The manufacture of automatic chicken feed making machines as an economical solution for chicken farmers in Indonesia

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The manufacture of automatic chicken feed making machines as an economical solution for chicken farmers in Indonesia

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Abstract. Currently laying hens have a good chance to be developed in Indonesia, this breeding business experiences rapid development every year. The chicken farming industry has very interesting potential to be developed but there are still challenges in its development. One of the biggest challenges faced by chicken farmers in Indonesia today is the high cost of feed that they have to spend around 70% - 80% of the annual production cost. On the other hand, the key to success in the chicken farming industry is strongly influenced by meeting the need for adequate feed, both in quality and in quantity, this is because the feeding that is in accordance with the nutritional needs of chickens affects the amount and quality of produced. Based on these problems, we assume that the independent supply of poultry feed by breeders by providing livestock feed making machines using equipment and components that are widely available on the market today is an economic solution that can reduce production costs in a chicken farming industry in Indonesia. The manufacture of automatic chicken feed making machines 2.02 kg / hr for laying hens using 1400 rpm electric motor and automatic control system is expected to be an economical and practical solution in improving the quality of production of the chicken farm industry in Indonesia.

1. Introduction

According to handbook series of agribusiness manuals prepared by the FAO Investment Centre Division (ICD), the world egg production increases has tripled since 1970 when global output was about 20 million tons to 60 million tons in 2007 [1]. This tren showes like in Indonesia too, currently. The poultry industry in Indonesia follows the development of the global poultry industry which is experiencing rapid development from year to year. This industry is the main sector in supporting national economic growth in Indonesia where 10% (around 12 million) of the national workforce are currently absorbed in the poultry industry sector. With an economic value of USD 35 billion (Rp. 494 trillion) making this industrial sector very potential and interesting to develop in Indonesia now [2].

At present, the poultry industry in Indonesia has major obstacles in the availability of raw materials for feed production, where the supply of feed raw materials, which are still largely imported, such as corn 40-50 percent, soybean meal 95 percent; fish meal 90-92 percent, bone meal and vitamin / feed additives almost 100 percent imported [3]. Based on this problem, several studies have been carried out to find alternative substitutes for corn and soybean meal as the main raw material for making feed. One alternative that has been carried out by several breeders in Indonesia is to utilize food waste in the form of dry rice, rice bran, CGM, cassava flour, rijek noodles, sorting bread, rijek rice as an energy source to replace corn. As for substituting soybean meal commonly used tempe tofu making industry waste in the form of soybean epidermis as a source of protein.

The use of alternative raw materials in making poultry feed requires a machine that can process these raw materials into ready-to-use feed by poultry farmers to be very important. At present the widely available feed making machines on the market are feed pellet making machines with a price range of Rp. 1.7 million - 15 million per unit. This price does not include shredder (Hammer Mild)

and mixing machine (Mixer) raw materials, which costs Rp. 10 million - Rp. 50 million per unit. This condition is certainly very burdensome for farmers in meeting their livestock feed needs.

To overcome these obstacles at this time, the design of poultry feed manufacturing has been carried out by several researchers, such as research on the design of a mixer and pellet maker using a PLC control system [4], then the corn sheller machine which is used as poultry feed [5], Furthermore, the feed making machine is carried out by PT. Popular Farm located in the city of Semarang, Indonesia. This feed making machine made by PT Poluper Farm uses grinder and vertical mixing methods to produce feed for the company's poultry feed needs.

Of the three feed making machines that have been made today, some of the fundamental problems faced by chicken farmers in Indonesia have not been resolved directly and clearly. Such as the use of raw material for feed substitutes for corn and soybeans as the main source of energy and protein for poultry, the integrated feed making machine has not been integrated in a whole machine series consisting of grinder-mixer-feed pellet makers and the unavailability of machines that use automatic control systems in one the working circuit of the machine.

