

**DIFFERENT GROWTH PERFORMANCE - TILAPIA  
(*OREOCHROMIS NILOTICUS*) IN USING TWO DIFFERENT TYPES OF  
FEED AT HOA MY RESERVOIR, THUA THIEN HUE PROVINCE, VIETNAM**

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**Abstract:** *Aquaculture is a kind of method for utilizing the potential of available water areas such as at Hoa My reservoir. The Tilapia (*Oreochromis niloticus*) with average weight of 20.3 g is a candidate for developing aquacultural activities. Objective find the effect of different protein level: industrial feed (35% protein) and blended feed (21% protein) on growth performance, survival rate parameters of fish. The fingerlings were stocked in four cages (3.5x 2.5x 1.5 meter each), surrounded by fishing net. The temperature, pH and DO parameters were recorded 2 times per day at 7am and 2pm, being calculated as an average value at 7 days interval. Growth measurements of Tilapia relating to the weight and length of fish were recorded at 15 days intervals. The findings show that Hoa My reservoir seems a potential with stability of pH (6.8-7) and DO (4.5-5.4 mg/l). The survival rate (SR) in the blended feed is 89,7% and the industrial feed is 94,7%. The feed conversion ratio (FCR) of fish fed by blended feed and industrial feed is 1.6 and 1.42, respectively. It means that the industrial feed had higher economic efficiency 175.000VND, compared with the blended feed in same environmental conditions.*

**Keywords:** reservoir; Tilapia; water parameters; nutrition; economic efficiency.

### **1. INTRODUCTION**

Aquaculture seems as the fastest growing food-production sector in the world. Aquaculture contributes to the economy and has the potential for mitigating environmental impacts (Silva and Soto 2009) because of the advantage of fish characteristic, requiring less than 2 kilograms of feed for providing each kg product. This characteristic show the most efficiently producing aquatic animals in terms of the feeds - associated with the amount of water use (Verdegem, Bosma, and Verreth 2006). People nowadays require the amount of fish as food and as human population increases and natural fisheries resources diminish, this promotes an increasing market demand because fish contains very high quality protein and it has sufficient amounts of all the essential amino acids for

maintenance of lean tissues. This makes it become important food for humans (Obe 2014). It is a reason for the overexploitation of fisheries resources due to overcapacity and over fishing. Therefore, it is a motivation for increasing aquaculture production to supplement the market demand of fish and fish products in order to protect the natural fish resources and water environment.

Following the status report about the safety of reservoirs from the Ministry of Agriculture and Rural development, in which more than 200 reservoirs in the central region of Vietnam were statistically reported (Khâm 2014). There are over 50 reservoirs in Hue Province, as irrigation lakes and hydroelectric reservoirs, with a total capacity up to several billion m<sup>3</sup> of water. There are some examples of reservoirs for irrigation such as Truoi lake (55 million m<sup>3</sup>), Khe Ngang lake (15 million m<sup>3</sup>), Hoa My reservoir (9.67 million m<sup>3</sup>). They are considered

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to be potential for aquaculture activities, because of good water sources. First of all, these sources aren't uncontaminated from excessive nutrients, chemicals and heavy metals because these areas are far from villages and cities. The second criteria of these places are the availability of the large volumes of water which can supply water for commercial fish farming.

Even though, fresh water has been a traditional system long time ago but its development is less than that of saltwater and brackish because of economic efficiency for farmers. We can develop aquaculture in fresh water by choosing potential areas and economic fish species. It is a reason that this research aims to conduct at Hoa My reservoir in Phong Dien district, Hue Province, with the water capacity of 9.67 million m<sup>3</sup> and the basin area of about 37 km<sup>2</sup>.

The species selected to portray the potential yield in Hoa My reservoir for aquaculture production is *Tilapia*, a kind of fresh fish, which was imported into Viet Nam several centuries ago because of high quality and quantity, commercial efficiency and adapt to Vietnam regional conditions. Moreover, *Tilapia* are selected to culture in 100 nations in the tropical as well as sub-tropical regions and are known as the third most important cultured fish group in the world, after *carps* and *Salmonids*.

