

# ADDITION OF POTENTIAL PROBIOTIC BACTERIA TO INCREASE GROWTH PERFORMANCE AND FEED EFFICIENCY OF COMMON CARP (*Cyprinus carpio*)

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## ABSTRACT

Three intestinal bacteria isolates (namely C1, C2, and C3) from common carp (*Cyprinus carpio*) were isolated and identified as new potential probiotics. This research aimed to study the effect of three isolates potential probiotics addition on growth performance, survival rate and feed efficiency of common carp. Completely randomized design was assigned to fourth diet treatments with five replicates. As a control, we used the feed without any supplementation of potential probiotic. The result showed that the addition of potential probiotic bacteria (C1, C2, and C3) gave significant effect on daily growth rate, survival rate, and feed efficiency and could be used in aquaculture industry to reduce feeding cost.

Key words: common carp (*Cyprinus carpio*), feed efficiency, probiotic potential bacteria, survival rate

## ABSTRAK

Tiga isolat bakteri yang diisolasi dari saluran pencernaan dari ikan mas (*Cyprinus carpio*) (C1, C2, and C3) telah diidentifikasi sebagai bakteri yang berpotensi probiotik. Penelitian ini bertujuan mengetahui pengaruh tiga isolat bakteri berpotensi probiotik terhadap pertumbuhan, kelangsungan hidup, dan konversi pakan dari ikan mas (*Cyprinus carpio*). Dalam penelitian ini digunakan rancangan acak lengkap dengan empat perlakuan berupa pakan yang ditambah bakteri yang berpotensi probiotik dengan masing-masing terdiri atas lima ulangan. Kontrol yang digunakan adalah pakan yang tidak ditambah bakteri yang berpotensi probiotik. Hasil penelitian menunjukkan penambahan bakteri berpotensi probiotik memberi pengaruh terhadap pertumbuhan, kelangsungan hidup, dan konversi pakan.

Kata kunci: ikan mas (*Cyprinus carpio*), efisiensi pakan, bakteri berpotensi probiotik, kelangsungan hidup

## INTRODUCTION

Common carp (*Cyprinus carpio*) is a widespread freshwater fish in lakes and large rivers in Europe and Asia. Common carp is a favorite fish target for aquaculture farmers in Aceh Province, Indonesia. Common carp require artificial food with a protein content of about 30-35% for the optimal growth. One of the efforts to improve the ability of fish to digest the feed is by adding probiotics. According to Iribarren *et al.* (2012) the use of probiotics may be an internal solution to improve growth and feed efficiency optimally, reduce production costs which in turn reduce the environmental problem due to the accumulation of waste water. Probiotics are live microbial cells that are administered to the gastrointestinal tract of the host as a feed supplement, improving its intestinal microbial balance and health (Fuller, 1989), but their effects may vary in different digestive system.

Verschuere *et al.* (2000) stated that probiotic can improve the digestibility of nutrients, increase tolerance to stress, and encourage reproduction. Probiotic may include microbial that prevent pathogens from proliferating in intestinal tract, on the superficial structures, and in the culture environment of the cultured species, that secure optimal use of feed by aiding its digestion. Probiotic has antimicrobial effect through modifying the intestinal microbiota, secreting antibacterial substances (bacteriocins and organic acids), competing with pathogens to prevent their adhesion to the intestine, competing for nutrients

necessary for pathogen survival, and producing an antitoxin effect. Probiotics are also capable of modulating the host immune system, regulating allergic response of the body, reducing proliferation of cancer in mammals, and improving water quality.

There is many research on the application of probiotics in aquaculture as growth promoter such as in *Cyprinus carpio* (Lin *et al.*, 2012); *Macrobrachium rosenbergii* (Rahiman *et al.*, 2010); *Poeciliopsis gracilis* (Hernandez *et al.*, 2010); *Xiphophorus helleri* (Dharmaraj and Dhevendaran, 2010); *Scophthalmus maximus* (Gatesoupe, 1999); catfish (Queiroz and Boyd, 1998); and *Penaeus monodon* (Rengpipat *et al.*, 1998). The present study used probiotic bacteria isolated from the stomach and intestines of common carp that were expected could improve growth performance and feed efficiency of common carp. Therefore, the purpose of this study was to analyze the effect of potential probiotic bacteria addition on growth performance and feed efficiency of common carp.