Based on the conditions above, it is currently very necessary for a practical feed making machine and velcsibel in the use of alternative raw materials to substitute corn and soybeans in the manufacture of feed, a feed making machine that has a whole working circuit system in the process of making poultry feed consisting of a grinder process - mixing and printing pellets. The choice of pellets as a form of feed is because the pellets have more durable properties in terms of storage and practicality in their use. In addition, to improve the efficiency of the feed making machine, we need a machine that can operate automatically in each work series.

Therefore, we are trying to design a practical machine for making semi-automatic and flexible poultry feeds so that they can utilize alternative raw materials for poultry feed manufacturing. In addition, this machine will work in a whole work series of the process of making feed consisting of a grinder - mixer - pellet printer. The existence of this machine is expected to reduce the dependence on imported raw materials for making feed and increase the production of the poultry industry in Indonesia now.

2. Methodology

The design and assembly of the equipment was carried out at the ATI Makassar Polytechnic workshop. The design of the tool is done by using the AutoDesk Inventor 2017 software, using the Parametic Solid Modeling function in which this application can design and edit in the form of a solid model with data that has been stored in a data base so as to facilitate the design editing process. Furthermore, the Adaptive function of this software has the ability to analyze the friction of an animation of a tool and can adjust itself [6].

To test the success in the design of this poultry feed making machine, several mechanical testing parameters and tool function testing were established. In the mechanical testing parameters, testing is carried out on each feed manufacturing process consisting of mechanical testing of the working system of the grinding machine, mechanical testing of the working system of the mixing machine and mechanical testing of the working system of the printing machine. And constant loading at various turns, then from this process, the function test is carried out in parallel by measuring the results of grinding, mixing and printing results in the form of pellets produced, both in quality and quantity.

