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Effect of Dietary Probiotic on Survival and Growth of *Penaeus indicus* Cultured Shrimps

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Abstract: The aim of this research was the study of effect of dietary probiotic in diet on growth rate and survival rate of *Penaeus indicus* shrimp. For this study, two groups selected as case and control group (each group containing fifteen shrimps) with three replicates for each group and they were studied prospectively. Both groups were equally fed by oral commercial probiotic (Protexin) containing 2×10^9 microorganisms per gram. During the course of shrimps feeding with probiotic, their growth factors including survival rate and the rate of weight gain were calculated separately in both study groups. To compare the quantitative data of the two groups, independent t-test and to compare qualitative data, Chi-square (χ^2) test was used. According to the results of current study, the use of commercial probiotic in *P. indicus* shrimps was led to a significant increase in weight and growth rate of shrimps in case groups at the end of breeding period.

Key words: Probiotic, feeding, weight, shrimp, breeding, Iran

INTRODUCTION

The demand for animal protein for human consumption is increasing and is met largely by terrestrial farm animals. Aquaculture is an increasingly important source of animal protein (Lara-Flores *et al*., 2003), the global aquaculture industry has grown rapidly in the past decades as a consequence of enhanced fish meal requirements for commercial feed manipulation. However, the availability of wild fish species used as feed in fish farming is a limiting factor for future aquaculture expansion (Naylor *et al*., 2000).

Thus, there is international concern about dealing with the tough problem of the decrease in fish meal used as feed stuff which is being overcome by using protein sources from plants (Shiau *et al*., 1988; Gallagher, 1994; Webster *et al*., 1997) or by increasing feed digestibility and absorption. Thus, the research into the use of probiotics for aquatic animals is increasing with the demand for environment-friendly sustainable aquaculture (Gatesoupe, 1999). A probiotic is by definition, a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance (Fuller, 1989). An expert with the Joint Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO), stated that probiotics are live microorganisms which when consumed inadequate amounts, confer a health benefit for the host (FAO/WHO, 2001). In recent years, there were increasing researches have demonstrated the potential benefits of probiotics in aquaculture ponds that include improvement of water quality, enhancement of nutrition of host species through the production of supplemental digestive enzymes, lower incidence of diseases and greater survival and improved immune response (Boyd and Massaut, 1999; Verschuere *et al*., 2000). However in aquaculture, probiotic can be administered either as a food supplement or as an additive to the water (Moriarty, 1998). Indian white shrimp, *Penaeus indicus* has widespread culture in the Indian ocean and it is dominating the crustacean fishery of some regions in this zone but it has not been studied as much as other shrimp such as *P. monodon* and *P. japonicus* (Omondi and Stark, 1996). According to researches, the probiotic-supplemented diets resulted in an increase in the growth performance and survival of shrimps compared to the control (Wang, 2007; Austin *et al*., 1995). Therefore, the objective of this research was the study of the effect of oral probiotic in the diet on shrimp growth rate and mortality rate of *Penaeus indicus* shrimp.

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MATERIALS AND METHODS

This study is a descriptive-analytic study that was done in 2010 in Iran. For this research, two groups selected as case and control groups and they were studied prospectively.

The shrimp population was selected from south breeding shrimps of Iran species *Penaeus indicus* (at the age of juvenile) in a growing period (4 weeks). Six fiberglass pools with three replicates for each case and control group were used. Pools were provided from the Ecology Institute of Persian Gulf and Oman Sea for shrimp breeding with their requirements for this research. Fifteen shrimps were randomly selected as control and case groups (totally 90 shrimps).

After shrimps buying from Colahi wharf and transferring them to the institute, they were divided into case and control groups. Case groups were equally fed by oral commercial probiotic (Protexin) containing 2×10^9 microorganisms per gram with equal proportion of *Streptococcus feacium*, *Streptococcus termophilus*, *Lactobacillus plantarum*, *Lactobacillus johnsonii*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, *Aspergillus ourozai* and *Candida pentolopsy* at the amount of 1 kg per each ton of concentrate.

During the course of shrimps feeding with probiotic, their growth factors including survival rate, the rate of weight gain were calculated separately in both study groups (with the precision of /100). To compare the quantitative data of the two groups, independent t-test and to compare qualitative data, Chi-square (χ^2) test was used.

RESULTS AND DISCUSSION

After doing different phases of the test, all of the results were illustrated in following tables after statistical analysis. The mean weight (mean±SE) between *P. indicus* shrimps (deheaded) in case and control groups at the end of feeding with probiotic and the mean weight difference between the beginning and end of the breeding course in two groups is shown in Table 1. As there is seen, the mean weight of shrimp *P. indicus* in case group was more than the control group and the mean weight difference between the beginning and end of period in the case group is more than control group.