## MATERIALS AND METHODS

### Isolation Bacteria Potential Probiotic

The common carp indigenous was obtained from the Center Seed Fish Hatchery located in Jantho, Aceh Besar. Three potential bacteria (C1, C2, and C3) have successfully isolated from common carp stomach in previous study based on *in vitro* selection criteria for probiotic-potential bacteria (Yulvizar *et al.*, 2014). Then, the bacteria isolates were added to the

commercial feed to increase fish growth performance and feed efficiency.

### Preparation Feed with Addition of Potential Probiotic Bacteria

The common carps were stocked in 20 plastic tanks (20 cm x 20 cm) with a stocking density of 10 juvenile fish (4-5 cm in length) per tank. Prior to used, the tanks were disinfected with calcium hypochlorite to avoid contamination, filled with 10 L water and equipped with aeration. The fish were reared for 40 days. The fish in control group (C0) were fed a commercial feed with protein grade of 35%, while fish in C1, C2, and C3 groups were fed the similar commercial feed but added with the potential probiotic bacteria isolate 1, 2, and 3, respectively with amount of 16 mL/kg feed. About 2% egg yolk was also added as a binder. The fish was fed the diets at 5% body weight with the feeding frequency of three times a day, at around 08:00 a.m, 12:00 pm, and 16:00 pm. The feed containing the potential probiotic bacteria and egg yolks were only given once at 12.00.

### Data Analysis

The growth performance, survival rate, and feed efficiency parameters were measured using the following formula:

Daily growth rate (DGR) =  $Wg/t$ , where  $Wg$ = weight gain during the experiment (g),  $t$ = duration time of the experiment (days).

Survival rate (SR, 100%) =  $(No-Nt)/No \times 100$ , where

$Wo$ ), where  $F$ = the amount of given feed (g),  $Wo$  = the total initial weight of the fish,  $Wt$  = the total final weight of fish. The feed efficiency (FE) is the total weight gain produced per total weight of feed consumed,  $FE (\%) = (1/FCR) \times 100$ .

All data were subjected to analysis of variance (ANOVA), followed by the comparison of means using Duncan's multiple range test.

## RESULTS AND DISCUSSION

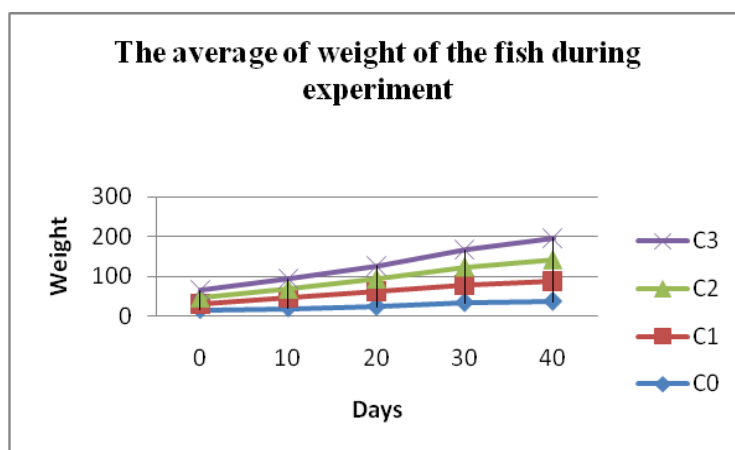
The result showed that the daily growth rate was from 0.3125 g/ day to 1.075 g/ day; survival rate ranged from 84.66% to 100%; feed conversion ratio ranged from 1.96 to 4.44; feed efficiency ranged from 22.50 to 50.90 (Table 1). The ANOVA test revealed that the addition of potential probiotic isolate in the experimental diets (C1, C2, and C3) gave significant effects on daily growth rate, survival, feed conversion ratio, and feed efficiency of common carp ( $P<0.05$ ) compared to control (C0). However, these values were not significantly different among C1, C2, and C3 ( $P>0.05$ ). Probiotic supplemented diets (C1, C2, and C3) resulted in higher average weight than control diet (Figure 1).