*Tilapia* culture is considered one of the fastest growing in farming activities. There are many advantages in selecting *Tilapia* because of the rapid growth rates, high tolerance to the low water quality, ease of spawning, efficient feed conversion (FCR), resistance to disease and good acceptance of consumer, these characteristics make *Tilapia* a suitable fish for culturing.

Moreover, choosing feed for rearing *Tilapia* with the different proteins because protein are the most important nutrients for mobilization and formation of fish body tissues (Silia Maria de Negreiros Sousa, André Freccia, Lilian Dena dos Santos, Fábio Meurer, Lucélia Tessaro 2013) for the growth performance of *Tilapia* in the same environmental conditions. From all of

these reasons, our research aimed at determining the growth performance of *Tilapia* rearing by two different types of feed with industrial feed containing 35% protein and blended feed containing 21% protein at Hoa My reservoir, Phong Dien district, Thua Thien Hue Province.

## **2. DESIGN OF EXPERIMENT**

### **2.1 Experimental Cages**

Four cages were built by fishing net with size (3.5x 2.5x 1.5 meter) and the water level was maintained at 4/5 capacity in all cages throughout the period of the experiment with the same management practice at Hoa My reservoir in Phong Dien district, Hue province from January 5th, 2011 to May 5th, 2011.

### **2.2 Experimental Diets**

All cages are separated into two types, it mean that experimental cages A1&A2 using industrial feed (Table 1) with 35% of protein which come from Lai Thieu company, Binh Duong province, Vietnam and experimental cages B1&B2 using blended feed (Table 2) with nearly 21% of protein from the formula of HUE Fish Hatchery at Thien An Hill, Hue Province with rice bran 60% + corn flour 20% + fish flour 20%. So, roles of protein considered the dietary macronutrient which is essential in nutritional studies because protein demonstrates the fish feed cost or greatly affecting the fish weight gain.

### **2.3 Experimental Fish**

Fingerlings, 360 heads of fish were fed in two-cages A with the mean average weight of  $20.3 \pm 0.8$  g and  $10.4 \pm 0.14$  cm long and 360 heads of fish were feed in two-cages B, which has the mean average weight of  $20.3 \pm 0.96$  g and  $10.3 \pm 0.13$  cm long. All fish in the experiment were obtained from HUE Fish Hatchery at Thien An Hill, Hue Province. They were fed at the same time, rearing for 4 months in the same experimental conditions. During this adaptation period, the changes of weight and length of fish were recorded 2 times/month.

## **3. METHOD**

### **3.1 Feeding Regime and Management**

Experimental diet was offered spreading by hand for each cage. Analyzing the feed conversion ratio (FCR) and the survival rate (SR) are essential because the feed conversion ratio  $FCR = \text{total feed (kg)} / \text{amount of increased weight (kg)}$  and the survival rate  $SR (\%) = \text{harvested heads} / \text{initial heads}$  (El-Sheriff and El-Feky 2009b). Physicochemical analysis of water includes water temperature, pH and DO (Yatawara and Hettiarachchi 2010), which was measured using Mercury Thermometer (0.5), PH test of CP company at Dong Nai Province, Vietnam and WalkLAB machine respectively. Temperature, pH and DO are checked 2 times per day at 7.am and 2.pm, and during 7 days in the experimental period.

### 3.2 Statistical Analysis

All data were subjected to analyze by Excel program. Especially, the weight of fish was analyzed by ANOVA method in order to test the effects of the different diets on fish performance and whether significant ( $p < 0.05$ ) differences were found.

