. However, there were some incidences, farmers avoided the emergency harvest and got successful crop. In general, the White spots could be due to the infection of WSSV, \textit{Vibrio} spp. and \textit{Bacillus} species. The present work helps in differential diagnosis of white spots at the laboratory level and confirmatory diagnosis by using rapid test kits like rapid dot or Shrimple. On the other hand, it is necessary that the farmers should maintain strict biosecurity measures to prevent the spread of the diseases to the other species.

5.3 Infectious hypodermal and haematopoietic necrosis (IHHNV)

The present study confirms the IHHNV causing RDS in \textit{L. vannamei} in our country for first time. Even though there is no mortality, production loss due
to poor growth has economic impact. An interesting observation has also been made in the present study that the shrimp, *Metapenaeus monoceros* does not suffer any mortality or RDS due to IHHNV infection even though present in the same pond.

**Vibriosis**

The present investigation has revealed that the prevalence of *Vibrio parahaemolyticus* has caused the occurrence of vibriosis and resulted in severe crop losses to the farmers. As reported earlier, the *Vibrio* is the natural flora of the Penaeid shrimps and can cause disease, when the shrimp is under stress condition. In general, the high density culture of *L. vannamei* may also prevail the similar stress condition and there is every possibility for occurrence of vibriosis. As the use of antibiotics has been banned for control of Vibriosis, it is necessary to search for an alternative control measures, probably the use of Probiotics be an effective alternative for control of Vibriosis (Moriarty, 1999).

**White fecal matter**

The impact of white fecal matter has been found to be very less in *L. vannamei* culture and it was also observed that there was no possible association with Loose shell syndrome. The severity of the problem due to occurrence of white fecal matter has been observed to be very less, where as it is reported to be a serious problem during the culture of *P. monodon*.
Interestingly, the problem has been observed with the *L. vannamei* ponds having high count of blue green algae.

**Black gill disease and Brown gill disease**

The present investigation has been elucidated that both the Black gill disease and Brown gill diseases have been identified to prevail in exotic species, *L. vannamei*. And the present study has revealed that the Black gill caused by iron and manganese salts can be effectively treated by using 5 ppm of hydrogen peroxide 50% and 1 ppm of BKC 50%.

**Body cramp**

The study has revealed the occurrence of body cramps and envisaged that they are not associated with thermal shock during the culture of *L. vannamei*. The incidence of body cramps can be effectively reduced by the possible supplementation of magnesium sulphate in the feed.

**Gas bubble disease**

The study has reported first time the occurrence of gas bubble disease in culture of *L. vannamei* and only two cases were reported so far in this area. However, it was observed that the mortality caused by this disease is very less (< 1%).

**Blisters and Tail rot**
The present investigation has established the formation of Blisters in cultured *L. vannamei* and the Blisters were classified first time basing on the clotting factor and place of development. During the present study, the process of Blister development has been reported first time with documentary evidence.

**Melanized lesions on the body**

The study has revealed that the percentage of melanized lesions is relatively more in *L. vannamei* and further revealed that there was no involvement of TSV. As the this species is being cultured in high density, there was a high probability of mechanical damage and subsequent melanization due to the shrimp immune response, probably to prevent the loss of blood and spread of pathogens.

**Shrimp with different pigmentation**

The observation made in the present study during the culture of *L. vannamei* with a golden yellow and blue pigmentation has revealed that might be due to the genetic variation and not associated with any disease or mortality. The redness might have been associated with stress causing during its culture and resulted in the chromatophore expansion.

**Low Dissolved oxygen**
As per the available literature, the morning DO levels should be more than 3 ppm in \textit{L. vannamei} culture ponds. However, in our observation, it was found that 90\% of the ponds are observed with dissolved oxygen less than 2.5 ppm and found that the shrimps stopped feeding and came to surface when the DO levels are less than 2 ppm and mortality occurred when DO levels are at 1.5 ppm.

Even though the symptoms caused by prolonged exposure to low dissolved oxygen resemble that of IMNV disease, as the mortality was reported only in the particular pond with low DO, as there are no epizootics in that area suggesting that the problem could be because of environmental variation and not because of any virus.

\textbf{Body deformities}

During the culture of \textit{L. vannamei}, several types of deformities have been reported in the present investigation. It was observed that these deformities were not caused by IHHNV, in most of the cases it could be other than RDS. The deformities of the internal organs like heparopancreas and mid gut can not be caused by IHHNVas this virus affects the tissue of ectodermal and mesodermal tissue only. It was observed that the shrimp grow normally and the percentage of deformities has been less than 1\%, and there was no economic importance to the farmers.

\textbf{External fouling}
During the culture of *L. vannamei*, there was no case of external fouling visible externally and there were no reports of causing moulting problem and mortality. However, in routine microscopic observations, protozoans with severity grade-1 has been reported.

