Potential of laboratory developed marine bacterial consortium as antibacterial and growth promoting agent in mariculture

Jayasree Loka*, Shubhadeep Ghosh, Ritesh Ranjan, Biji Xavier, Sekar Megarajan, Narasimhulu Sadhu, P. Shiva and A. Gopalakrishnan

Visakhapatnam Regional Centre of ICAR-Central Marine Fisheries Research Institute, Visakhapatnam -530 003, Andhra Pradesh, India

*E-mail: lokasree@gmail.com

Mariculture is the fastest growing subsector of aquaculture in India, and it provides a significant contribution to animal production and is of economic importance. Technology of marine cage culture in India is pioneered by ICAR-Central Marine Fisheries Research Institute for providing an additional livelihood for the upliftment of economic status of coastal communities, and this transfer of technology was successfully implemented throughout coastal India. Indian Pompano, *Trachinotus mookalee* is the most potential species for marine cage farming in India. Management of water quality and fish health in culture systems is a great challenge in mariculture. Emergence of environmental issues and disease occurrence becomes inevitable due to the increasing demand for intensification and commercialization in mariculture production. In order to manage the culture systems for attaining sustainable production, application of probiotics is the best tool, to achieve better growth rate, survival and disease resistance of fish. Marine microorganisms are identified as potential source of enzymes which may enhance host digestion since they have greater capacity of adhesion to gastrointestinal mucus and tissues. There are several reports of research works on the application of probiotics in aquaculture though very few studies relate its usage in finfish culture. Several commercial probiotic bacteria are being used in aquaculture industry, especially in shrimp aquaculture, but the role of its application in marine finfish culture needs to be established. Hence, the present study was undertaken to evaluate the efficacy of marine probiotic consortium (MPC) (developed in laboratory) on survival and growth of *Trachinotus mookalee*.

Experiment on efficacy of laboratory developed probiotic bacteria belonging to genera *Bacillus, Paenibacillus and Shewanella* (isolated from fish gut) on survival and growth of Indian pompano.

Hundred fingerlings, with an initial average weight of 30g, were kept in one tonne tanks. Fishes, designated as control were fed with pelleted feed at 6% fish biomass. In experimental treatments (T1: laboratory developed probiotics and T2; T3: commercial probiotics), the fishes were fed with commercial pelleted feed (6%), supplemented with the probiotics at a concentration of $1x10^6$cfu/g. Triplicates were maintained for each treatment. Growth and survival of the fished were estimated using standard formulas. Water quality parameters were monitored at fortnightly intervals. Microbiological analysis of the fish gut was undertaken at monthly intervals. All statistical analyses were performed using SPSS software.

Experiment on efficacy of probiotics (T1, T2 and T3) on growth and survival of Indian Pompano revealed a significant increase in average weight (g), % weight gain and specific growth rate (% SGR) of fish in T1 and T2, when compared to T3. Final average weight (g), average daily growth rate (ADGR g day^{-1}) and specific growth rate (SGR % day^{-1}) of fish at 90 days of experiment were recorded in T2 and T1 as 180 g and 130 g, 1.67g/day and 1.12g/day, 0.87 and 0.71 respectively. Details on growth parameters of *T. mookalee* supplemented with marine probiotic consortium are given in Table 1.

100% survival of fish was recorded in T1 and T2, followed by 85% in T3 and 75% in control at 90 days of culture (Fig. 1). No significant variation in % survival of fish was found between days of culture ($p>0.05$). A positive correlation ($r=0.89$, 0.94, 0.86 in T1, T2, T3, respectively)

Table 1. Growth parameters of *T. mookalee* supplemented with three different microbial consortia

Parameter	T1	T2	T3	C
Initial Biomass (kg)	3	3	3	3
Final Biomass (kg)	13	18	9.8	6.75
Survival %	100	100	85	75
Weight Gain (g)	100	150	85	60
% weight gain	333.34	500	283.34	200
Average Daily Growth rate (g/day)	1.12	1.67	0.95	0.67
Specific growth rate (%/day)	0.71	0.8646	0.6484	0.53
Initial Biomass (kg)	3	3	3	3
Final Biomass (kg)	13	18	9.8	6.75

was observed between % survival and concentration of probiotic bacteria supplemented in all treatments.