## 4. RESULTS AND DISCUSSION

The recorded values (Table 3) showed suitable environmental conditions for rearing *Tilapia* in four cages at Hoa My reservoir during the experimental period. Firstly, the values of pH was lowest at 6.8 and highest at 7. This interval is optimum for *Tilapia* (El-Sheriff and El-Feky 2009a) because it was concluded that feed conversion ratio (FCR) of *Tilapia* raised at pH 6-9 and the water pH 7-8 could be more suitable *Tilapia* culture for its optimum growth performance and survival rate. Secondly, Table 3 shows that there are the lowest and largest amounts of DO (4.5mg/l and 5.4 mg/l respectively). This range of DO is suitable for the growth performance of this fish following (Watanabe et al. 1990) the recommended 3mg/l as the minimum DO level. If this DO level is lower, the adverse effects occur through cage culture of *Tilapia* in freshwater system. Therefore, based on the above pH and DO level, Hoa My reservoir with the large amount of water for

agricultural irrigation activities is considered a potential fresh water area to develop *Tilapia*.

Another factor affecting the growth of *Tilapia* is temperature. In Table 3, the temperature values in the period from January 12<sup>th</sup> to February 12<sup>th</sup>/2011, the temperature was under 20°C, there was a decrease in the growth performance of *Tilapia*. Following (Mirea et al. 2013), they showed that the temperature range 20 – 30°C was suitable for intensive culture of *Tilapia* regarding the optimum growth performance and survival rate. Determined by the experimental measurements at the beginning and end of the experiment, the environmental conditions such as DO, pH and temperature affected on all of four cages, are the same. It means that the goal of this paper is kept in order to demonstrate the effects of different feeds on the growth performance of *Tilapia*.

Since the successful result of rearing fish, based on the provision of the suitable and economical fish feeds, we need to select locally available feedstuff, they may be the available agricultural products in purposing of reducing the price of complete feeds (Ochieng and Munguti 2014). The goal is the profitability of fish production, being partially hinged on the ability for formulating the economically viable feed which support the efficient growth and healthy fish (Furuya and Furuya 2010).

Due to the rising cost of commercial *Tilapia* feeds, we were looking for alternative feeds. With permission from the Hue Hatchery operators, the above blended feed was chosen. After that, this blended feed and Lai Thieu industrial feed were used, rearing *Tilapia* in cage culture in experimental area at Hoa My reservoir. At the end, we had some following results. General characteristic of fish growth indicates that a growth rate of weight gain is higher than length parameters.

Figures 1 and 2 demonstrated that the coefficient b in the length – weight rate of *Tilapia* rearing using blended feed, being lower than that using the industrial feed. This is due to

the different nutrition having different protein. In addition, the table 1&2 of nutrient elements show that the amount of protein in the industrial feed is 35% and in the blended feed 21% approximately. Different dietary protein levels (21 % and 35%) clearly influenced the growth of *Tilapia* during the experimental period and was obtained using ANOVA analysis with results  $F > F_{crit}$  ( $P = 0.05$ ) as shown in Table, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8 and 7.9, with the exception of Table 7.1 having  $F < F_{crit}$  showing no difference in the growth rate of fish ( $P = 0.05$ ). According to (Mabroke et al. 2012) their results could be concluded that the dietary protein up to 35% provides good performance for *Tilapia*.

*Tilapia* growth obtained at the end of the experimental period were summarized in table 4&5 and graphically presented in Figures 1 and 2. The following is a critical analysis of the most significant results, namely, the survival rate (SR) and the feed conversion ratio (FCR). SR of *Tilapia* using the industrial feed was 94,7%, compared with 89,7% of the blended feed. Feed conversion factor (FCR) was 1,42 g feed /g gain biomass (in an industrial feed type), 1,61 g feed/g gain biomass (in a blended feed type) (Table 5).

### 5. COST ANALYSIS

Table 6 shows that it is calculation about an economic efficiency of this study with *Tilapia* price at here being 30.000VND. After calculation, income of *Tilapia* using industrial feed, blended feed was 1.230.000VND, 1.055.000VND respectively. In comparison, income of rearing *Tilapia* using the industrial feed was higher than the blended feed, being 175.000VND.

