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# Mechanisation for preparing animal feed pellets

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**Abstract**
Mechanization in agriculture plays a significant economic role in increasing the value of agriculture produce. Postharvest processing of agricultural materials is highly essential for its storability and consumption by humans. Machines need to be designed and fabricated to achieve this purpose. The level of agricultural products goes on increasing with mechanization of different post-harvest operations, which aims at achieving timeliness of operations, efficient use of inputs, improvement in quality of produce, safety, comfort and reduction in drudgery of labours. Enhancing the productivity can be increased by reducing losses in pre and post harvest systems by adopting modernization/mechanization and also by increasing the productivity of small and marginal farmers through mechanization and efficient use of agricultural inputs.
Animal Feed Mill (AFM) was developed to process 100 kg of byproduct per day. The commercialized technology, PKV mini dal mill gives the recovery of nearly 72 to 75% and 25 to 28% byproduct (brokens+husk+powder). Amongs the byproduct, the brokens are used for human consumption where as remaining 15-16% is husk and powder. This remaining 15-16% byproduct (husk + powder) contains nearly 18-22% of proteins and hence can be used for preparing Animal feed pellets.
Animal Feed Mill is developed having capacity of 100 kg per day operating at a speed of 28 rpm. The machine consist of hopper, mixing chamber, compaction chamber, die/outlet, power transmission system and frame. Optimum proportion of ingredients for making pellet are byproduct 1kg, 500 ml of water (50% of byproduct) and 50 g of jaggery as binder (5% of byproduct) and 20 g of salt (5% of byproduct)). The unit cost of processing animal feed pellet is @ Rs 12/kg.

**Keywords:** Animal feed mill, animal feed pellets, dal mill byproduct, pulses, proteins

## Introduction
Animals are given a wide range of different feed, but the two major types of animal feed are processed animal feed (compound feed) and fodder. Livestock feed are generally classified according to the amount of specific nutrient that furnish in the ration. They are divided into two general classes-roughages and concentrates. Roughages are bulky feed containing relatively large amount of less digestible material i.e. crude fibre more than 18 per cent. Concentrates are feeds which contain relatively smaller amount of fibre and have a comparatively high digestibility and as a result higher nutritive value per unit weight than the roughages (Banerje,1978). Concentrates is usually described as a feed or feed mixture which supplies primary nutrients (protein, carbohydrates and fat), contains less than 18 per cent crude fibre and usually low in moisture (Reddy,2001). In general concentrates are rich in either energy or protein and thus are expensive. Energy rich concentrates consists of gram which is a leguminous grain and is fed in India to almost all classes of farm stock. Most of the research works which covered the wide range of qualitative and quantitative nutritional requirements of animals were, however, undertaken during the first half of the 20$^{th}$ century. Since then, the nutritional science has been moving forward at an ever increasing pace (Reddy,2001).
Usually roughage and concentrate ratio is being maintained as 60:40.For high yielding cows 50:50 roughage: concentrate is usually adequate. Complete feeds are processed in following ways:

- Chaffed mix: finely chopped roughages are mixed with ground concentrate ingredients.
- Silage mix: fine chopped silage is evenly mixed with concentrate mixture at the time of feeding.
- Mash mix: roughages are ground, evenly mixed with concentrate ingredients and converted to pellets using pellet mill.
- Blocks: mixture of roughages (chopped) and concentrate ingredients are pressed in a block of desired shape and weight. (NDRI,2010) [1]

For milking cows, yielding milk upto 5 kg (2kg/day concentrate is feed), for 6-10 kg (4 kg/day of concentrate is feed) for 11-12 kg (8 kgs/day of concentrate feed), for 21-30 kgs, (10 kgs of concentrate feed) and for 31-40 kg, (12 kgs concentrate is feed). (NDRI, 2010) [1]

Pigeon pea (*Cajanus cajan*) is a locally available, affordable and under-utilized grain legume of the tropics and sub-tropics. In Asia, pigeonpea is grown in an area of 4.3 m ha and production of 3.3 m tons (Figure 1). India has the largest area (3.6 m ha) under pigeonpea, followed by Myanmar (560,000 ha), Kenya (196,000 ha), China (150,000 ha), Malawi (123,000 ha), Uganda (86,000 ha), Mozambique (84,000 ha), Tanzania (68,000 ha) and Nepal (21,000 ha). Maturity duration (at $17^0$N latitude) varies from about 90 days for extra-early varieties to more than 260 days for long-duration varieties. In Asia, between 1976 and 2006 [2], pigeonpea recorded 56% increase in area (2.76 to 4.32 m ha) 54% increase in production (2.14 to 3.29 m t). (Rao,2010) [7]

Pigeon pea varieties has protein content in the range of 23 - 26%. PKV mini dal mill gives the recovery of nearly 72 to 75%, hence the remaining is 25 to 28% is byproduct (brokens +powder + husk). This byproduct contains nearly 18-20% of proteins and hence can be used for preparing animal feed. It was bit difficult to handle, store and transport husk due to its fluffy nature, besides being underutilized and low value. It was thought to develop animal feed mill, which will convert the husk + powder into pellets form. This pellets can fulfill the nutritional requirement of animals. By pelleting the byproduct the volume can be reduced and is easier for handling and storage of original materials.

