Jurnal Agricultural Biosystem Engineering
https://jurnal.fp.unila.ac.id/index.php/ABE/index
ISSN 2830-4403
Received: August 21, 2023
Accepted: September 2, 2023
Vol. 2, No. 3, September 29, 2023: 438-449
DOI: http://dx.doi.org/10.23960/jabe.v2i3.8059

Performance Test of Hotong Seed Billing Machine (*Setaria italica* (L.) P. Beauv) Abrasive Roll Type with Grinding Stone

Agus Sutejo[1]*, Kemas Asror Abdillah[1], Lilis Sucahyo[1], Dionisius Dwi Wicaksono[1], Gatot Pramuhadi[1]

[1]Departement of Mechanical Engineering and Biosystem, IPB University

**Corresponding Author*: agussutejotmb@gmail.com

Abstract. *Indonesia has a lot of diversity, one of which is in food. Carbohydrates are basic food needs that must be met, in Indonesia there is the potential for various alternative foods. One of the alternative food ingredients producing carbohydrates is hotong. Hotong is a plant that is often found in Indonesia but has post-harvest constraints, namely in the sowing process. Therefore, research was conducted to determine the performance of an abrasive roll type grinding machine with the characteristics of hotong seeds. The research was conducted at PT. Daud Teknik Maju Pratama in November 2022. The treatment of hotong seeds that are sprayed as many as three passes with various levels of rpm speed, namely 806, 940, and 1128 rpm and carried out three repetitions at each rpm. The performance test results of the crushing machine showed the highest scattered capacity and shrinkage at a rotating speed of 1128 rpm, the highest yield and effectiveness of skin separation at a speed of 806 rpm, while at the highest polishing quality at a speed of 940 rpm. Rotating speed affects the sowing results, the faster the engine rotation speed, the quality and capacity of the sowing will increase. In addition, the tilt angle of the machine also affects the result of the sowing capacity. The terminal velocity value is influenced by the weight of the hotong seeds, the higher the weight on the sample, the higher the terminal velocity value obtained.*

Keywords: *Abrasive Roll, Hotong, Polisher.*

1. Introduction

Indonesia is a place that has a lot of diversity, there are a variety of healthy foods. Food itself is very important for the life of living things. One source of local food diversity is the hotong plant or more commonly known as "foxtail millet" (*Setaria italica* (L.) P. Beauv) which is one of the superior food sources and is widely consumed because it contains carbohydrates (Tuasamu, 2009).

Hotong itself is a plant similar to sorghum originating from Buru Island in Maluku (Herodian *et al*., 2009).

The hotong plant is a plant that grows annually, the panicles on the hotong plant can grow to an average length of 15.2 cm with a diameter of 1.2 cm and reach an average weight of 5.7 grams per panicle (Kharisun, 2003). Hotong plants can be harvested within 75-90 days after planting. Handling in the cultivation of hotong plants is very easy and simple, the principle used is not to require a lot of water so drainage channels are absolutely necessary for setting the level of immersion and also using soil with highly clay soil types. After the planting period is harvesting and followed by post-harvest handling, in post-harvest handling there are several stages, namely; harvesting, threshing, cleaning, drying, polishing, and flouring (Darajat, 2008).

There are quite a lot and very diverse potential alternative food ingredients in Indonesia. Efforts to diversify food for public consumption in Indonesia continue to be carried out so as not to depend on the staple ingredient rice. Hotong is one of the alternative carbohydrate-producing foodstuffs, because judging from its high nutritional content, hotong is used as a substitute for rice (Tuasamu, 2009). Hotong plant seeds have a much higher protein and fat content than rice, while for a comparison of the amount of carbohydrate content, hotong is almost the same as rice. Therefore, hotong can be used as a staple food source of fat, carbohydrates, and protein.

Post-harvest process, there are stages before hotong can be used for public consumption, one of the important processes in post-harvest is the polishing process. The polishing process itself is a process that aims to remove the outer skin (pericarp) on the hotong seeds with as little damage as possible to the hotong seed grains (endosperm) (Kharisun, 2003). This polishing process can be produced in the form of milled hotong rice. This polishing can be done using 2 ways, namely; using manual methods and using machines (Maris, 2008). The manual polishing method utilizes human power, which can be done by slamming or hitting, peeling, or using a pestle or mortar (hand mill). The second way is to use the help of machines, with the use of machines you can get good results with high efficiency because it doesn't require a lot of time and also the energy used (Darajat, 2008). The purpose of this study was to analyze the suitability of the polishing machine design with the physical characteristics of the hotong seeds and test the performance of the abrasive polishing machine.