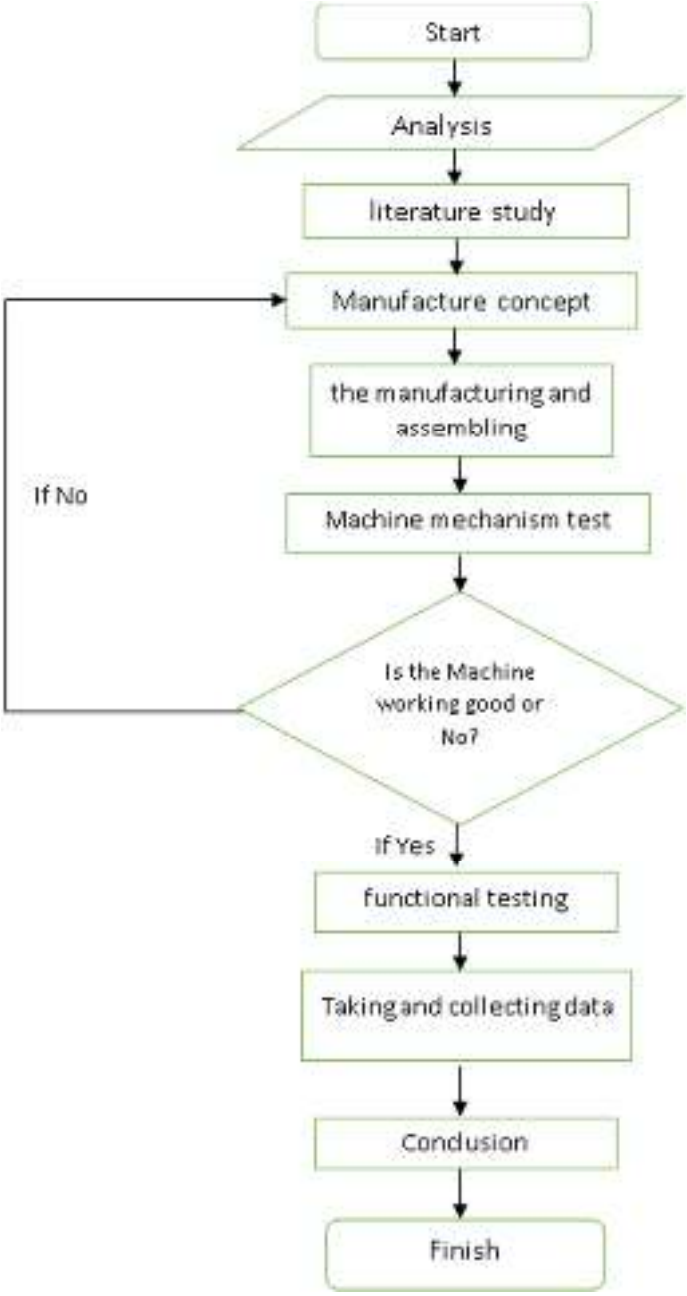

Figure 1. Flow chart research

In the main drive system of the engine using the main driving motor used is an AC electric motor with power (P_m) = 1 HP = 745.7 Watt, voltage (V_m) = 220 volts and rotation (n_m) = 1400 rpm. The results of this round are transmitted with pulleys using V-belts with motor pulley size (D_m) = 80 mm, diameter of the pulley grinder 1 (D_{p1})= 180 mm and grinder 2 (D_{p2}) = 80 mm, pulley mixer diameter (D_{mix}) = 155 mm and the diameter of the round reduser (D_r) =75 mm. To calculate the balance in each series, the equation is used:

$$n_2 = \frac{n_{1\,x}\, d_1}{d_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where: n_1 = pulley rotation speed of drive (rpm)
D_1 = diameter of drive pulley (mm)
n_2 = pulley rotational speed moved (rpm)
D_2 = diameter of pulley actuated (mm)

To calculate the length of the belt (L) be used the equation:

$$L = 2C + \frac{\pi}{2}\left(D_p + d_p\right) + \frac{1}{4C}(D_p - d_p)^2 \ldots\ldots\ldots\ldots\ldots\ldots 2$$

where: L = belt length (mm)
C = the distance of the pulley center point to the driven pulley (mm)
D_p = diameter of drive pulley (mm)
d_p = diameter of pulley actuated (mm)

Next to calculate the torque (T) and angular velocity (ω_p) drive for each work circuit using the equation:

$$T = \frac{P}{\omega_p} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

$$\omega_p = \frac{2\pi \cdot n_p}{60} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

where: T = torque (Nm)
P = Power shaft (Watt)
ω_p = angular shaft velocity (rad/s)

As for the safety factor was used 1.25-1.5 for load-controlled conditions and the working voltage can be determined in advance.

The loading on the function test is carried out with three different loading, each of which consists of 1 kg, 2 kg, and 3 kg of feed material at a constant rotation of 1400 rpm which will be processed into poultry feed. The raw material for making feed with the composition of each used consists of 50% dry rice as a source of carbohydrates, 20% rice bran, fish meal and starch 20% and 10% respectively. Furthermore, water is added as much as 0.5 liters of solvent.

3. Result and Discussion

From the results of the design carried out using Autodesk Inventor 2017 software, a design of the device was obtained, the researcher took a benchmark from the scale of planning that has been made either 2 dimensions or 3 dimensions. Below this is a 3-dimensional planning drawing created by the researcher.

The image description:

1. Chassis as a holder for all engine parts
2. Crusher Chamber as a home of a hammer mill
3. Cover as a crusher and hammer mill cover
4. Exit funnel as a conduit or a place for the release of expert materials that have been milled in cattle

5. Entrance funnel as a place to enter new poultry feed ingredients will be ground.
6. Knife crusher as a beater for poultry feed which is put into the crusher room
7. Crusher as a place to install the blade holder shaft, and also counter balance hammer mill
8. Blade spacers as a knife edge so that they do not come into contact with each other.
9. Knife holder shaft as a blade that will hit poultry feed ingredients
10. Material funnel as a place to collect feed ingredients
11. Mixer blades as a mixer for poultry feed dough consisting of 3 blades with a length of 180 mm wide by 20 mm in the shape of an anchor
12. Mixer container as a place for mixing poultry feed dough
13. Pellet maker as a dough maker which is driven by a screw conveyor with a hole size of 5 mm each
14. Speed modifier with a ratio of 1:30 from the motor speed
15. Electric motor; As the driving force of the poultry feed making machine.