Average weight (g), % weight gain, ADGR (g/day) and SGR (%/day) of Indian pompano at 90 days of culture significantly varied between treatments ($p<0.05$) (Figs. 2, 3, 4 and 5). Increasing trend in weight gain of fish was recorded in T2 and T1, but random variations were

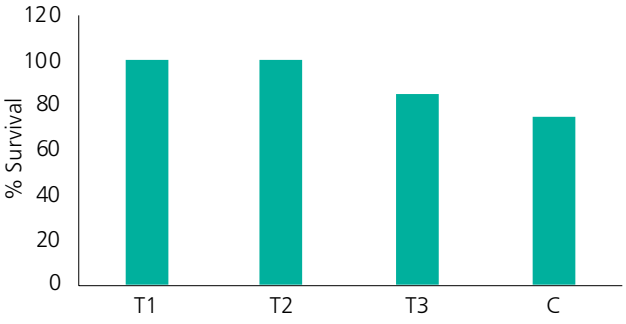

Fig.1 Survival % of Indian pompano with dietary supplementation of MPC

observed in T3 and control, with a decline at 45 days. Weight gain of fish varied significantly ($p<0.05$) between days of culture and treatments.

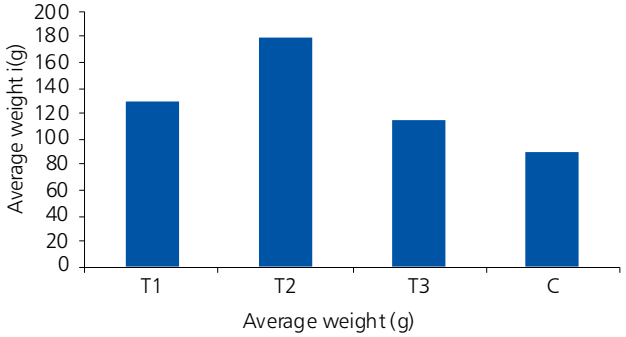

Fig. 2. Average weight (g) of Indian pompano with dietary supplementation of MPC at 90 days of culture

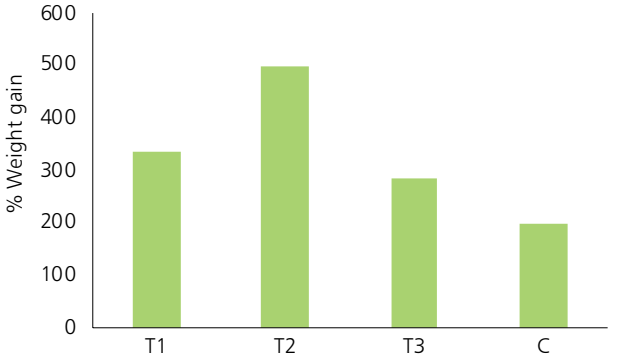

Fig. 3. Weight gain % at different treatment compared to control

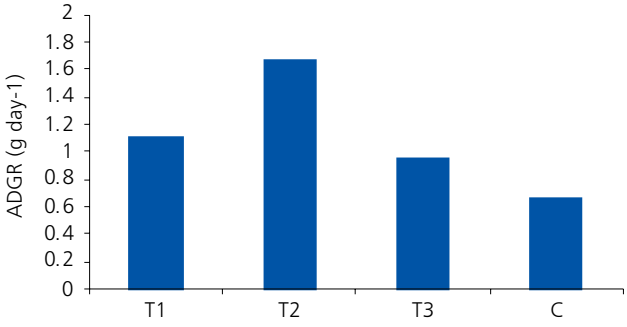

Fig. 4. ADGR of Indian Pompano under different treatments

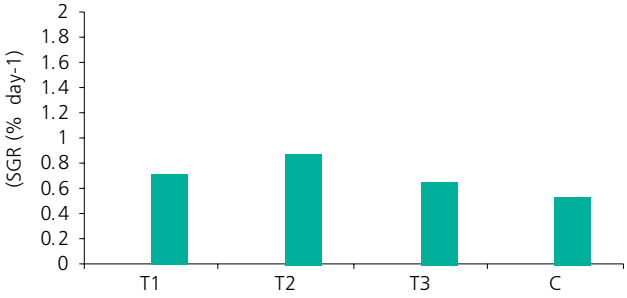

Fig. 5. Specific growth rate (SGR) of Indian Pompano under different treatments

Table 2. Water quality parameters in experimental treatments

	T1	T2	T3	C
Temperature °C	28.5±0.2	28.9±0.3	29.0±0.4	29.1±0.1
Salinity ‰	28±2	28±3	27±3	30±2
Dissolved Oxygen (mg l^{-1})	5.8±0.1	6.1±0.2	4.2±0.3	4.1±0.4
pH	8.1±0.03	8.2±0.03	8.0±0.03	8.3±0.04

Water quality parameters

Temperature (°C), salinity (ppt), dissolved oxygen and pH of water in all the treatments and control are given in Table 2. No significant variation in water quality parameters were observed between the treatments and days of culture ($p>0.05$). Significantly, higher values of ammonia, nitrate and nitrite were recorded in T3 and control ($p<0.05$).

