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# Enhancing the productivity performance of *Cyprinus carpio* L. by *Manihot utilissima* Pohl. leaves supplementation

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**ABSTRACT**

*Cyprinus carpio* is an economically crucial freshwater commodity in Indonesia and across the globe. Fish demand has a rising trend, which not in line with productivity. Innovation and aspects of food safety are the primary keys to increasing productive capacity. Therefore, the utilization of *Manihot utilissima* leaves as an alternative to improve national fish's productivity rate is a worthy consideration. They have multiple nutrients, including protein and fat needed by *C. carpio* seeds. This study aims to determine the optimal dose of *M. utilissima* supplementation to increase the productivity of *C. carpio* seeds. The methodology consisted of four treatments (0.5 mL/250 g, 10 mL/250 g, 15 mL/250 g) with four replications for 21 days. The outcome showed that P4 treatment (15 mL) could increase the relative growth rate by 21.10%/day, and it decreased the feed conversion ratio by 0.84. However, there is no significant effect on the survival rate. The study concludes that P4 treatment (15 mL) has positively increased the relative growth rate of *C. carpio*, and decreased its feed conversion ratio.

Keywords: cassava; common carp; energy; growth; immunostimulant

## INTRODUCTION

*Cyprinus carpio* L. is a freshwater commodity that has an important economic value in Indonesia and across the globe. Its productivity in Indonesia continues to increase by reaching 8.92% in 2019, with a total production value of 785.800 tons (Ministry of Agriculture Republic Indonesia, 2015). However, the demand for *C. carpio* L. shows an increasing trend but not in line with its productivity rate. Some factors that should be considered in aquaculture activity consisted of water quality (Davidson *et al*., 2013; Tallar & Suen, 2016), disease (Stentiford *et al*., 2012; Stentiford *et al*., 2017), microalgae-bacteria interactions (Natrah *et al*., 2014), biosecure (Bhowmick & Crumlish, 2016; Hasimuna *et al*., 2020), and nutrition ((Mente *et al*., 2011; Belton *et al*., 2014; Ekasari *et al*., 2016). Moreover, the use of antibiotics as disease control in aquaculture may pose a negative impact on human health, since antibiotics can leave residues in aquatic organisms that are harmful to world food security (Li *et al*., 2006; Zhang *et al*., 2014). Therefore, alternative antibiotic substances can come from plants that have the potential to be utilized in aquaculture activity (Citarasu, 2010; Hai, 2015).

Immunostimulant plant-based materials such as seaweed, probiotics, and fungi contain anti-microbial effects that can improve product performance and immune system in aquaculture (Efianda *et al*., 2018; Ramadhani *et al*., 2019; Rudi *et al*., 2019). Immunostimulant material derived from plants is relatively easy to handle, and it poses no pollution toward the environment, thus it is recommended for cultivation activity in the long term (Panda *et al*., 2012; Munaeni et al., 2020). One particular ingredient to be used to increase productivity growth is the leaves of *Manihot utilissima* Pohl. The leaves contain 29% of protein, 19.06% of crude fibre, 9.41% of fat, 8.83% of ash (Iheukwumere *et al*., 2008). Further, feed containing micro and macronutrients can increase the energy needed to increase growth and feed efficiency in carp (Syafar *et al*., 2017). The additional use of *M. utilissima* leaves for feeding purposes is viewed as an effort to meet the needs of proper nutrition as well as to enhance the immune system of *C. carpio* without a costly budget. The fact that limited

information is available regarding the utilization of *M. utilissima* as a supplement in *C. carpio* feed has prompted this study. Therefore, its use as a supplementary feed needs to be developed for a wide application by fish farmers throughout Indonesia. The purpose of this study was to determine the optimal dosage of *M. utilissima* leaves as supplementary feed to improve the productivity performance of *C. carpio*.

## MATERIALS AND METHODS

**Supplementation preparation.** The experimental design was carried out with four treatments and four replications for 21 days of maintenance**.** *Manihot utilissima* Pohl. leaves were prepared and washed thoroughly then dried in the open air, then mashed using a blender with a mixture of a small amount of water (50 mL). Extraction result was applied for supplementation in feeds with doses of P1 (0 mL/250 g), P2 (5 mL/250 g), P3 (10 mL/250 g), and P4 (15 mL/250 g). Feed composition included feed size by 0.7 mm, protein by 40%, lipid by 5%, fibres by 4%, and water content by 10% (Matahari Sakti PF500 brand).

**Culture Preparation.** Square containers were placed in a pool with an area of 2 x1 m with a water level of 50 cm. Some 160 test fish were measured by 3-5 cm and were acclimatized for two days before the practical research. Ad libitum feeding method with a frequency interval of 08.00 a.m., 13.00 p.m. and 18.00 p.m., respectively.