### 6. CONCLUSION

Hoa My reservoir is an example about the potential areas, with the large amount of water to develop aquaculture by rearing *Tilapia* because of two reasons. Firstly, stable pH (6.8-7) with agreement of the findings (El-Sheriff and El-Feky 2009a) in water pH 7-8 could be very suitable to *Tilapia* culture and second is

DO (4.5 - 5.4 mg/l), being great for successful fish production in good oxygen management (Watanabe et al. 1990) and (Mallya 2007), oxygen is essential to the survival (respiration) of *Tilapia* in order to sustain healthy fish. It can increase growth rates, reduce the food conversion ratio (FCR) and increase *Tilapia* production. In addition, avoiding rearing fish in the low temperature period because the low temperature in early two months (January and February, 2011) makes *Tilapia* grow slightly and lethal condition and fish began to grow significantly from March, 2011 in the experimental period.

*Tilapia* fingerlings with average weight 20.3 g were more suitable for cage culture with amount of feed-protein 35% for optimum growth performance and survival rate than blended feed with protein 21% under similar experimental conditions because high protein contains high levels of essential amino acids, seems attractant in aqua-feeds, it also help promoting rapid ingestion in many farmed fish species. Moreover, two kinds of feed both have economic efficiency for farmers and this research recommended utilizing dietary sources in the local areas such as rice, corn and fish flour, which are cheap and readily available in order to increase the income for farmers who lacks of finance in buying industrial feed.

### 7. ACKNOWLEDGMENTS

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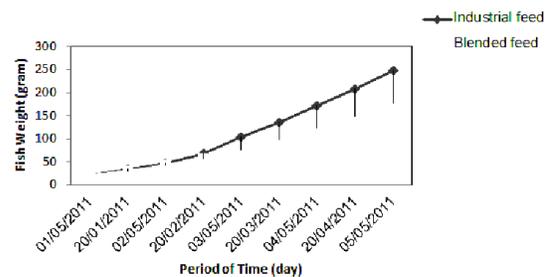


Figure 1. Effect of different feeds on *Tilapia* weight (gram)

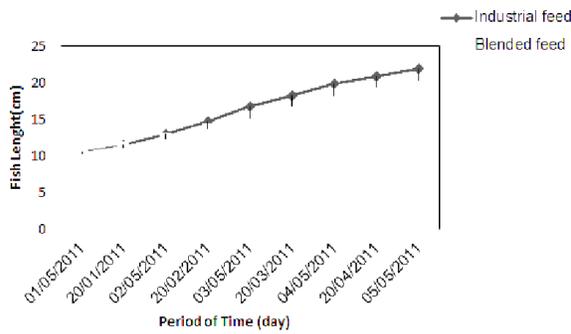


Figure 2. Effect of different feeds on *Tilapia* length (cm)

Table 1. The nutrition's parameters of industrial feed

Items	DT01	DT02	DT03	DT04	DT05	DT06
Weight of fish (gr)	<1	1_5	5_20	20_200	200_500	>500
Maximum size (mm)	Pieces	1.5	2.5	5	10	12
Maximum moisture (%)	11	11	11	11	11	11
Protein minimum (%)	40	35	30	26	22	18
Digestible energy minimum (k cal/kg)	3.3	2.8	2.4	2.1	1.8	1.5
Fat minimum (%)	8	6	5	5	4	3
Maximum cellulose (%)	6	6	7	7	8	8
Lysine minimum (%)	2	1.8	1.5	1.3	1.1	0.9
Methionine minimum (%)	0.9	0.8	0.7	0.6	0.5	0.4
The amount of feed (% weight of fish body)	15_10	10_7	7_3	5_3	5_3	3_2

Table 2. The nutrition's parameters of blended feed

Items	gram/100 gram feed	Dried Protein (%)	Dried Fat (%)	Dried cellulose (%)	ADP (%)	NDP (%)	NFE
Fish flour	20	55.03	4.75	1.32			5.33
Corn flour	20	9.64	4.6	2.61	3.77	12.8	81.54
Rice bran	60	13.39	13.13	9.4	11.76	20.65	55.04
Total	100	20.968	9.748	6.426	7.81	14.95	50.398

