__Original Research Article__

The Utilization of Vegetable Waste on The Growth of Java Barb (*Barbonymus gonionotus*) and Kissing Gourami Fish (*Helostoma temminckii*) (Case Study of Traditional Market in Bandung City, West Java, Indonesia)

ABSTRACT

This study aims to calculate the production of vegetable waste from several traditional markets in Bandung City, select vegetable waste, and provide selected vegetable waste to Java Barb (*Barbonymus gonionotus*) and Kissing Gourami fish (*Helostoma temminckii*). The method used in calculating the production of market vegetable waste is to use secondary data, while the test feeds on fish using a Completely Randomized Design. The results obtained from this study are the production of vegetable waste from the 9 markets surveyed reached a total of 2,628.37 kg/day. The types of vegetable waste selected for the test fish feed were water spinach (*Ipomoea aquatica)* and mustard greens (*Brassica juncea)*. The best absolute growth value was obtained in pond fish with an absolute growth value of 63.76 g. Based on the results of the study, traditional market vegetable waste can be a solution to reduce vegetable waste and as cheap alternative feed ingredients.

Keywords: vegetable waste, traditional market, alternative feed, java barb, kissing gourami, growth

1. INTRODUCTION

The purpose of aquaculture is to produce high-quality animal protein commodities at affordable prices for the community [1]. One of the factors to support the success of aquaculture is the availability of artificial feed that is sufficient in quality and quantity. A Quality feed with sufficient quantity can increase the growth and survival of fish [2].

The main raw material used as a source of protein in feed is fish meal. Farmers usually use imported fish meal which is higher quality than local fish meal [3]. However, the price of imported fish meals continues to increase [4]. If the raw materials used are its expensive will cause high production costs because costs spend about 50-60% of production costs. This will have an impact on the high selling price [5]. Therefore, reducing production costs through lower feed costs must be carried out to increase the purchasing power of the domestic community. One of the efforts to reduce feed costs is the use of local raw materials as alternative feed [6].

Bandung is a big city that has many markets. These markets produce vegetable waste which is increasing every day, making it increasingly difficult to find a place for disposal [7]. This waste is also a pollutant because it causes a foul odor [7]. However, this organic waste still contains nutritional value such as protein, carbohydrates, fat and so on. So that, it can be processed as fish feed ingredients [8]. The treatment of waste as fish feed is expected to be a solution to two problems at once, namely reducing feed costs and secondly, reducing the amount of waste.

This study aims to calculate the production of vegetable waste from several traditional markets in the city of Bandung, select vegetable waste, and provide selected vegetable waste to Java Barb (*Barbonymus gonionotus*) and Kissing Gourami fish (*Helostoma temminckii*).

2. METHOD

2.1 Locations

This research was conducted in Ciparanje Pond, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran and the forage analysis laboratory, Faculty of Animal Science, Padjadjaran University.

Figure 1. Fishpond cultured

2.2 Materials

The materials used in this study were java barb fish seeds and 500 fish kissing gourami fish each. Java barb weight of 500 fish of 8.7 g. Meanwhile, kissing gourami fish seeds were obtained from the Singaparna Fish Seed Center, Tasikmalaya. The average weight of kissing gourami fish used is 12.1 g. The test feed material used was vegetable waste consisting of water spinach, mustard greens, and a mixture of water spinach and mustard greens from the Cileunyi market, Bandung Regency.

2.3 Proximate analysis

2.3.1 Protein analysis

A. Protein analysis was carried out in three stages, namely oxidation, distillation, and titration. In the oxidation stage, 0.5 g of vegetables were added with 3 g of catalyst (9 g K_2SO_4 + 1 g $CuSO_4$), then 10 ml of concentrated H_2SO_4 was added. All materials are then heated to obtain a clear liquid (heating is complete when a clear green solution has formed). The liquid was cooled and added 20 ml of distilled water, then transferred to a beaker, then added distilled water until the volume of the solution was 100 mL (A).

B. Distillation

Ten ml of 0.05 N H_2SO_4 was put into an Erlenmeyer, then two drops of MR-MB were added. Prepare the distillation apparatus. Five ml of solution A was put into a Kjeldahl flask. From the top of the distillation apparatus, 10 mL of 30% NaOH was added. Heat until condensation occurs for 10 minutes starting with the first drop.

