







|     |                                 |  |  |
|-----|---------------------------------|--|--|
|     |                                 | Inorganic wastes 1 sack.   | Inorganic waste is picked up by garbage officer.   |
| 13. | Eatboss                         | Organic and inorganic wastes is separated. Total of wastes about 2 bags with size of 40x70.              | Garbage is picked up by garbage officers (pay garbage fees)  |
| 14. | Warung Nasi Sambal Pedas Gurih  | 1 trashbag.<br>Organic and inorganic wastes is not separated.  | Garbage is picked up by the cleaners every day.  |
| 15. | Geprek Benu                     | Organic and inorganic wastes is separated. Organic and inorganic wastes are 1 big trashbag respectively. | Garbage is picked up by the cleaners every day.  |
| 16. | Hipotesa Dalam                  | 10-20kg of wastes/day.<br>Organic and inorganic wastes is not separated.                                 | Garbage burned behind the restaurant.  |
| 17. | Waroeng Steak                   | 4 trashbags.<br>Organic and inorganic wastes is not separated.   | Garbage is taken by officers periodically  |
| 18. | Pajawan                         | 1 big trashbag.<br>Organic and inorganic wastes is not separated.  | Picked up by the clerk (paid).   |
| 19. | Geprek rempah                   | 1-2 trashbags.<br>Organic and inorganic wastes is not separated.   | Disposed by garbage officers every 2 days (paid)   |
| 20. | Ndower                          | 3 trashbags.<br>Organic and inorganic wastes is not separated.   | Thrown into the garbage bin in front of the restaurant and taken by garbage officers. Cost 200k/month. |
| 21. | Ramen bajuri                    | 3 trashbags.<br>Organic and inorganic wastes is not separated.   | Taken by the cleaners. Cost 450k/month.  |
| 22. | Ibu eyang                       | 2-3 trashbags.<br>Organic and inorganic wastes is separated first, but ended in one big bags.            | It is taken per day by residents at a cost of 15k and burned near the Puri Indah housing complex.      |
| 23. | Checo                           | Total wastes:<br>8 trashbags. Organic and inorganic wastes is not separated.                             | Garbage is placed in the checo garbage storage area, then garbage officers will take it every 3 days.  |
| 24. | Warung Nasi Chafizh             | 2 medium plastic bags.<br>Organic and inorganic wastes is separated first, but ended in one big bags.    | Garbage is picked up by the cleaners every day.  |
| 25. | Nasi Padang Fajar Indah         | 3-4 trashbags/day, Organic and inorganic wastes is not separated.  | Garbage is collected behind the restaurant and picked up by officers from the sub-district.            |
| 26. | Warung Jembatan (Warjem)        | 2-3 trashbags/day, Organic and inorganic wastes is separated.  | Garbage is collected behind the restaurant and taken by the cleaners.                                  |
| 27. | Nasi Uduk Najwa (Sebrang Checo) | 1 big plastic bag/day. Organic and inorganic wastes is not separated.                                    | Garbage is collected and disposed of at the Cibeu-si market.   |
| 28. | Warung Gemas                    | 5 trashbags/day. Organic and inorganic wastes is not separated.  | Garbage is collected and burned independently  |
| 29. | SPG                             | 1 sack.<br>Organic and inorganic wastes is not separated.  | Garbage is picked up by the cleaners.  |

Based on Table 1, information was obtained about the amount of organic and inorganic waste in each restaurant, the different ways of handling the waste of each restaurant, the flow of waste traveling from outside the restaurant to the end of the waste journey at the final disposal site. The amount and volume of waste produced by each restaurant varies depending on the production capacity and the number of consumers. In general, Jatiningor sub-district produces about 5 tons of waste every day. Based on the results of a survey of restaurants in Jatiningor, the waste generated from restaurant activities is not separated between organic and inorganic waste, but is immediately thrown away which is then transported by the garbage officers. The survey results also show that

there are only 2 (two) restaurants that manage waste to be used as catfish pellets.

Evaluating the results of the waste generated by restaurants around Jatinangor, the organic waste collected every day from 22 restaurants around Jatinangor were weighed 105 kg. The large amount of waste produced is actually an opportunity and can be utilized for fish feed ingredients. Waste from every restaurant in Jatinangor is collected in one day, then the waste is processed to make feed. Waste treatment in its fresh state is avoided to prevent bacterial contamination [4].

Restaurant waste is consisted of by-products of food preparation process and leftovers. Restaurant waste is categorized as organic waste, consisted of unconsumed components such as vegetable, rice, meat and fish leftovers. Accumulation of restaurant waste can have a negative impact on the environment, so efforts need to be made to overcome these problems, one of which is utilizing waste as alternative fish feed ingredient. Utilization of these wastes in the field of fisheries can be one solution to reduce feed costs. Commercial feed is very easy to obtain and its nutritional content fit the needs of the fish, but commercial feed costs about 60-70% of the total production costs incurred. Alternative feeds can utilize unused waste such as restaurant waste, therefore cut the cost. The requirements for alternative feeds are that they are abundant, contain sufficient nutrients for fish growth and unconsumed by humans [1].

