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Design and Evaluation of Livestock Feed Chopper Machine

Angela Wetron Pai[1,*], Kasmawati Senawing[1], and Fethma M Nor[2]

[1] Jabatan Kejuruteraan Mekanikal, Politeknik Kota Kinabalu, 88460 Kota Kinabalu, Sabah, Malaysia

[2] School of Design, Universiti Teknologi Brunei, Gadong BE1410, Brunei Darussalam

* Correspondence: angela@polikk.edu.my

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Abstract: Nowadays in Malaysia, the livestock industry has become the increasing demand over the past few years. Like agriculture, livestock is also a growing business that can help local farmers to generate their income. Thus, an economic and practical chopper machine for livestock feed is necessary to fulfil this demand. The machine is driven by an AC powered motor (1400 rpm, 1 Hp). It is divided into five major components, which are the fodder inlet, fodder outlet, power unit, cutting unit and frame stand. For safety reason, a cover made by clear acrylic Perspex were built in front of the blade to prevent any injuries. The machine structure is reasonable and practical as it is supported by four lockable wheels and handle for easy movement. Time taken to finish the chopping process will be analyzed for both methods. Three different weights of fodder will be used. For 500g, 1000g and 1500g of weight, average production time taken by machine is 15s, 33s and 42s respectively. While conventional method is 240s, 400s and 640s respectively. The percentage decrease of production time was calculated to evaluate the performance. Based on the result obtained, it shows that by using the chopper machine, it can help to reduce the production time to produce the chopped fodder compared to the conventional method. For weight 500g, it reduces the production time to 93.75%, for weight 1000g to 91.75% and lastly for weight 1500g to 93.44%. Hence, the chopper machine is practical, flexible and cost effective to use for chopping fodder.

Keywords: livestock industry, chopper machine, cost effective, machine adaptability

1. Introduction

Nowadays, livestock has become an important industry that supplies the largest source of protein for Malaysian population. It was reported that Malaysia currently produced 52,000 tonnes of beef worth RM169 million and import beef worth RM1.14 billion annually to meet local demand of about 191,000 tonnes [1]. The consumption growth of meat demand is due to the migration of rural population to urban areas. Urbanization is associated with increase in wealth and higher purchasing power which leads to greater demand for processed food, meat, dairy, and fish [2]. Also, according to Academy of Science Malaysia, it is expected that the population of Malaysia is growing to 35 million by 2020 [3]. However, the domestic production of meat has not kept pace with the increasing demand due to several constraints. Usually, smallholders still use the conventional method to prepare the livestock feed. This method apparently is quite time consuming, drudgery, ineffective and hazardous [4]. In addition, the proper chopping of fodder can affect the quality of meat production. Usually, the fodder given to livestock is in unchopped or irregular chopped form [5] which leads to feed wastage [6]. Therefore, in order to overcome the problems stated, a modified chopper machine was developed by considering several criteria such as simplicity, material

availability and machine adaptability. Thus, this machine is aimed to give benefits to the agricultural industry, local farmers as well as to help increase the government economy.

2. Materials and Methods

The purpose of this project is to design, fabricate and to test the functionality of the livestock feed chopper machine. In the methodology section, it started with the conceptual design. It came up with three different designs. Every design has their own concept, strength and weaknesses. The best design will be selected by using the design matrix selection. In this method, all the design will be rated according to several criteria that fulfil the best requirements for the machine.

There are five criteria chosen in this matrix which are material cost, design, dimension, durability and ease of fabrication. The drawing of the final design will be drawn by using the Autodesk Inventor software. It is shown in Figure 1. Basically, this machine has five major components. There is fodder inlet, cutting unit, power unit, fodder outlet and frame stand with four wheels for easy movement. The dimension for length, width and height were 25, 17 and 31 inches respectively.

