A Pellet Forming Machine with Steel Wheel Pressing System Using Banana Sticks Raw Material

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Abstract

Gedebog banana or banana stem is a part of the banana tree that is considered waste and is often thrown away, but it can be optimized to become a feed raw material with economic value. One of the benefits of banana gedebog is that it can be used as a mixture of fish feed which is formed with feed raw materials into pellets. Based on laboratory analysis, the content of banana gedebog includes Dry Material (BK). 87.7%, ash 25.12%, crude fat (LK) 14.23%, crude fibre (SK) 29.40%, crude protein (PK) 3% including amino acids, amine nitrate, glycosides, contains N, glycolipids, B vitamins, nucleic acids, extract ingredients without nitrogen (BETN) 28.15% including carbohydrates, sugars and starch. This research aims to produce a pellet-forming machine for fish feed using a mixture of banana gedebog as the raw material. The research method involves building a machine according to the design and testing of the machine using a steel wheel mould pressing system. This research results in a pellet-forming machine unit that can produce pellets utilising a mixture of banana gedebog as raw materials. Average printing results per minute, 3 mm diameter pellets = 1137 grams, 4 mm diameter pellets = 1607 grams and 5 mm diameter pellets = 1553 grams with an average machine capacity that can produce pellets reaching 75 kg/hour to 90 kg/hour.

Keywords: Banana Tree Trunk, Gedebog Banana, Fish Feed, Pellet Forming

1.0 Introduction

In a freshwater fish cultivation business, feed is the biggest cost because it can reach 75% of the total costs required. One of the obstacles faced by cultivators in the field is that the price of feed is quite expensive, making it unaffordable for the community. The high price of feed results in a lack of public interest in developing their business because the profits obtained are less than optimal and can even result in losses [1].

Funding for feed prices tends to increase while the selling price of fish has not increased, and breeders currently still use concentrate as animal feed from factories so that the harvest results obtained are not commensurate with

production costs. Seeing the large need for manufactured fish food, the business of making fish food on a home scale is considered promising enough to become a god of help for fish farmers in various fish cultivation centres. Therefore, it is necessary to overcome this problem. One alternative is to make feed independently using materials available in the environment, such as banana tree trunks known as gedebog banana.

Banana gedebog is one part of the banana tree is lacking utilized and considered as waste. The existence of the banana gedebog is only considered as a waste that is often simply thrown away, not many know that the waste from this banana fruit can be optimized into a variety of materials that has a sale value and can be used as material fermented animal feed. The way of fermentation is by adding ingredients proteolytic, lignolytic, cellulosic, lipolytic, and non-symbiotic nitrogen fixation. Availability of raw materials (banana gedebog) is abundant in the country and the price of materials is very high and affordable. Processing of banana gedebog as mixed feed ingredients for fish farming is expected to be able to be a breakthrough for breeders to be able to minimize costs [2].

Banana gedebog is a Javanese term or name that is better known as banana stem, which has benefits as animal feed, especially fish. Banana stems contain 87.7% dry matter (DW), 25.12% ash, 14.23% crude fat (LK), 29.40% crude fibre (SK), 3% crude protein (PK) including amino acids, amine nitrate, glycosides, contains N, glycolipids, vitamin B, nucleic acids, organic matter extract without nitrogen (BETN) 28.15% including carbohydrates, sugars and starch [3].

Figure 1: Banana gedebog

If banana stems are fermented, the organic compounds they contain can be broken down into simple molecules, for example, carbohydrates which are broken down into glucose [4] so that they can be utilised by microorganisms in fish-rearing media. Fermenting banana stems can also grow natural food from the zooplankton group, namely Daphnia and Infusoria [4], [5]. It turns out that old banana stems can be used as fish food. The method is to chop the banana gedebog stems until they are fine, then put them in a plastic drum with a capacity of 100 litres and add 1 litre of a special prebiotic mixture on the market. Add 10 litres of clean water and cover the drum for 10-12 days.