The utilization of restaurant waste has been widely studied. Several studies regarding the use of restaurant waste as fish feed ingredients has been carried out. Setiawan in 2006 has conducted a study on the use of restaurant waste as fish feed mixed with rice bran [5]. Fahmi [6] conducted a study on a mixture of market waste, palm oil cake and fish waste on the nutritional content of magot which was applied as a feed for carp. Hukamana et al. in 2015 has been conducted research on household organic waste used as material for making African catfish pellets [7]. Nasser et al. in 2018 had been used restaurant waste in tilapia feed [8]. Furthermore, ZeinEddine et al. [9] conducted a study on the use of restaurant waste as a feed ingredient for trout (*Oncorhynchus mykiss*).

## 2. Making Fish Feed from Organic Waste

The production of feed begins with conducting a preliminary test of the nutritional quality of restaurant waste. A total of 858 grams of waste is then processed into pellets for fish feed (Fig 2). Then the test was carried out to determine the protein content in the fish pellets. Based on laboratory results, it is known that the protein content contained in the pellet sample is 20%. The high protein content may be influenced by the dominant waste content containing protein sources, such as fish, meat, tofu and tempeh.



**Figure 2.** The process of making feed is carried out by grinding feed ingredients (a), mixing with tapioca (b) and molding into pellets (c)

The resulting fish feed products were then proximately analyzed (Table 2), and the results were compared with standard feeds in the form of commercial feeds on the market.

**Table 2.** Comparison of Nutritional Content of Independent Feed and Standard Feed

| No | Parameter     | Nutritional Content (%) |                |
|----|---------------|-------------------------|----------------|
|    |               | Test Feed               | Standard Feed* |
| 1  | Water Content | 48.83                   | 9.01           |
| 2  | Ash           | 42.39                   | 13.37          |
| 3  | Protein       | 5.13                    | 30.80          |
| 4  | Fat           | 3.17                    | 7.10           |

|   |              |      |      |
|---|--------------|------|------|
| 5 | Carbohydrate | 0.49 | 8.98 |
|---|--------------|------|------|

Information:

\* Cahya [11] Fermented Restaurant Waste Feed

According to Achadri et al. [10], restaurant waste have nutritional contents of 10.89% protein, 9.70% and 9.13% crude fiber. The low levels of protein and high crude fiber were the obstacles to directly utilize restaurant waste as fish feed ingredients. So the waste must be processed first in order to meet the requirements of fish feed ingredients, and undergo fermentation process. The fermentation of restaurant waste can change the chemical composition from a complex structure to a simpler one. This process occurs due to the activity of enzymes produced from secondary metabolites of microorganisms such as bacteria, molds and yeasts [12].

Fermentation is a biological treatment that can increase the nutritional value of low-quality materials. The fermentation method usually uses cellulosic microbes, these microbes can be isolated from natural sources or from commercial microbial products such as probiotics. Fermentation is able to increase or improve the nutritional value of local feed raw materials so that they can be used as fish feed raw materials [13]. Furthermore, the quality of restaurant waste organic matter can be improved through the fermentation process [2]. Based on the results of the study, there were differences between the nutritional content of the test feed and the fermented restaurant waste feed (Table 2). The difference in nutrient content is caused by a fermentation process. In the test feed, the protein content of 5.13% was much lower than that of restaurant waste that had undergone a fermentation process, which was 30.80%. The low protein content in the test feed does not fulfill the criteria of good quality feed, and make the test feed unfit for fish farm. According to Beruatjaan et al. [14], generally, fish needs protein ranged from 35-50%; with carnivorous fish needs protein of 40-50% and omnivorous fish 25-35%.

Protein is one of the nutrients needed by fish. Protein is the main component of tissue that also builds up nitrogen compounds, such as nucleic acids, enzymes, hormones and vitamins, so their existence are crucial for fish survival and growth. In addition, protein also plays an important role as enzymes and hormones that support metabolism. Insufficient feed protein will inhibit growth, while excess protein will result in protein catabolism into energy so that only a small amount of protein is used to build body tissues [15]. Therefore, fermented restaurant waste can be used as high quality fish feed ingredients.

Several studies on the use of fermented restaurant waste as fish feed ingredients have been carried out by several researchers. Based on the results of research conducted by Sandra (2019), regarding the addition of 30% fermented restaurant waste flour to tilapia (*Oreochromis niloticus*) feed, it resulted in a growth rate of 1.57%; feed conversion ratio of 0.53 and survival rate of 90% [15]. According to Admawati et al. [16], the addition as much as 60% of fermented household waste to fish feed resulted in survival rate of 76% with a specific growth rate of 4.23. According to Cahya [11], the addition of 20% fermented restaurant waste flour to catfish feed resulted in a feed conversion value of 1.95 with a daily growth rate of 1.63%. Furthermore, based on the results of Anasih [17], research that the addition of fermented restaurant waste flour as much as 40% in carp feed, resulted in a feed conversion value of 0.80 with a daily growth rate of 1.05% and survival ranging from 70-88%. Based on the results of several studies, it can be concluded that restaurant waste can be used as fish feed, but to produce optimal fish growth, a fermentation process need to be carried out to increase the nutritional value of the feed.

## Conclusion

Household wastes are the most produced waste in rural and urban areas. Waste from restaurants is produced from almost every restaurant located around the Jatinangor sub-district. This study is done to increase public awareness concerning the problems caused by accumulation and improper handling of restaurant wastes in Jatinangor district; and utilization of wastes to make fish feed. In conclusion, unwanted restaurant wastes can be processed through fermentation to increase its protein content, and utilized as fish feed with economical value. This pellets can be used so they can increase people's income in the Jatinangor sub-district.

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