Table 3. Temperature, DO, pH during experiment

Times	Temperature (°C)	DO (mg/l)	pH
1: 5.1 - 12.1	20.5 ± 0.78	4.9 ± 0.39	6.9 ± 0.14
2: 13.1 - 19.1	18.7 ± 0.56	5.4 ± 0.50	6.9 ± 0.18
3: 20.1 - 27.1	18.9 ± 0.83	5.2 ± 0.39	6.9 ± 0.10
4: 28.1 - 4.2	19.0 ± 0.65	5.2 ± 0.45	6.8 ± 0.11
5: 5.2 - 12.2	19.6 ± 0.54	5.5 ± 0.87	6.9 ± 0.11
6: 13.2 - 19.2	22.5 ± 1.13	5.0 ± 0.63	7.0 ± 0.09
7: 20.2 - 27.2	22.8 ± 1.13	5.0 ± 0.61	6.9 ± 0.07
8: 28.2 - 6.3	24.5 ± 0.83	4.1 ± 0.46	6.9 ± 0.10
9: 7.3 - 13.3	23.4 ± 0.93	5.5 ± 0.55	6.9 ± 0.09
10: 14.3 - 21.3	22.9 ± 1.19	5.6 ± 0.35	6.9 ± 0.15
11: 22.3 - 28.3	22.6 ± 1.77	5.3 ± 0.40	6.8 ± 0.12
12: 28.3 - 4.4	21.0 ± 1.14	5.4 ± 0.42	7.0 ± 0.10
13: 5.4 - 12.4	25.4 ± 0.64	4.7 ± 0.40	6.9 ± 0.14
14: 13.4 - 19.4	27.0 ± 0.87	4.5 ± 0.35	6.9 ± 0.10
15: 20.4 - 27.4	27.0 ± 0.89	4.7 ± 0.31	6.8 ± 0.12
16: 28.4 - 4.5	28.7 ± 0.46	4.6 ± 0.48	6.9 ± 0.11

Table 4. Survival rate (SR)

Items	Number of initial heads	Number of harvested heads	Survival rate (%)
Industrial feed	360	341	94.7
Blended feed	360	323	89.7

Table 5. feed conversion ratio (FCR)

Items	Industrial Feed	Blended Feed
Weight total at the initial period (kg)	7.3	7.3
Weight total at harvested period (kg)	84.3	57.7
An increased weight(kg)	76	50.4
Total Feed(kg)	108	81
FCR	1.42	1.61

Table 6. Economic efficiency (VND)

Items	Industrial feed	Blended feed
A. Tilapia price	30.000 Dong/kg	30.000 Dong/kg
B. Total purchases(Dong)	1.300.000	680
- Offspring	90	90
- Feed	1.210.000	590
C. Total sales (Dong)	2.530.000	1.735.000
D. Income (Dong)	1.230.000	1.055.000

Table 7. COMPARATIVE ANOVA about the growth rate of *Tilapia* in industrial feed (column1) and blended feed (column2)

Table 7.1. Comparison of *Tilapia* weight after rearing of 15 days

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	609.3	20.31	0.645069		
Column 2	30	609.1	20.30333	0.912747		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.000667	1	0.000667	0.000856	0.976761	4.006873
Within Groups	45.17667	58	0.778908			
Total	45.17733	59				

Conclusion:  $F < F_{crit}$ , no difference in the growth rate of fish ( $P = 0.05$ )

Table 7.2. Comparison of *Tilapia* weight after rearing of 30 days

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	982.1	32.73667	7.639644		
Column 2	30	861.1	28.70333	6.54792		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	244.0167	1	244.0167	34.39867	2.27E-07	4.006873
Within Groups	411.4393	58	7.093782			
Total	655.456	59				

