Effect of Adding Fermented Restaurant Waste Meal with Different Concentration to Physical Quality of Fish Pellet

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Authors’ contributions

This work was carried out in collaboration among all authors. Author MAS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors YA and KH managed the analyses of the study. Authors IZ and MFW managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study aims to evaluate the physical quality of fish feed pellets formulated with different concentration of fermented restaurant waste meal (FRWM). The treatments given consisted of treatment A (control, without adding FRWM), treatment B (adding FRWM 10%), treatment C (adding FRWM 20%), treatment D (adding FRWM 30%) and treatment E (adding FRWM 40%). The study was conducted from July to October 2019 at the Aquaculture Laboratory and Hatchery in Ciparanje of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. The parameters observed include the breaking rate test, sinking rate test, durability test, and stability test. Results showed that the use of FRWM gave significant difference (p<0.05) for breaking rate and stability value. However, result showed that the sinking rate and durability value generally did
not show significant difference (p>0.05). The FRWM can be used up to a concentration of 30% which gives effect to the sinking rate of the fish pellet which is similar to the control fish pellet namely 0.38 cm/s while the concentration of the meal of the FRWM gives the closest value of breaking rate and stability control as much as treatment B (adding FRWM 10%) with a break rate for 19.93 hours and stability in water for 10 minutes by 91.66%, 30 minutes by 87.60%, and for 60 minutes by 75.26%. The different adding concentration of FRWM gives effect to the quality of fish pellet while more than 10% can decrease its quality. The difference were show in all treatment in some parameters observed.

Keywords: Fermented restaurant waste meal; fish pellet; stability; durability.

1. INTRODUCTION

The key factor determining the success of aquaculture activity, was the availability of adequate food in terms of both quality and quantity. The supply of feed in aquaculture consuming relatively in high cost [1]. The cause of high cost as it represents about 60-80% of total production cost is most of the raw material from other countries (imports) [2,3]. The high cost of feed be the strong reason that the Directorate of Animal Feed, Directorate General of Aquaculture, Ministry of Maritime and Fisheries in Indonesia called Gerpari (Gerakan Pakan Ikan Mandiri) promote the use of feed raw materials locally [4]. One of the materials has potential to be an alternative for feed is restaurant waste. Components of the restaurant waste are rice as a source of carbohydrate, vegetable as source of vegetable protein, and the bone with rest of meat as a source of animal protein. Based on proximate test, the nutritional contents of restaurant waste are 15.58% of protein, and 4.88% of crude fiber. To increase their nutritional content, it was necessary make a fermentation process [5]. Feed production using alternative feed ingredients through the fermentation process is expected to improve the quality of feed material. Artificial feed was formulated in accordance with nutritional needs of each cultured organism, which were able to support their growth. Artificial feed was made, commonly, in pellet shape. But, it is necessary to make it with high stability in water to avoid their disintegration and lose their nutrient content [6,7]. Therefore, the aim of this study was to evaluate the effect of fermented restaurant waste meal (FRWM) on the physical quality of fish feed pellets formulated with locally available raw materials.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Aquaculture Laboratory and Hatchery in Ciparanje of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Sumedang, Indonesia.

2.2 Collection and Processing of FRWM

Fresh restaurant waste was collected from restaurants located around Universitas Padjadjaran, Sumedang, Indonesia. Probiotics were used in the fermentation process. The probiotics are BIOM-s. Probiotics were prepared as much as 8% of the total weight of waste. Waste was weight and chopped to reduce their size and increase the surface area to make the product can be spread evenly. Waste put into the basin and added probiotics then put it into plastic with vacuum condition. Waste fermentation is carried out for 7 days. The next step are drying and flouring.

2.3 Formulation of Experimental Pellets

Five pellet with different inclusion levels of FRWM (0%, 10%, 20%, 30% and 40%). The treatment designated as A, B, C, D and E respectively was used (Table 1). The experimental pellets were formulated according to pearson square methods.

2.4 Production of Pellet

Mix binder (CMC) and water as much as 10% of the pellet weight therefore becomes thick like glue. Add the binder that have mixed with water into the mix of another material include of fish meal, soy meal, bran, fish oil and premix. begin by mixing the lower FRWM concentration percentage to the higher concentration percentage. Stirr well all the raw materials until homogeneous and until become dough. Subsequently, put the mix into pelletizer with a bore diameter of about 1 mm. Cut into small pieces with a length about 0.2 cm to produce a small pellet that fit to the fish mouth, then dried under the sunlight for one day.
2.5 Observation Parameter

The parameters observed in this study include the following:

2.5.1 Breaking rate test

Breaking rate test is used to measure the time until the pellet breaks in the water. This parameter was observed visually [8]. Pellet as much as 10 rods inserted into 1 L water. The observations were made every 5 minutes to determine the feed already soggy or not. Observations continued until the feed broken.