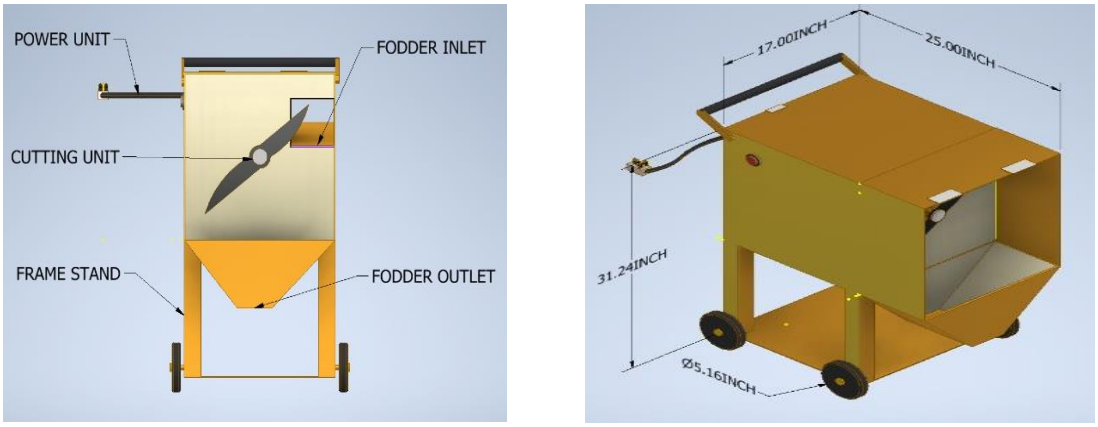

Figure 1. Design drawing of livestock chopper machine

After the material has been selected, the process of fabrication will be implemented. It includes process such as cutting, drilling, welding and painting. After the prototype has finished, the functionality of the machine will be tested. Data will be collected and analysis accordingly. Next the result and discussion will be made to obtain the conclusion for the entire project.

3. Results and Discussion

Based on Table 1, the total rate point obtained from the design matrix selection it shows that design 1 has 14-point, design 2 has 18 point and design 3 has 23 points**.**

Table 1. Result for the design matrix selection

Scale	**1**	**2**	**3**	**4**	**5**
Rate	**Poor**	**Moderate**	**Satisfactory**	**Good**	**Excellent**
	Criteria		**Design 1**	**Design 2**	**Design 3**
	Material Cost		3	4	5
	Design		2	4	4
	Dimension		4	3	4
	Durability		3	3	5
	Ease of fabrication		2	4	5
	Total		**14**	**18**	**23**

Therefore, Design 3 which has the highest total point was selected to be fabricated into the machine. The performance of the machine was evaluated based on the production time taken to produce the chopped material. All the data were analyzed and transform into a graph. Figures 1 and 2 show the production time by using the chopper machine and conventional method for three different weights of 500g, 1000g and 1500g.