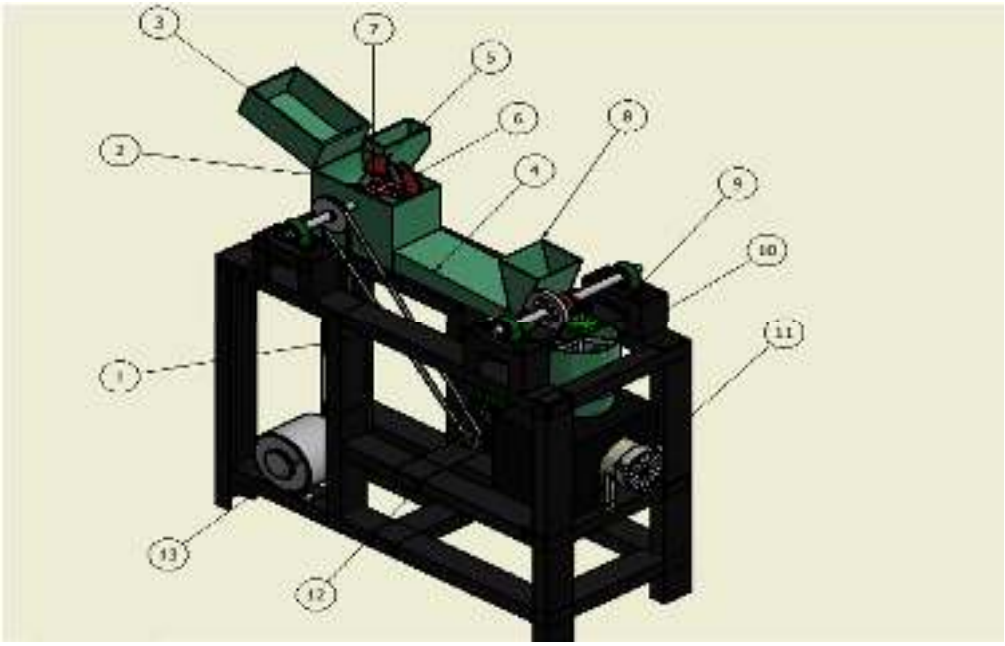

Figure 2. The results of the design of the feed making machine in 3 dimensions

The results of testing in the machine testing process are carried out in 3 times they are:

1. The first experiment was tested by entering 1 kg of poultry feed ingredients consisting of 500 grams of corn, 200 grams of fish meal, 200 grams of bran and 100 grams of starch with a constant rotation speed.
2. The second experiment was tested by entering 2 kg of poultry feed ingredients consisting of 1 kg of corn, 400 grams of fish meal, and 400 grams of bran and 200 grams of starch with a constant rotation speed.
3. The third experiment was tested by inserting 3 kg of poultry feed ingredients consisting of 1.5 kg of corn, 600 grams of fish meal, 600 grams of bran and 300 grams of starch with a constant rotation speed.

Figure 3. material funnel as a place to collect feed ingredients before mixing well

Figure 4. Mixing process

Figure 5. pellet making process as chicken feed

Table 1 Comparison of feed ingredient composition in three experiments

No.	Raw material	Persentasi (%)	Mass of raw materials (kg)		
			1	2	3
1	Dry rice	50	0.5	1	1.5
2	rice bran	20	0.2	0.4	0.6
3	fish meal	20	0.2	0.4	0.6
4	starch	10	0.1	0.2	0.3

From tests conducted using the comparison of ingredients above, the following results are obtained (see table 2)

Tabel 2. Test results

No.	Mass of raw materials (kg)	Time (menit)	Rotation (rpm)	Production capasity (kg/jam)
1	1	29.003	1400	2.06
2	2	59.316	1400	2.02
3	3	88.100	1400	2.04

4. Conclusion

From the results of the design this feed making machine concluded, Making feed using alternative raw materials is very possible using this machine, so that the content and composition of nutrients needed by chickens can be adjusted to the needs of farmers. Poultry feed ingredients that use alternative raw

materials in the form of dry rice, rice bran can produce poultry feed in the form of pellets with an average production capacity of 2.04 kg / hour.

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