Figure 2: Chopping banana gedebog

To produce perfect fermentation, every 3 days open the drum lid to release the gas formed due to fermentation. If the ingredients have been completely fermented, sprinkle 1-2 kg of chopped banana stems for a fish population of more than 1000 fish. The process of processing banana stems as fish food is done by first drying the banana tree trunks that have been cut down or the fruit is taken. After that, the banana stems are mashed to kill the bacteria on the banana stems using lime juice. To add aroma to fish food, crustacean or fish aroma is used. Then it is made into pellets or small granules. Artificial feed is made from a mixture of natural ingredients and/or processed ingredients which are then processed and made in a certain shape so that it has an attraction that can stimulate fish to eat it easily and with gusto.

Meanwhile, pellets are a form of artificial feed made from several types of ingredients which are mixed and made into a dough, then moulded so that they are small sticks or circles of a certain size. So, pellets are not in the form of flour, not in the form of granules, and not in the form of a solution. Pellets are known as a mass form of feed material that is compacted in such a way by mechanically pressing it through a mould hole [6], [7].

The characteristics of the pellets produced refer to fish feed standards according to the 2006 Indonesian National Standard (SNI), namely: containing protein (20-35%), fat (2-10%), ash (<12%), and water (<12%). Several forms of pellets can be produced by both feed factories and home-scale industries. The feed given is in the form of flour, which is usually used to feed fish seeds, pellets (dense dough formed into small cylinders), and crumbs (coarsely ground pellets) as feed during growing up. Pellet sizes also vary from 1, 2, 3, 4, and 5 mm.

Pellets are a form of feed material that is compacted in such a way as to concentrate or forage materials to reduce the water content of the feed. Absorption of processed feed decreases as density increases. Pellets that have a high density will increase feed consumption and reduce scattered feed, as well as prevent mixing, namely the decomposition of the components that

make up the pellets so that feed consumption is by standard requirements [8]. Pellet production consists of the processes of mixing raw materials, moulding, and drying. Pellets are moulded with a machine that works by simply pushing the mixed feed material in a steel tube using a screw towards a mould in the form of a circular plate with holes with a diameter of 2-3 mm so that the feed will come out of the mould. in pellet form. The weakness of this system (Fig.3) is that it requires additional water of 10-20% into the feed mixture, so it needs to be dried after the printing process.

Figure 3: Horizontal pellet machine

The addition of water is intended to make the mixture or feed mixture soft so that it can come out through the mould. If forced without adding water to the mixture, the engine will stall. In addition, the pellets that come out are usually less dense. Another tool is a machine that works by pressing or grinding feed raw materials using a steel wheel (roller) that presses the mould so that the density of the pellets that come out of the mould is very good as in the machine design in Figure 4 below.