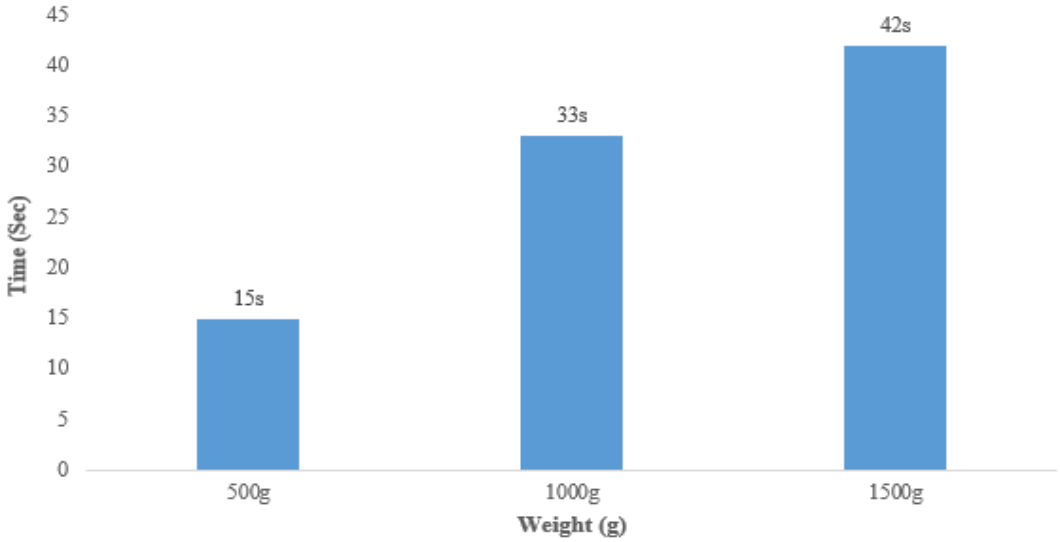

Figure 2. Average production time by using chopper machine

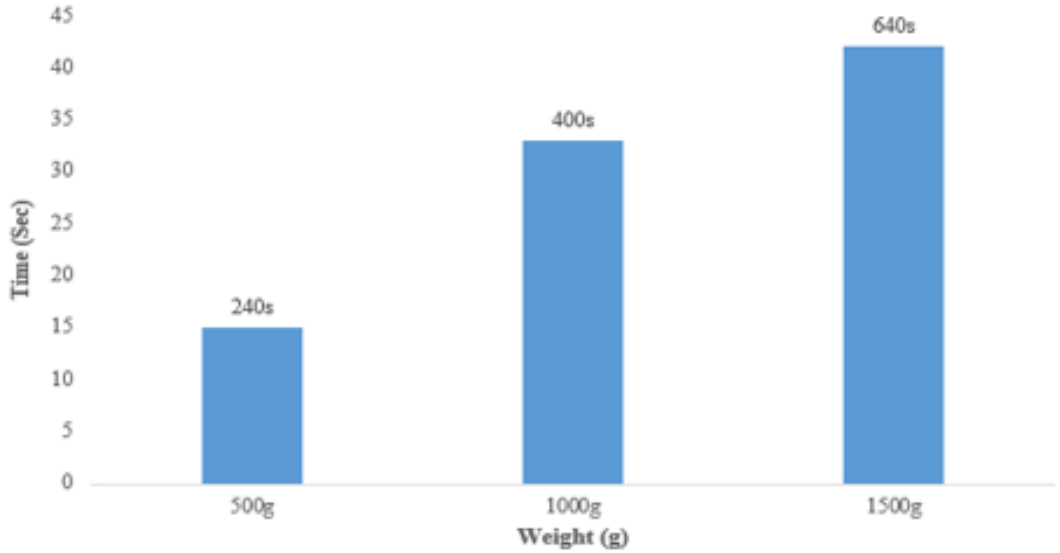

Figure 3. Average production time by using conventional method

There was big difference whereby the conventional method takes a longer time to produce the chopped material compare to the chopper machine. Table 2 shows the cost of the machine and estimated selling price for the product. In terms of the percentage decrease of production time taken between the chopper machine and conventional method, for weight 500g, the chopper machine helps to reduce the time to 94%, for weight 1000g to 92% and lastly weight 1500g to 93% of production time, as also mentioned by other [6].

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Table 2. Material cost of the chopper machine

Material	Quantity	Price (RM)
Motor	1	290
Mild Steel	4	298
Acrylic Perspex	2	38
Heavy Duty Wheel	4	30
Stainless Steel	4	130
Bolt & Nut	8	20
Spray	2	15
Total	23	RM821
Selling price (Assume 20% of cost of production) = RM985.20		

4. Conclusions

The performance of the chopper machine was evaluated particularly on time taken to produce the chopped forage. Overall, it shows that by using the chopper machine it can help to reduce more than 90% of production time compared to conventional method at three different weights of forage. Other than that, this machine is practical, simple, flexible and cost effective. Hence, it is helpful especially for the smallholder to produce the livestock feed.

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