2.5.2 Sinking rate test

Sinking rate test is done by measuring the time it takes to move from the surface to the bottom of the water. Pellet as much as 5 rods is put into a measuring cylinder with a height of 20 cm from the surface of the water. Calculate the time needed for the pellet to reach the bottom of the measuring cylinder. The formula for calculating for the sinking rate is:

\[ \text{Sinking rate} = \frac{\text{distance (20 cm)}}{\text{time of pellet until reach under cylinder glass}} \]

2.5.3 Durability test

Durability is the number of pellets were returned intact after mixing with mechanical (pneumatic). The formula for calculating the durability [9] as follows:

\[ \text{Durability} = \frac{\text{weight of pellet after stirred}}{\text{weight of pellet before stirred}} \times 100\% \]

The first step is to prepare the feed testing that was created first and then enter all feed into the Tumbling Box, then performed the screening of tumbling box 50 rpm for 10 minutes, thus 1 minute is 50 times rotary.

2.5.4 Stability test (Water stability)

The pellet is weighed 30 grams for all treatment. Before dipped to be tested by soaking time, each treatments were divided into three equal parts, respectively 10 grams. Soaking time for 10, 30, 60 minutes after dipped. After soaking the pellet removed and then dried and dried such that the moisture content of the pellets before soaking the same as after soaking, then calculated dry weight and stability of the pellets. Calculation of stability tests performed using the formula according to [10] as follows:

\[ \text{Stability} = \frac{\text{final dry weight}}{\text{initial dry weight}} \times 100\% \]

2.6 Statistical Analysis

The data were analyzed using Analysis of Variance (ANOVA) F test in line with the 95% confidence level. If there is a significant difference then carried Duncan's multiple range test [11].

3. RESULTS

Breaking rate test (Table 2) is one of the parameters in the physical testing of fish to see the outbreak of the feed in the water. The result showed that the average breaking rate of pellet in the water with the addition of fermented restaurant waste meal with different concentration (treatment B, C, D, and E) given significant difference (p<0.05) improvement in their breaking rate compared to the control treatment (A). Treatment A (control or additions FRWM 0%) has the longest time average of breaking rate among other pellet treatment, namely 22.98 ± 0.36 hours. Treatment B (addition FRWM 10%) has value that most closely breaking rate of control treatment, namely 19.93 ± 0.34 hours. The fastest time average of breaking rate among other pellet treatment is treatment E (addition FRWM 40%), namely 15.95 ± 0.53 hours.

Result obtained for the sinking rate value of the experimental pellet (Table 2) formulated with FRWM showed that treatment B, C, and D there was no significant difference (p>0.05) compared to the control treatment. However, treatment E (addition FRWM 40%) has the fastest time average of sinking rate among other pellet treatment, namely 0.53 ± 0.43 cm/s. Treatment B (addition FRWM 10%) has value that most closely sinking rate of control treatment, namely 0.06 ± 0.01 cm/s. The FRWM can be added up to 30% to produce the value of sinking rate similar with control.

Result obtained for the durability value of the experimental pellet (Table 2) formulated with FRWM showed that treatment B and C was no significant difference (p>0.05) compared to the control treatment. However, treatment D and E
given significant difference (p<0.05) compared to the control treatment. Treatment A (control) showed that has the highest durability value of 97.23 ± 0.0002% and the lowest durability value is treatment E (FRWM 40%) namely 96.65 ±0.010%.

The result showed that the stability value in the water (Table 2) for 10, 30, and 60 minutes of pellet in the water with the addition of fermented restaurant waste meal with different concentration (treatment B, C, D, and E) given significant difference (p<0.05) improvement in their stability value compared to the control treatment (A). The data showed that treatment A (control) by soaking in water for 10 minutes has a highest stability value namely 93.53 ± 0.06% and treatment E (FRWM 40%) has a lowest stability value is 83.47 ± 0.06%. Treatment B has higher value closely to control among the other treatment that is added FRWM. Based on the data, addition of FRWM more than 10% tend to lower value of stability in water for 10 minutes. The stability value by soaking in water for 30 minutes showed the result are treatment A (control) has a highest stability value namely 88.80 ± 0.09% and treatment E (FRWM 40%) has a lowest stability value is 81.13 ± 0.77%. The pellet that is soaked for 30 minutes begin to show differences with the 10 minutes soaked pellet. This is indicate the decreasing of adhesive power. That treatment A (control) by soaking in water for 60 minutes has highest a value of stability namely 76.27 ± 0.08% and treatment E (FRWM 40%) has a lowest stability value is 69.63 ± 0.08%. The pellet that is soaked for 60 minutes seems to be differences with two other soaked pellet. The decreasing adhesive power shows poor than other.

4. DISCUSSION

Findings of this study showed that pellet formulated with FRWM exhibited physical quality decreased with the increase in inclusion level. The addition of FRWM concentration recommended to get the value that most closely breaking rate of control treatment is 10% (treatment B). The data shows that the higher concentration more than 10% of FRWM will increase the breaking rate in water. The FRWM can be added up to 30% to produce the value of sinking rate similar with control. However, the increasing more than 30% of the concentration of FRWM will decrease the quality of pellet, especially for sinking rate value. This is because the non-uniformity of component size in pellet. Components of the restaurant waste meal is dominated by vegetable waste which generally composed of fibers therefore while materials are refined, it produced non-uniform size, made it doesn’t compact. The feed compact texture will be more stand up to the effect of intense pressure during transport and storage, on the other hand the advantages of the feed material composition of uniform size will make it less likely to break easily feed in the water [12].