C. Titration

The liquid in Erlenmeyer is titrated with 0.05 N NaOH until the liquid turns light green.

$$\text{Protein contents (\%)} = \frac{0{,}0007 \times (Vb - Va) \times F \times 6{,}25 \times 20}{s} \times 100\%$$

Information:

Vb = blank titration volume (mL)

Vs = sample titration volume (mL)

F = 1

S = sample (gr)

(Source: Watanabe 1988) [9]

2.3.2 Lipid contents analysis

Five grams of vegetable waste is put into the pumpkin. Then, 150 ml of petroleum benzine was added to the flask. The solution is heated. After that, steam the solution so that the fat remains. Calculation of fat content according to the formula below:

$$\text{Lipid contents (\%)} = \frac{Y - X}{5} \times 100\%$$

(Source: Watanabe 1988) [9]

2.3.3 Water Content Analysis

Vegetable waste samples were weighed and placed in a special dish and heated in an oven at a temperature of 105 ^oC. The heating continues until the sample no longer loses weight. After heating the food sample is called a "dry matter sample" and its reduction with the food sample is called the percent water or water content.

2.3.4 Ash Content Analysis

The porcelain dish was dried in a dryer at a temperature of 105°C. The cup is then cooled and then weighed. Vegetable waste samples were put into porcelain dishes. The porcelain cup containing the sample was ignited over a Hunson burner until it no longer smoked, then put into an electric furnace (temperature 400-600°C). After the ash turns white completely, then it is removed, cooled, and weighed.

.

$$\text{Ash (\%)} = \frac{Z - X}{Y} \times 100\%$$

Z = Weight of cups and samples that have been reduced to ashes

X = Weight of empty cup

Y = Sample weight
(**Source**: Watanabe 1988) [9]

2.3.5 Fiber Content Analysis

Two grams of fat-free vegetable waste samples were put into an Erlenmeyer. 200 ml of 1.25% H_2SO_4 was added to the Erlenmeyer, boiled for 30 minutes, and stirred using reverse cooling. The residue was poured into a Buchner funnel with filter paper and washed with distilled water until the pH was neutral. The residue was poured into another clean Erlenmeyer and added 200 ml of 1.25% NaOH, boiled for 30 minutes, stirred by cooling again. The residue was poured into a Buchner funnel with filter paper, washed with distilled water until the pH was neutral. Dry in an oven at 110°C for 24 hours and cool in a desiccator for about 30 minutes and weigh.

$$\text{Fiber content (\%)} = \frac{\text{Drying sample weight (gr)} - \text{filter paper weight (gr)}}{\text{Sample weight (gr)}} \times 100\%$$

2.4 Vegetable Waste as Fish Feed

The method used in this study was a completely randomized design experimental method (CRD) with a factorial pattern, which consisted of two factors, namely the type of fish (Java barb fish and kissing gourami fish) and vegetable waste factors (water spinach, mustard greens, mixed). Each treatment was repeated three times.

The test fish were put into the experimental pond with a density of 100 fish/pond. Fish *were* fed vegetable waste of about 75 grams per day. The feed given previously was withered, chopped, and homogeneously stirred. Feeding was done once a day at 08.00 WIB. Sampling weighing biomass weights was carried out once a week for three months of maintenance. Feed adjustments were made after weighing the fish.

3. RESULTS AND DISCUSSION

3.1 Waste production data

The survey results to observe market waste production in Bandung are as follows:

Table 1. Market Waste Production (Kg/m^3)

No.	**Market**	**Density** (Kg/M^3)
1	Caringin	345.99
2	Sederhana	297.99
3	Andir	326.15
4	Kiara Condong	257.30
5	Moch.Toha	291.22
6	Cijerah	289.11
7	Balubur	226.24
8	Tpu Gg.Saleh	320.99
9	Tpu Caringin	273.61
	Total	2.628.37
	Average	292.04

The density of market waste is very high, because it contains a lot of wet waste in the form of vegetables and fruit residue. The density of market waste is highly dependent on the type of food sold. Meanwhile, the density of road waste is 130.84 kg m^{-3}, shops 103.27 kg m^{-3} and offices 99.69 kg m^{-3}, much smaller than the specific gravity from other sources, because the components of waste, mostly consist of: inorganic such as paper, plastic, and garbage organic (dried leaves).

The average density of Bandung city waste is 252.41 kg m^{-3} as shown in Table 1. The lowest density is office waste 99.69 kg m^{-3} and the highest is sourced from hospitals at 295.08 kg m^{-3}.

3.2 Proximate Analysis

Based on the results of a proximate analysis of vegetable waste used in fish feed, namely water spinach and mustard greens waste, the following results were obtained:

Table 2. Proximate analysis of water spinanch and mustard greens waste

No.	Nutrient	Water spinanch (%)	Mustard greens (%)
1.	water	89.36	90.52
2.	ash	15.45	16.05
3.	Crude protein	2.11	2.71
4.	Crude fiber	15.91	14.91
5.	Crude lipid	1.08	0.47

From the water content possessed by these two vegetables the value is quite high (± 90%). This makes the feeding of these vegetables quite large quantitatively, which is about 90% of body weight, while the protein content of these two types of vegetables is relatively small ± 2%. These results are like those of Afifah *et.al* (2021) [10] who found that the protein content of kale and cabbage waste was low (1.5185%). However, protein still plays a role as a supplier of the basic ingredients for fish meat deposition. To meet protein needs, other protein sources need to be added to the feed [10].