**Growth comparision**

The present study has revealed that there was a clear growth difference during summer and winter seasons. The study has clearly established that as the temperature increases, the growth rate has ben enhanced.

**Emerging Diseases of *P. monodon***

**Swollen hind gut syndrome in shrimp larvae**

The present investigation has clearly established the relationship between the texture of the feed and its possible role in prevalence of swollen hindgut syndrome in shrimp post larvae. The histopathology studies revealed that it was caused because of the hypertrophy of the cells, which might have been occurred because of the rough structure of ingesta. Interestingly this problem has not been reported with liquid and live feeds.

**Mortality caused by calcification and its control measures**

The present investigation has revealed the abnormal deposition of calcium on the exoskeleton during the culture of *P. monodon* and confirmed the
calcification process during the culture practices. The attempts for decalcification process has revealed that the calcium deposits can be dissolved with the acidic compounds like acetic acid, alum, B-green, neutral etc., which can also reduce the water pH.

**Effect of calcium and magnesium ratio**

The present study has evidenced that the ratio of calcium and magnesium is very important for the survival and growth of the shrimp. It was confirmed that the magnesium level always should be more than the calcium concentration. The study further established that it is very much necessary to test the pond water for calcium and magnesium levels before the stocking of post larvae in culture ponds using bore water and if necessary, the culture ponds need to be applied with magnesium sulphate for improvement of magnesium levels.

**Comparison of white gut and white fecal matter**

The White gut and White fecal matter are the two different problems in shrimp culture ponds that can possibly lead to Loose shell syndrome. In general, the White gut is caused by the necrosis of epithelial mucosa and resembles the haemocytic enteritis (Lightner et al., 1978). And usually, the White fecal matter is caused because of the damage to the hepatopancreas and sloughing of hepatocytes. And the sloughed cells are released into the gut and the gut looks white in colour. In general, the fecal matter contains undigested feed particles, but in case of white fecal matter, it is from the dead hepatocytes.
As the hepatocytes store lipid droplets, whose density is lesser than the water, hence the white fecal matter floats on the water

**Controls of Gregarines**

It was established that if more the number of gregarines higher the chances of lesions and infections in cultured shrimp. As the number of gregarines grow in number and get the nourishment from the host leaving lesion for the infections to set in. And they also interfere in assimilation of nutrients by the villi. Thus resulting in the poor growth of cultured shrimps. In our attempts to have effective control this problem, successful results have been obtained using combination of Allicin in feed and copper sulphate in water, the intermediate hosts can be controlled efficiently and in turn the severity of the problem can be reduced.

**Immunostimulant properties of *Tinospora cordifolia***

The attempts to enhance the immune capability of the cultured shrimps using *T. cordifolia*, has shown that it can effectively boost up the immune system of the shrimp at 4 g/kg of feed. It has a visible impact on the shrimp's activity apart from increasing prophenol oxidase activity, hemocyte count, percentage of granulocytes and increased bacterial clearance. This can be used as an effective tool to control bacterial diseases in shrimp culture practices and and can be included in shrimp health management program.
Treatment of iron and magnesium deposits on exoskeleton

The accumulation of iron and magnesium deposits on the exoskeleton of the shrimps is not at all a disease condition or problem. However, due to the accumulation of these metals, the shrimp looks dirty and fetches less price for the product at harvest. Our experiments to control this problem, has clearly showed that by using hydrogen peroxide 50% at 5 ppm concentration and in combination with 1 ppm of BKC 50%, this can be effectively treated.

False negatives in PCR Diagnosis of Monodon Baculovirus

The possibility of getting false negatives during the PCR diagnosis of Monodon Baculovirus has been resulting in devasting results during the culture of shrimps. It has been analyzed and identified that the diagnostic sensitivity of 100% with phenol-chloroform and spin column method of DNA extraction showed that the false negatives are due to the poor quality of DNA.

Blisters

The study clearly established the existence of two types of Blisters prevailing in cultured crustaceans. These Blisters can be distinguished based on the factor of haemolymph clotting, and it was observed and established that the Blisters that are always associated with mortality are without haemolymph clotting.
Comparison of diseases between *P. monodon* and *L. vannamei*

From the present investigation, it was clearly evident that the endemic diseases like white spot syndrome, vibriosis, IHHNV are the major emerging diseases for exotic species *L. vannamei* (Table 23). Further it is evident that as this species is an imported one with SPF status and strict quarantine at RGCA, so far there were no reports of diseases like TSV and IMNV. And the study has further envisaged that the possible effect of second most serious problem of loose shell syndrome is very less in *L. vannamei* and in addition evidenced the compatibility for high densities, is being an added advantage to the farmers. And present study also established that there are no new diseases that can be transmitted from *L. vannamei* to *P. monodon*. 