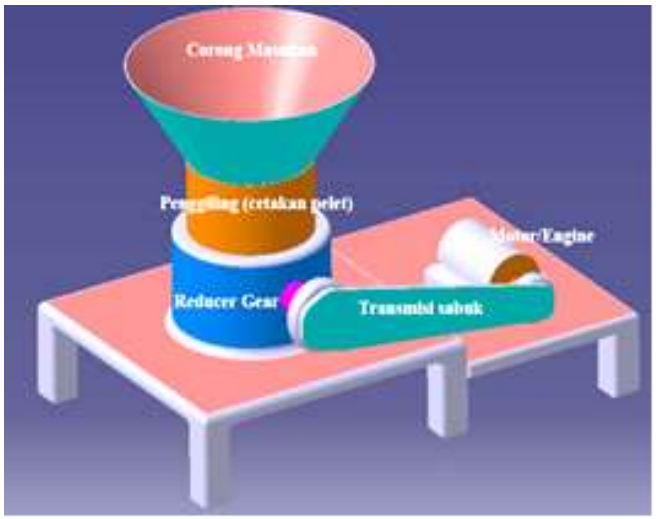

Figure 4: Design of a vertical pellet machine

2.0 Methodology

Research methodology includes the techniques and approaches used to fulfil the aims and objectives of the research. The use of a systematic research methodology ensures that the research is directed towards its intended objectives. This research began with a literature study and field study, the process of forming the pellets is carried out using a pellet moulding machine by pressing a steel wheel (roller) on the mould so that the pellets that come out of the mould have an even density. The way this machine works is that the motor drives the shaft which is coupled to a V-belt/pulley. The shaft rotates the steel wheel (roller) pressing the raw material in the cavity between the steel wheel and the mould (die) which has a certain hole. Due to the pressure from the steel wheel and being held by the mould, the raw material enters the mould holes, forming pellets with a size corresponding to the diameter of the mould hole. Fish food in pellet form is adjusted to the size of the fish, the bigger the fish, the bigger the size of the fish pellets. There are various sizes of fish pellets on the market, the sizes available are generally 1 mm to 5 mm. The banana stems used as pellets vary in size, namely 3 mm, 4 mm, and 5 mm. The stages of the research process are shown in Figure 5 below.

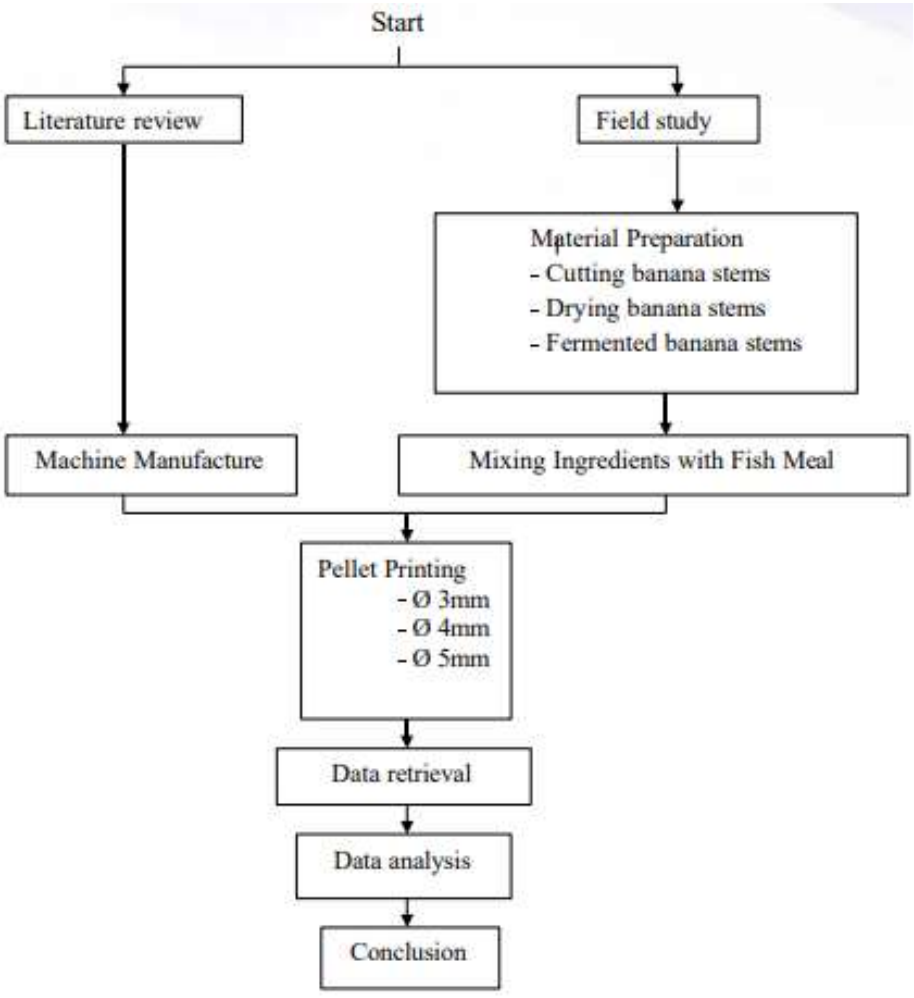

Figure 5: Research flowchart

3.0 Results and Discussion

The analysis produced two research findings regarding pellet-forming machines and pellet products using banana gedebog as the raw material. Pellet-forming machines with mould discs and steel wheels (Figure 6 and 7) operate mechanically with a capacity of up to 75 – 90 kg/hour of pellets.