An appropriate fiber content may improve digestive efficiency. However, too high insoluble fiber content leads to food acceleration through the digestive tract and shortened digestion time. High fiber content will also interfere with the absorption of nutrients [11]. However, Herbivorous fish with specific digestive tracts have enzymes and digestive juices that are ready to process feed ingredients that contain high crude fiber such as vegetables. The result of proximate analysis in this case that the crude fiber of two types of vegetables (water spinach and mustard greens) were 15.91% and 14.91%, respectively. High fiber content can be reduced by fermentation [12].

We also see the protein content and fat content as suppliers of the energy value of feed ingredients, which in fact are not much different. The implication of the energy value that is not much different is that the consumption of fish for the two feeds will be the same.

5.3 Absolute Growth

Fish growth is one of the most important criteria in measuring response in feed research. Growth is the increase in length and weight over time. Growth is a change in length, volume, or wet or dry weight. According to Effendi (1997) [13] growth can be divided into absolute growth, namely the average size of animals at a certain age, and relative growth, namely the length or weight achieved in a certain time associated with the length or weight at the beginning of the period.

The absolute growth of two types of fish namely java barb and kissing gourami is shown in table 3 below:

Table 3. Avarage of absolute growth of java barb and kissing gourami fish with two vegetable waste feed

Fish type	Absolute growth (g)		
	Water spinach	Mustard greens	mixed
Java barb	15,97	13,30	19,27
Kissing gourami	17,54	19,57	63,76

To see more clearly the growth trend of each type of fish, a graph of the absolute growth of various types of fish given three types of feed will be presented below.

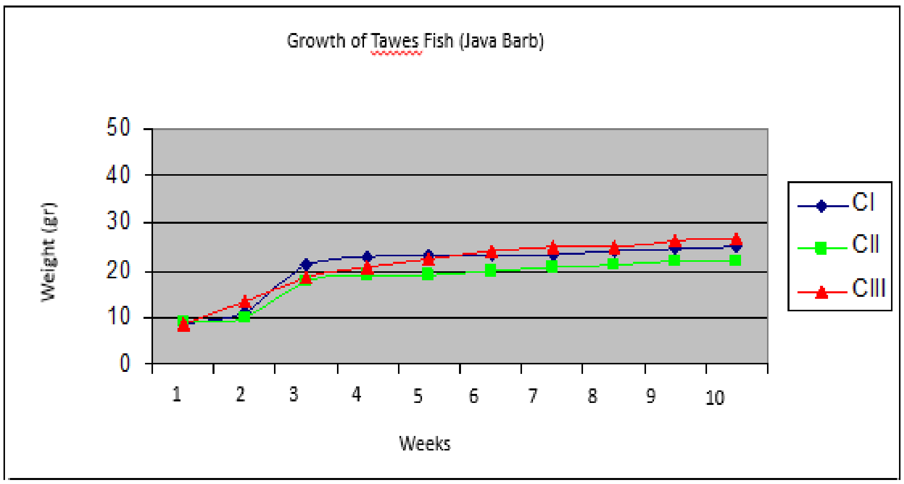

Figure 2. The growth of Java barb
CI (water spinach), CII (Mustard green), CIII (Mixed)

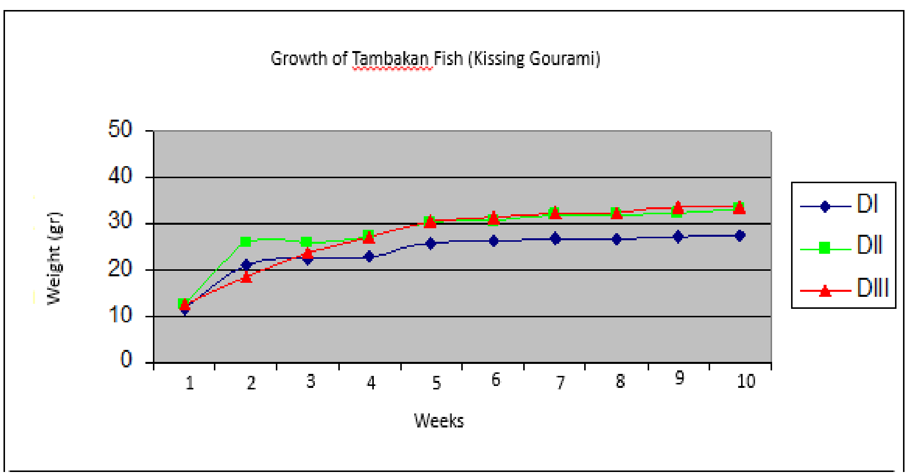

Figure 3. The growth of Kissing Gourami
DI (water spinach), DII (Mustards green), DIII (Mixed)