Analysis of gut microbes

Total Viable Heterotrophic bacterial count (TVHC) and Total *Vibrio* loads (presumptive) of water and fish gut were monitored at monthly intervals. TVHC in fish gut varied between 2.8×10^{12} to 3.2×10^{15} cfu/g in T2 at 90 days of experiment (Fig. 6). A significant variation was recorded between the initial and final Vibrio counts (Presumptive) in all the treatments ($p<0.05$). A significant variation in bacterial diversity between the treatments was recorded. In T2 and T1, *Shewanella* spp., *Paenibacillus* spp. and *Bacillus* spp. were the most dominant bacteria; whereas, in T3, *Bacillus* spp. are the most dominant. A significant increase in *Vibrio* loads of gut was recorded in fishes of control group. However, in T1 and T2, a declining trend in *Vibrio* loads was noted with application of probiotic consortium ($r = -0.92$).

The findings of the study indicated that the marine probiotic consortium (laboratory developed) was found to be highly potential, and it can be used as feed probiotics for enhancement of growth and production of Indian Pompano. The study showed promising results in enhancement of survival (%), ADGR (g/day) and SGR (%/day) of Indian pompano; which resulted in significant increase of biomass in fish supplemented with MPC. The supplementation of multistrain probiotic played an important role in elimination of *Vibrio*s and in enhancement of growth and survival of *T. mookalee*. In conclusion, the experiment demonstrated supplementation of laboratory developed probiotic consortium (isolated from host gut) in positively impacting growth enhancement and vibriocidal activity. The laboratory developed marine microbial consortium can be recommended as a natural alternative to antibiotics, and as a novel tool for better health management practices in mariculture.

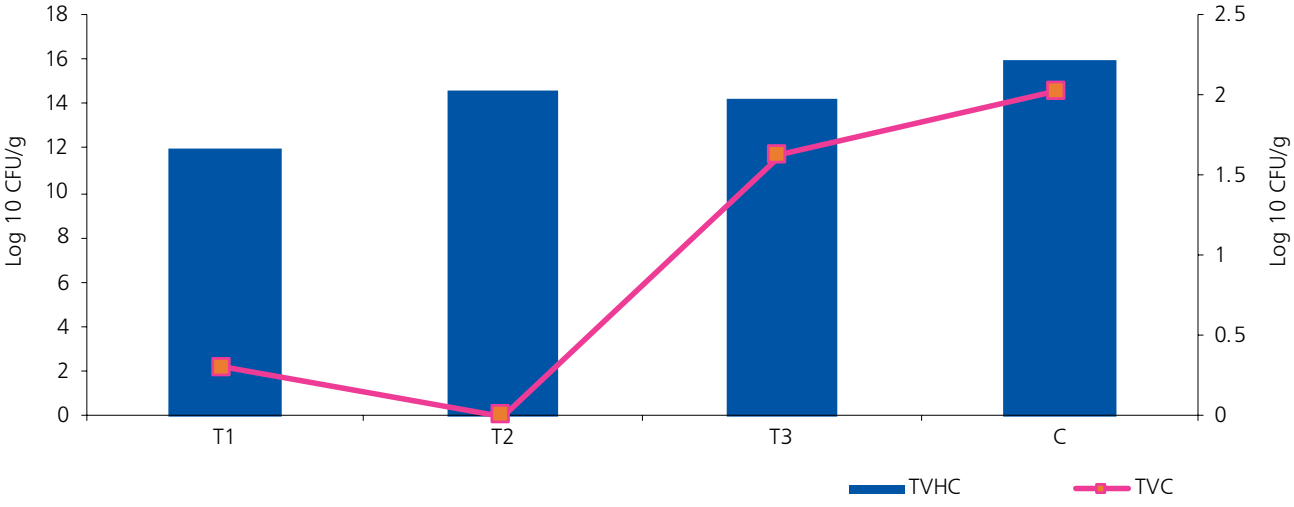

Fig. 6. Total Viable Heterotrophic Bacterial Count and Total Vibrio Count of fish gut