Figure 6: Vertical pellet machines

Figure 7: Mould disc and steel wheel

Testing of the pellet moulding tool is carried out according to the stages specified above with a time of one minute for each experiment. The results of the experiment are shown in the following table.

Table 1: Pellet moulding test results

Mold diameter (mm)	Testing Phase (minute)	Result (gram)
Ø 3	1	1069
	2	1097
	3	1136
	4	1187
	5	1197
	Average	**1137**
Ø 4	1	1494
	2	1554
	3	1609
	4	1681
	5	1695
	Average	**1607**
Ø 5	1	1449
	2	1499
	3	1553
	4	1627
	5	1635
	Average	**1553**

From table 1 the average printing results per minute:
- Diameter 3 mm = 1137 grams
- Diameter 4 mm = 1607 grams
- Diameter 5 mm = 1553 grams

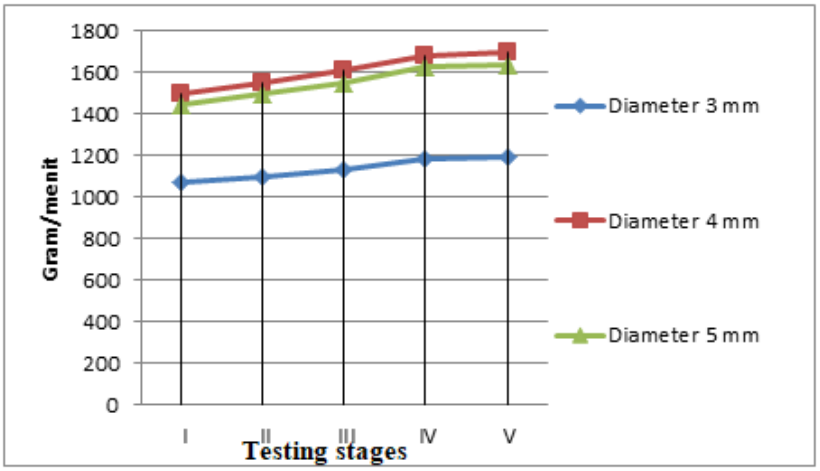

Figure 7: Pellet moulding comparison diagram

Figure 8: Sample pellet diameter 3 mm

Figure 9: Sample pellet diameter 4 mm

Figure 10: Sample pellet diameter 4 mm

4.0 Conclusion

Based on the results of the analysis and discussion above, this study can be concluded as the pellet moulding machine with steel wheel mold pressing system can work. The way this machine works is that the motor drives a shaft that is coupled to a V-belt/pulley. The shaft rotates the mold (die) which is pressed by a steel wheel (roller), by means of a funnel the raw material is inserted into the cavity between the steel wheel and the mold. As a result of the pressure from the steel wheel and being held by the mold, the raw material enters the mold holes, forming pellets with a size according to the diameter of the mold hole. Fish feed in the form of pellets is adjusted to the size of the fish, the bigger the fish the bigger the size of the fish pellets. Then, this pellet moulding machine can produce an average of 75 – 90 kg/hour of pellets. The pellets with gedebog banana raw materials can provide feed efficiency 25% - 45% against the manufacturer's feed. Lastly, there is a difference in results between one diameter and another, because the number of holes in each mold of each diameter and the size of the grooves on the steel wheel have not been considered. Because the amount of material entering the hole each turn will not be the same if the total surface area of the hole is not the same. Likewise, the width of the steel wheel rolling plane to the width of the mold hole will

affect the crushed material in the mold hole.

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Author Contributions

Abdul Rahman: Original idea of study and conceptualization, Methodology, Writing original draft preparation; **Aulia Salman**: Data curation, reviewing and editing; **Sarjianto**: Supervision, Fabrication Machine; **Heru Pranoto**: Software, Validation, Touch-up writing.

Conflicts of Interest

The manuscript has not been published elsewhere and is Not under consideration by other journals. All authors have approved the review, agree with its submission, and declare no conflict of interest in the manuscript.

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