Based on the results, the addition of potential probiotic in C1, C2, and C3 groups promote the growth of common carp. Probiotics have a beneficial effect on the digestive processes of fish in which nutrients are absorbed more efficiently when the feed is supplemented with probiotic. Gatesoupe (1999) stated

**Table 1.** The daily growth rate, survival rate, feed conversion ratio, feed efficiency of common carp (*Cyprinus carpio*)

Experimental diet	Daily growth rate (g/day)	Survival rate (%)	Feed conversion ratio	Feed efficiency (%)
C0 (commercial feed)	0.50±0.004 <sup>a</sup>	84.66±11.47 <sup>a</sup>	3.36±0.63 <sup>a</sup>	30.49±4.89 <sup>a</sup>
C1 (commercial feed + probiotic isolate 1)	0.92±0.002 <sup>b</sup>	100±0.00 <sup>b</sup>	2.39±0.28 <sup>b</sup>	42.18±5.40 <sup>b</sup>
C2 (commercial feed + probiotic isolate 2)	0.95±0.006 <sup>b</sup>	100±0.00 <sup>b</sup>	2.26±0.21 <sup>b</sup>	44.51±4.14 <sup>b</sup>
C3 (commercial feed + probiotic isolate 3)	0.91±0.001 <sup>b</sup>	100±0.00 <sup>b</sup>	2.30±0.14 <sup>b</sup>	43.56±2.94 <sup>b</sup>

<sup>a, b</sup>Values in the same column with a different superscript are significantly different ( $P<0.05$ ). All data were presented as mean±SE



**Figure 1.** The average weight of common carp (*Cyprinus carpio*) fed experimental diets for 40 days

SR= survival rate (%),  $Nt$ = total fish died during of the experiment,  $No$ = total fish at the start of the experiment. The feed conversion ratio (FCR) is the amount of feed (g) required to produce 1 gram of fish,  $FCR = F/(Wt -$

that the activity of bacteria in digestive tract would change quickly if there were other microbes that enter the digestive tract through the feed and water causing the changes of the balance of bacteria in fish

intestines. Hidalgo *et al.* (2006) observed that supplementation of 0.5 g *Bacillus cereus* strain E per kg feed increased juvenile common dentex (*Dentex dentex* L.) growth. Similar result has been reported for probiotic bacteria used in diets for carp (Noh *et al.*, 1994) and Nile tilapia (Lara-Flores, 2003). Probiotic may improve digestion by stimulating and producing digestive enzyme such as proteases, amylases, and lipases (El-Haroun *et al.*, 2006), amino acids (Fuller, 1989; Ahmadi *et al.*, 2012), short chain fatty acids and vitamin (Welker and Lim, 2011), all leading to improved growth performance as also shown in this study.

In this experiment, the survival rate in groups C1, C2, and C3 were 100%, while the survival rate in control group was 84.66%. Similar result also reported by Anggriani *et al.* (2012) in red tilapia (*Oreochromis niloticus*) fed diets supplemented with probiotic which resulted in 100% of survival rate. Balcazar *et al.* (2007) analyzed the effect of probiotic strains on the immune responses of rainbow trout (*Oncorhynchus mykiss*) and found that rainbow trout fed with probiotic supplemented diet exhibited survival rates ranging from 97.8% to 100%, whereas survival rate was 65.6% in fish not treated with the probiotics. There is possibility that the use of probiotic bacteria added to diets in C1, C2, and C3 also increase immune response in fish, therefore survival rate in groups C1, C2, and C3 was higher than the control diet.

The best FCR values observed in probiotic-supplemented diets (C1, C2, and C3) groups than control group (C0) suggested that the addition of probiotic improved feed utilization. The higher feed efficiency and lower feed conversion ratio indicate that the addition of potential probiotic bacteria in diet can improve the feed utilization of common carp. This finding was similar to the previous study that reported supplementation of mixture of bacteria and yeast in commercial diets improved growth and food conversion efficiency of fish sheat fish (*Silurus glanis*) (Bogut *et al.*, 1998).

Overall, the results showed that the best growth performance, feed utilization and survival rate were observed in fish fed diets containing potential probiotic bacteria than diet control (without potential probiotic bacteria). Yanbo and Zirong (2006) suggested that the addition of probiotic reduced the culture cost of fishes in cultivation system. Probiotics assists the fish to absorb nutrients efficiently, thus shortening the rearing duration. Probiotic used can also decrease the amount of feed necessary for animal growth which resulted in reduction of production cost. The result of the present study could be a basis for further research and development of probiotic from digestive tract.

## CONCLUSION

The result showed that the addition of potential probiotic bacteria (C1, C2, and C3) positively affect the daily growth rate, survival rate, and feed efficiency compared to control (without addition potential

probiotic). Therefore, these probiotics may be used in aquaculture industry to reduce feeding cost.

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