Conclusion:  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

Table 7.3. Comparison of *Tilapia* weight after rearing of 45 days

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	1385.3	46.17667	4.424609		
Column 2	30	1224.1	40.80333	3.20723		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	433.0907	1	433.0907	113.4958	2.82E-15	4.006873
Within Groups	221.3233	58	3.81592			
Total	654.414	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.4. Comparison of *Tilapia* weight after rearing of 60 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	2025.2	67.50667	3.16892		
Column 2	30	1693.1	56.43667	0.80792		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1838.174	1	1838.174	924.4395	2.48E-37	4.006873
Within Groups	115.3283	58	1.98842			
Total	1953.502	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.5. Comparison of *Tilapia* weight after rearing of 75 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	3073	102.4333	31.22506		
Column 2	30	2265.3	75.51	1.134034		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10872.99	1	10872.99	672.0206	1.38E-33	4.006873
Within Groups	938.4137	58	16.17955			
Total	11811.4	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.6. Comparison of *Tilapia* weight after rearing of 90 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	4035.8	134.5267	45.65582		
Column 2	30	2919.4	97.31333	9.03292		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	20772.48	1	20772.48	759.6622	5.11E-35	4.006873
Within Groups	1535.973	58	27.34437			
Total	22358.46	59				

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**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.7. Comparison of *Tilapia* weight after rearing of 105 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	5136.4	171.2133	77.69706		
Column 2	30	3675.2	122.5067	124.4606		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	35585.09	1	35585.09	352.0528	2.61E-26	4.006873
Within Groups	5862.573	58	101.0789			
Total	41447.66	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.8. Comparison of *Tilapia* weight after rearing of 120 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	6221.6	207.3867	146.3964		
Column 2	30	4446.8	148.2267	99.50961		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	52498.58	1	52498.58	426.981	1.99E-28	4.006873
Within Groups	7131.273	58	122.953			
Total	59629.86	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

**Table 7.9. Comparison of *Tilapia* weight after rearing of 135 days**

SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	30	7413.9	247.13	109.907		
Column 2	30	5357.2	178.5733	67.48064		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	70500.25	1	70500.25	794.8721	1.5E-35	4.006873
Within Groups	5144.242	58	88.69382			
Total	75644.49	59				

**Conclusion:**  $F > F_{crit}$ , difference in the growth rate of fish ( $P = 0.05$ )

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#### **Tóm tắt:**

### **SỰ TĂNG TRƯỞNG KHÁC NHAU CỦA CÁ RÔ PHI (*OREOCHROMIS NILOTICUS*) DO SỬ DỤNG HAI LOẠI THỨC ĂN KHÁC NHAU TẠI HỒ HÒA MỸ, TỈNH THỪA THIÊN HUẾ, VIỆT NAM**

Nuôi trồng thủy sản là phương pháp để tận dụng tiềm năng vùng nước ở các đập như hồ Hòa Mỹ. Cá rô phi vằn với trọng lượng trung bình 20,3g được là ứng cử viên cho việc phát triển nghiên cứu. Mục tiêu là tìm ra ảnh hưởng của mức độ protein khác nhau: thức ăn công nghiệp (35% protein) và thức ăn phối trộn (21% protein) lên tăng trưởng, tỷ lệ sống của cá. Cá giống nuôi trong bốn lồng (3,5 x 2,5 x 1,5 mét), bao quanh bằng lưới đánh cá. Nhiệt độ, pH và oxy hòa tan (DO) được ghi 2 lần mỗi ngày, lúc 7 giờ sáng và 2 giờ chiều, được tính với giá trị trung bình trong 7 ngày. Đo tốc độ tăng trưởng của cá rô phi về trọng lượng và chiều dài trong khoảng 15 ngày.

Kết quả cho thấy hồ Hòa Mỹ rất tiềm năng với sự ổn định của pH (6,8-7) và DO (4,5-5,4 mg/l) cho phát triển nuôi trồng thủy sản. Tỷ lệ sống (SR) thức ăn phối trộn là 89,7% và thức ăn công nghiệp là 94,7%. Tỷ lệ chuyển đổi thức ăn (FCR) của cá nuôi bằng thức ăn phối trộn và công nghiệp lần lượt là 1,6 và 1,42 có nghĩa là thức ăn công nghiệp có hiệu quả kinh tế cao hơn 175.000VND so với thức ăn phối trộn trong điều kiện môi trường như nhau.

**Từ khóa:** Đập nước; Cá rô phi; chỉ số môi trường nước; dinh dưỡng; hiệu quả kinh tế.

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