Researchers did not observe any significant difference between two groups about survival rate in the study and the survival rate was approximately similar between two groups ($p<0.05$). According to Table 2, there is a statistically significant difference between the mean weight of *P. indicus* (deheaded) in control and case groups at the end of the breeding period ($p<0.05$). Also, the variation of the mean weight difference between the beginning and end of the breeding course (growth) between two groups was significant ($p<0.05$).

The enhanced growth performance of shrimp might be due to increasing digestive enzyme activity induced by the probiotics (Lovett and Felder, 1990; Kamarudin *et al*., 1994). However, the exogenous enzymes produced by the probiotics would represent at most, only a small contribution to the total enzyme activity of the gut (Xian *et al*., 2004; Ziaei-Nejad *et al*., 2006) and the presence of the probiotics might stimulate the production of endogenous enzymes by the shrimp. The higher level of enzyme activity obtained with diets containing probiotics improved the digestion of protein, starch, fat and cellulose which might in turn explain the better growth observed with the probiotic supplemented diets. The antagonism mechanism, based on the removal of the pathogen by the beneficial population has been regarded

Table 1: The comparison of the mean weight (mean±SE) between *P. indicus* shrimps (deheaded) in case and control groups at the end of feeding with probiotic and the mean weight difference between the beginning and end of the breeding course (growth) in two groups

Groups	N	Mean±SD	SEM
Weight			
Case	42	6.5050±0.99849	0.15407
Control	43	6.0453±0.90861	0.13856
Growth			
Case	3	3.4286±0.15629	0.09024
Control	3	2.5543±0.26498	0.15299

Table 2: The comparison between the mean weights of shrimp *P. indicus* (deheaded) in case and control groups at the end of feeding with probiotic and the mean weight differences between the beginning and the end of the breeding course (growth) in two groups by independent sample t-test ($p<0.05$)

	Levene's test for equality of variances		t-test for equality of means					
							95% confidence interval of the difference	
Parameters	F-test	Sig.	t-test	df	Sig. (2-tailed)	Mean±SE difference	Lower	Upper
Weight								
Equal variances assumed	0.351	0.555	2.221	83.000	0.029	0.45965±0.20698	0.04798	0.87133
Equal variances not assumed			2.218	81.865	0.029	0.45965±0.20721	0.04743	0.87187
Growth								
Equal variances assumed	1.898	0.240	4.922	4.000	0.008	0.87429±0.17762	0.38115	1.36742
Equal variances not assumed	-	-	4.922	3.241	0.013	0.87429±0.17762	0.33212	1.41626

as the important reason for survival rate increase of shrimps by many researchers (Fuller, 1989; Gatesoupe, 1999). Moriarty (1998) reported that probiotic strains were able to improve the water quality through degradation of waste organic matter.

In addition, some studies primarily have attributed the enhancement of animal growth to the nutritional benefits of probiotic bacteria such as vitamin production, availability of minerals and trace elements and production of important digestive enzymes (Holzapfel *et al*., 1998). In another study, a commercial probiotic preparation of *Streptococcus faecium* improved the growth and feed efficiency of the Indian white shrimp Fenneropenaeus indicus (Ziaei-Nejad *et al*., 2006).

Since, the 1st use of probiotics in aquaculture, a growing number of studies have demonstrated their ability to control potential pathogens and to increase the growth rates and welfare of farmed aquatic animals (Gatesoupe, 1991; Lara-Flores *et al*., 2003; Carnevali *et al*., 2004; Macey and Coyne, 2005; Wang *et al*., 2005; Yanbo and Zirong, 2006). Here there is reported for the first time, an enhancement of the growth rate of the shrimp *P. indicus*, one of the most important farmed species in the Indian ocean and shrimp market as a result of supplementing their basal feed with probiotics. According to the results of the study, the use of commercial probiotic in *Penaeus indicus* shrimps was led to the significant increase in weight and growth of the in case groups at the end of breeding period. Other studies related to the probiotic effect on other species of shrimp Penaeus confirmed the results of the study.

CONCLUSION

The results of this study and other researchers suggested that probiotic, supplemented as water or food additive at a certain concentration could significantly increase survival rate and growth of shrimps. However, it should be noted that these results were based on the trial in laboratory conditions and practical shrimp farming may differ in some properties.

Also, it is essential to understand the mechanisms of action in order to define selection criteria for potential probiotics. Therefore, more information on the host/ microbe interactions *in vivo* and development of monitoring tools (e.g., molecular biology) are still needed for better understanding of the composition and functions of the indigenous microbiota as well as of microbial cultures of probiotics.

The decision of using probiotics in aquaculture has been in large part a result of historical and empirical use and not based on scientific criteria.

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