**Research Parameter.** Survival rate was measured using the formula:

$$SR = \frac{Nt}{No} x\ 100\%$$

SR= Survival rate (%)
Nt= Number of fish at the end of the study
No= Number of fish in the initial study

The relative growth rate was measured using the formula:

$$RGR = \frac{Wt-Wo}{Wo\ x\ t} x\ 100\%$$

RGR= Relative growth rate (% / day).
Wt= Test fish weight at the end of the study (g)
Wo= Test fish weight at the beginning of the study (g)
t= time (days)

The feed conversion ratio was measured using the formula

$$FCR = F / Bt$$

FCR= Feed conversion ratio
F= Amount of fish feed given during research (g)
Bt= Fish biomass at the end of the research (g)

**Data analysis.** Quantitative data were analyzed with an ANOVA (analysis of variance) 95% confidence interval, and qualitative data were presented descriptively.

## RESULT AND DISCUSSION

The observations showed that supplementation of *Manihot utilissima* Pohl. leaves can significantly affect the production performance of *Cyprinus carpio* L. seeds with a maintenance period of 21 days in ponds. The results are presented in figure 1.

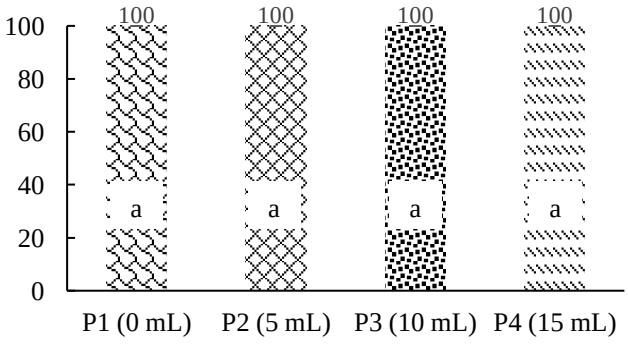


Figure 1. Survival rate of *Cyprinus carpio* L.

The statistical analysis showed that there is no significant impact on the survival rate from the use of *M. utilissima* leaf supplementation. The condition showed that the pond water quality environment during the study was in optimal condition. Water quality is the main

factor that must be considered for survival rate during aquaculture (Zhang *et al*., 2011; Estim *et al.,* 2019). The survival rate of fish affects the environmental conditions so that fish can adapt optimally, and there is no disruption to disease attacks. Further, the success of aquaculture is influenced by both internal and external factors of the fish. The genetics of the breeders predominantly influences internal factor since they are related to the immune system against disease. In contrast, external factors are influenced by the quality of feed and optimal water quality in each species of fish.

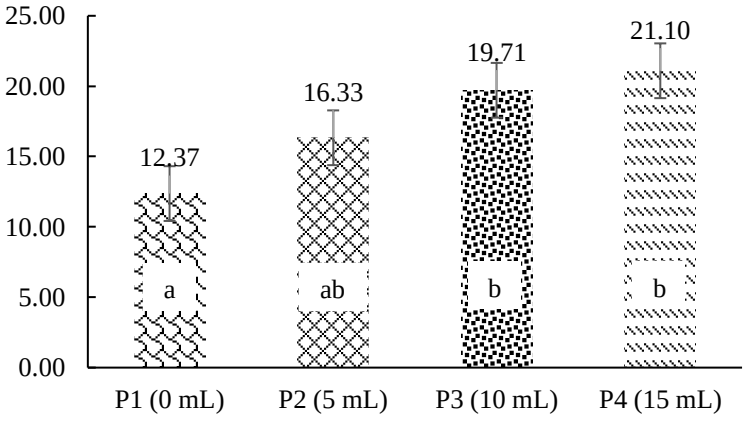


Figure 2. Relative growth of *Cyprinus carpio* L.

The use of *M. utilissima* leaves as supplementation significantly affected the relative growth of *C. carpio* seeds, where the best result came from P4 treatment (15 mL) by reaching 21.10%/day rather than P1 (control) 12.37%/day (Figure 2). Vitamin C and carbohydrates contained in the leaves of Manihot utilissima had a positive influence on the rate of growth of *C. carpio* seeds cultivated in the ponds. Iheukwumere *et al*. (2008) mentioned that *M. utilissima* leaves contain micronutrients and macronutrients such as vitamins, iron, protein, and carbohydrates that can improve nutrition in organisms. The absorption of nutrients in fish affects its digestive system so that growth patterns and body weight can increase ((Rašković *et al*., 2011; Rachmawati & Samidjan, 2013; Rønnestad *et al*., 2013).