The present study was undertaken with the following objectives:

1. To develop a small capacity animal feed mill for compacting dal mill byproduct into animal feed pellets.
2. Testing of the mill for preparing pellets.

**Fabrication material used for Animal Feed Mill**

A small capacity (100kg/day) mill is developed which can utilize the dal mill by-product and prepare animal feed pellets. Material used for fabrication of animal feed mill along with the specification and required quantity is given below in the table 1. The machine consist (Fig. 1) of hopper, mixing chamber, compaction chamber, die/outlet, power transmission system and frame.

**Raw Material and Process for making pellets**

**a. Raw Material for pellets**

The developed system was used to prepare Animal Feed Pellets using byproduct (powder + husk) obtained from PKV mini dal mill. The recovery of PKV mini dal mill is nearly 72 to 75% and the byproduct obtained is about 25 to 28%. Amongs the byproduct, the brokens are used for human consumption where as remaining 15-16% is husk and powder. Considering the difficulty in handling, storage and transport of this byproduct, besides low value, it was though to prepare Animal feed pellets by developing animal feed mill. This byproduct (husk + powder) contains nearly 18-22% of proteins and hence can be used for preparing nutritionally rich Animal feed pellets.

**b. Preparation of animal feed pellets**

The byproduct obtained from PKV mini dal mill is gound for a particle size of 0.424 mm and taken in a container (Reddy,2001). The separate mixture of jaggary (5% of raw material), salt (2% of raw material) and water (50% of raw material) is prepared, this solvent is then added to the raw material for making a uniform pellet mixture (Thomas 1996). Jaggery was added as a binder material as well as to impart good taste to feed. This was the minimum possible amount of jaggery, salt and water to form pellets after various trials. The pellet mixture is then conditioned for 2 hrs.

- The pellet mixture was fed to the animal feed mill at the feed rate of 200 gm/min from feeding hopper.
- The mixture then moved through the mixing chamber with the help of flight conveyer. This chamber ensures the uniform mixing of pellet mixture.
- After uniform mixing the pellet mixture is moved to compaction chamber (continuous screw) where the required pressure is developed for making pellets.
- The pellet mixture is then forced/ pressed out at the outlet/die/flange having dia. of 1cm.
- These pellets are then sun dried for 2 days to reach the moisture content of 8.23% (wb).

As shown in Table 2, the dried animal feed pellets was having 8.23% (wb) moisture content, 646 kg/m$^3$ bulk density, 25% porosity and 0.148 water activity. Besides it was having 20.46% protein which was equivalent to Godrej pellets (commercially available)

The cost of the Animal feed mill was worked out to about Rs 30,000/-. As per cost economics, the cost of pellets is worked out to be Rs 12 per kg.

**Table 1:** Some properties of animal feed pellets

| | |
|---|---|
| Moisture content of raw material (husk+powder) | 10.58% (wb) |
| Moisture content of mixture | 49.94% (wb) |
| Moisture content of pellets | 8.23% (wb) |
| Particle size of raw material (husk+powder) | 0.424 mm |
| Bulk Density of raw material | 571 kg/m3 |
| Bulk Density of pellets | 646 kg/m3 |
| True Density of pellets | 858 kg/m3 |
| Porosity of pellets | 25% |
| Water activity of Animal Feed pellets (aw) | 0.148 |
| Water activity of commercial pellets (Godrej Super pellets) (aw) | 0.384 |
| Protein content of raw material | 21.90% |
| Protein content of pellets | 20.46% |
| Protein content of commercial pellets (Godrej Super pellets) | 21.43% |

**Fig 1:** Animal Feed Mill

## Conclusion

1. Animal Feed Mill is developed having capacity of 100 kg per day (10 h) operating on 1 HP 3 phase motor.
2. Optimum proportion of ingredients for making pellets are 500 ml of water (50% of byproduct) and 50 g of jaggery as binder (5% of byproduct) and 20 g of salt (5% of byproduct) for 1 kg byproduct.

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