For each fish, it grew by 145.63 gr and 175.08 gr for java barb and kissing gourami, respectively. Based on the table above, it appears that each type of fish feed, namely water spinach, mustard greens, and a combination of both gave a growth response, but the absolute growth rate of each fish was different. The growth response by feeding a combination of water spinach and mustard greens gave the highest absolute growth value, which was 13.56 gr. This was different from the absolute growth response of fish fed with water spinach or mustard greens alone, which were 11.59 gr and 11.62 gr, respectively.

This difference in absolute growth response seems to be due to the complementary effect of the two types of vegetables. Both plants contain protein, lipid, fiber, and others. When combined, the amount of nutrients both will influence the fish. Fish require higher protein than lipids and carbohydrates as an energy source. However, lipids and carbohydrates are also needed. Lipids play a role in supplying essential fatty acids which are essential for the growth and development of fish [14].

4. CONCLUSION

In conclusion, water spinach and mustard greens waste can be used as feed ingredients of Java barb and Kissing gourami fish. Mixed of two vegetable waste give better effect on the growth of Java barb and Kissing gourami fish. The protein content in water spinach and mustard greens waste is low, so other protein source must be added to the feed.

REFERENCES

1. KKP. The Importance of the Role of Domestic Marketing of Fishery Products in Supporting National Fisheries Development. https://wpi.kkp.go.id/?q=node/54. Accessed 3 July 2022.

2. Syahailatua DY, Dangeubun JL, Serang AM. Artificial feed composition for growth and protein and fat retention of humpback grouper, *Cromileptes altivelis*. AACL Bioflux. 2017; 10(6):1683-1691

3. Miranti S, son of WKA. Potential Test of Fish Waste from Traditional Markets in Tanjungpinang City as an Alternative Raw Material for Making Feed for Marine Fish Cultivation. Aquaculture Intek. 2019; 3(1):8-15. Indonesia

4. Hodar AR, Vasaya RL, Mahavadiya DR, Joshi NH. fish meal and fish oil replacement for aqua feed formulation by using alternative sources : a review. Journal of Experimental Zoology, India. 2020; 23(1): 13-21.

5. Sangavi S, Sawant PB, Ande MP, Syamala K, Chandha NK. Palm Kernel Meal - An Alternative Cost-Effective Fish Feed Ingredient. www.aquastarmagazine.com July 2020. https://wpi.kkp.go.id/?q=node/54. Accessed 3 July 2022.

6. Sukarman. Various Alternative Local Raw Materials for Fish Feed. Aquaculture Media. 2011; 6(1). Indonesia

7. Utama CS, Mulyanto A. Potential of vegetable waste to be a starter for fermentation. Journal of Health. 2009; 1(1); 6-13. Indonesia

8. Arisa K, Fadli N, Anwar A, Nizamuddin, N, Parmakope P. Utilization of organic waste as raw material of fish feed production for African catfish *Clarias gariepinus*. IOP Conf. Series: Earth and Environmental Science 216 (2018) 012035.

9. Watanabe T. Fish Nutrition and Marine Culture. Department of Aquatic Biosciences Tokyo University of Fisheries, JICA. 1988.

10. Afifah SF, Rachmaniyah, Khambali. Utilization of Vegetable Waste for Feed Pellets for Tilapia (*Oreochromis niloticus*). Echo Environmental Health. 2021; 19(2).

11. Sun Y, Zhao X, Liu H, Yang Z (2019) Effect of Fiber Content in Practical Diet on Feed Utilization and Antioxidant Capacity of Loach, (*Misgurnus anguilicaudatus*). 10:577. doi:10.35248/2155-9546.19.10.57

12. Debi MR, Wichert BA, Liesegang A. Method development to reduce the fiber content of wheat bran and rice bran through anaerobic fermentation with rumen liquor for use in poultry feed. Asian-Australasian journal of animal sciences. 2019; 32(3), 395–404. https://doi.org/10.5713/ajas.18.0446

13. Effendi. Fisheries Biology Methods. Dewi Sri Foundation, Bogor. 1979.

14. Kim KD, Lim SG, Kang YJ, Kim KW, Son MH. Effects of Dietary Protein and Lipid Levels on Growth and Body Composition of Juvenile Far Eastern *Catfish Silurus asotus*. Asian-Australas J Anim Sci. 2012 Mar;25(3):369-74. doi: 10.5713/ajas.2011.11089. PMID: 25049575; PMCID: PMC4092954.