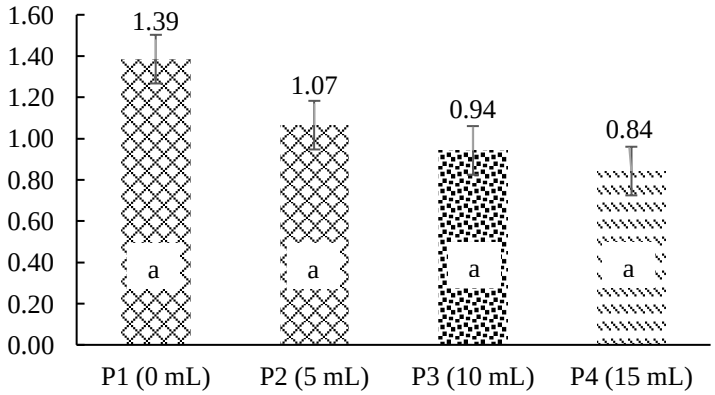


Figure 3. Decreased feed conversion ratio of *Cyprinus carpio* L. performance

The appropriate texture and attractants of the feed also affect the growth patterns for each species, making it more effective for spurring growth in fish (Dani *et al*., 2005). Besides, giving immunostimulants to fish will affect the immune system so that growth is enhanced (Yusuf *et al*., 2015). *C. carpio* is a herbivore that requires vegetable intake in its feed, since the addition of *M. utilissima* leaves supplementation have a significant effect on

their growth and reduce feed conversion ratio. Khairul & Hasan (2018) states that systematic and controlled feeding practices can increase the level of fish consumption, hence fish growth continue to increase.

Supplementation with *M. utilissima* leaves can significantly reduce the feed conversion ratio of *C. carpio* seed (Figure 3). The best result was obtained with P4 treatment with 0.84 rather than control 1.39. *M. utilissima* leaves supplementation has a role in growth, metabolism, and as a source of energy which increases fish growth and reduced feed costs. Immunostimulant properties of *M. utilissima* leaves affects the surface structure of the fish intestine. Thus, the intake of nutrients can be absorbed well, even with the low amount of feed consumed, the growth rate continues to increase. Efianda *et al*. (2018) mentioned that the supply of natural immunostimulant ingredients affects the structure of the intestinal surface of microvilli to become denser, thereby increasing growth and decreasing feed conversion ratio in aquatic organisms. Also, the effect of additional protein from Manihot utilissima leaves provides a significant effect on the efficiency of feed given during the study. Setiawati *et al*. (2008) stated that protein content in the feed is a major factor in aquaculture affecting feed growth and feed efficiency.

Table 1. Water quality during 21 days of conservation

| Parameters | Range | Unit | Optimal Range |
|---|---|---|---|
| **Temperature** | 25 - 30 | °C | 25 – 30°C |
| **pH** | 7 - 7.5 | - | 6.5 – 8.5 |
| **Dissolved Oxygen** | 10 - 12.1 | mg/L | > 5 mg/L |
| **Ammonia** | 0.01 | mg/L | <0.01 mg/L |

Source: National Standardization Agency of Indonesia, 2016.

The supplementation process of *M. utilissima* to *C. carpio* during its 21-days of conservation showed that the water quality was in the optimal range (Table 1). National Standardization Agency of Indonesia (2016) mentions optimal water quality factors, i.e. temperature ranges from 25 to 30°C, pH ranges from 6.5 to 8.5, DO above 5 mg/L and ammonia below 0.01 mg/L. In fact, environmental conditions will affect the growth and survival rate of *C. carpio*. Therefore, poor water quality can increase mortality and losses to farmers. Water quality must be maintained according to the optimal range for each species of aquatic organism.

Ammonia level is an indicator of water quality in fish farming, high levels of ammonia can negatively affect the growth and survival of carp. According to Prianggara *et al.* (2016) mentioned ammonia levels could cause stress and tissue damage in fish. Besides, the ammonia toxicity levels can accelerate the growth of aquatic plants and increase the number of algae that can cause eutrophication in aquaculture ponds. Further, the content of pH and dissolved oxygen are interrelated, as indicated if the pH is alkaline then the condition of dissolved oxygen has decreased, as well as the opposite condition if dissolved oxygen is high then the pH will be acidic. Furthermore, the conversion of ammonia to nitrate is influenced by stable dissolved oxygen (Cema *et al*., 2011; Xie *et al*., 2013; Azhari & Tomasoa, 2018). Therefore, the parameters of water quality are interrelated as a major factor in the growth of fish.

## CONCLUSION

The result of 15 mL supplementation *Manihot utilissima* has a positive effect on the fish relative growth rate, and feed conversion ratio of *Cyprinus carpio*. Water quality during research was in the optimal range for *Cyprinus carpio*.

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