The outline of comparing between adding different concentrations FRWM to the durability has not much different in value, respectively has good durability. Optimal value of good durability to determine pellet quality must have an endurance value above 80% [13]. Whereas according to Brings et al. [14] is over 90% and the optimum pellet quality should have a resistance index 96%. It is concluded that the pellets produced are of good quality is proved that the durability test results on average above 96%. However, the value of durability tended to decrease with increasing concentration FRWM. The result of durability value in this study showed higher than study Haetami et al. [7] reported durability value of pellet fish supplementation with results pairing coconut oils and hazelnut oil showed only range from 89.00-90.67%.

<table>
<thead>
<tr>
<th>Material</th>
<th>0% (A)</th>
<th>10% (B)</th>
<th>20% (C)</th>
<th>30% (D)</th>
<th>40% (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal (%)</td>
<td>22.62</td>
<td>23.86</td>
<td>25.25</td>
<td>29.13</td>
<td>28.56</td>
</tr>
<tr>
<td>Soy meal (%)</td>
<td>22.62</td>
<td>19.09</td>
<td>15.15</td>
<td>11.65</td>
<td>5.71</td>
</tr>
<tr>
<td>FRWM (%)</td>
<td>0</td>
<td>4.77</td>
<td>10.10</td>
<td>17.48</td>
<td>22.85</td>
</tr>
<tr>
<td>Bran (%)</td>
<td>46.76</td>
<td>44.27</td>
<td>41.51</td>
<td>38.40</td>
<td>34.88</td>
</tr>
<tr>
<td>CMC (%)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Fish oil (%)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Premix (%)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 2. Physical quality of pellets

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Breaking rate (Hours)</th>
<th>Sinking rate (cm/s)</th>
<th>Durability (%)</th>
<th>Water stability of pellet in water (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 minutes</td>
</tr>
<tr>
<td>A (0% FRWM)</td>
<td>22.98 ± 0.36</td>
<td>0.06 ± 0.01a</td>
<td>97.23 ± 0.0002a</td>
<td>93.53 ± 0.06a</td>
</tr>
<tr>
<td>B (10% FRWM)</td>
<td>19.93 ± 0.34d</td>
<td>0.19 ± 0.28ab</td>
<td>97.16 ± 0.0015cd</td>
<td>91.67 ± 0.08d</td>
</tr>
<tr>
<td>C (20% FRWM)</td>
<td>18.42 ± 0.16c</td>
<td>0.28 ± 0.15ab</td>
<td>96.69 ± 0.0010bc</td>
<td>90.23 ± 0.08c</td>
</tr>
<tr>
<td>D (30% FRWM)</td>
<td>16.83 ± 0.63b</td>
<td>0.38 ± 0.42ab</td>
<td>96.82 ± 0.0019b</td>
<td>88.03 ± 0.08b</td>
</tr>
<tr>
<td>E (40% FRWM)</td>
<td>15.95 ± 0.53a</td>
<td>0.53 ± 0.43b</td>
<td>96.65 ± 0.0010a</td>
<td>83.47 ± 0.06a</td>
</tr>
</tbody>
</table>

*means with the same superscript are not significantly different (p>0.05)
In general, the results showed stability tends to decrease with increasing concentration FRWM and longer soaking time in water. Based on data (Table 2) the concentration of the addition of 10% FRWM has closely value of stability control treatment. The addition FRWM exceeds 10% will make the level of compactness decreased therefore that the value of the stability decreases. The advantage of refining the raw material can improve the stability of the feed in storage and ease of handling during the mixing process and printing [15]. The relative fine raw material more easily to form homogenous mixing. In addition, the stability of the feed was influenced by the hardness level of the feed. The hardness level is influenced by the moisture content and feed ingredients mixture used. Fine mixture of feed ingredients will lead to a high pellet hardness the related to compactness. This is because the bonds between the particles are influenced by stronger manufacture emphasis in order to obtain pellets with high hardness [16]. The compactness of pellets will stabilize in water. The result of stability in this study showed lower than study Eze et al. [6] reported a water stability as high as 83.32% in fish feed formulated with baobab leaf meal (16% BLM) after 50 minutes exposure to water.

5. CONCLUSION

The addition of different concentration of FRWM showed different pellet physical quality in terms of sinking rate, breaking rate, stability and durability. The higher the concentration of FRWM is added in the feed will further lower physical quality of the feed is shown by the results of the testing are likely to decline. FRWM can be added up to a concentration of 30% with a value equaling sinking rate control treatment and to obtain the value of the breaking rate and stability that comes closest to the control treatment with the addition of FRWM with a concentration of 10%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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