2. Materials and Methods

This research conducted at PT. Daud Teknik Maju Pratama located in Dramaga District, Bogor Regency, West Java, from November 2022 to February 2023. The main ingredient used in this research is the hotong plant or more commonly known as "foxtail millet" (*Setaria italica* (L.) P. Beauv) originating from Sulawesi. The tools used in this study were hotong seed peeling machine, 1 HP 1410 rpm AC motor, digital scales, pulleys (sizes 5, 6 and 7 inches), tools, tachometers to test rpm speed, containers, laptops and sieves (with a mess size of 20).

2.1. Performance Test Procedures

This performance test aims to determine the technical characteristics of the hotong polishing machine which includes production capacity, polishing effectiveness (yield), polishing quality, scattered shrinkage and peel separation effectiveness. Measurements were made using hotong seeds with a moisture content of 12.5%. In the performance test stage, the hotong seeds were milled three times with various rpm speed levels, namely 805, 940 and 1128 rpm with three repetitions for each rpm. The difference in speed levels is made by replacing the pulley used with the upper pulley sizes of 5, 6 and 7 inches while the lower pulley measures 4 inches. This treatment is done to adjust the fast or slow rpm on the machine.

2.2. Data Analysis

The parameters that will be used as a reference in the study are as follows:

2.2.1. Polishing Capacity

The capacity of the polishing machine is the amount of hotong material that can be dispensed for 1 (one) hour. Milling capacity is the capacity obtained until the seeds are completely milled (clean). The polishing capacity can be obtained from equation (1):

$$KPS = (Wpk / t) \times 3600 \qquad (1)$$

Notes: Kps is refining capacity (kg/hour), Wpk is weight of broken hotong seeds (kg), and t is polishing time (seconds).

2.2.2. Refining Yield

The milling yield is the amount of hotong that can be milled by the polishing machine. The yield of polishing can be obtained from equation (2):

$$\eta p = (Wpk / Wp) \times 100\% \qquad (2)$$

Notes: ηp is refining yield (%), Wpk is weight of broken hotong seeds (g), and Wp is weight of milled hotong seeds (g).

2.2.3. Scattered Losses

Scattered losses in the refining process can be obtained from the formula in equation 3 (3):

$$Sts = (WbTc / WbTs) \times 100\% \qquad (3)$$

Notes: Sts is refining lost (%), WbTc is weight of scattered hotong seeds (g), WbTs is total weight of hotong seeds milled (g).

2.2.4. Polishing Quality

Measuring the milling quality of hotong seeds by calculating the percentage of milled seeds, the percentage of non-polished seeds, and the weight of broken seeds. These percentages can be obtained by equations (4) and (5):

$$\%btk = (Wbtk / WbTs) \times 100\% \qquad (4)$$

$$\%bttk = (Wbttk / WbTs) \times 100\% \qquad (5)$$

Notes: %btk is percentage of polished hotong seeds (%), Wbtk is grinded hotong seed weight (g), WbTs is total weight of hotong seeds milled (g), %bttk is percentage of unpolished hotong seeds (%), Wbttk is weight of unpolished hotong seeds (g), dan WbTs is total weight of hotong seeds milled (g).

2.2.5. Effectiveness of Skin Separation

The effectiveness of skin separation is obtained by dividing the amount of skin and dirt that can be sucked up by the blower by the total amount of skin produced in each polishing. Mathematically, the effectiveness of skin separation is formulated in equation (6):

$$\eta = (Wst / Wso) \times 100\% \quad (6)$$

Notes: ŋ is skin separation effectiveness (%), Wst is weight of skin sucked in by blower (g), and Wso is total skin weight polished (g).

2.2.6. Electric Motor Power Requirements

The power requirement of an electric motor is obtained from the results of calculating the voltage and current in the electric motor. To calculate the need for electric motor power on a polishing machine, equation (7):

$$P = V_L \times I_L \times \cos \varphi \quad (7)$$

Notes: P_{out} is electric motor output power (Watts), V_L is mains voltage measured line (Volt), I_L is line electric current (A), and cos φ is power factor.

2.2.7. Moisture Content (AOAC, 2005)

The cup to be used as a sample testing site is dried at 105 °C for 30 minutes and then cooled to room temperature in a desiccator. The cup is then weighed until the numbers show a constant. A 5 gram sample was put into the cup and heated using an oven at 105 °C for 6 hours, then cooled in a desiccator for 30 minutes. The cup and sample are weighed again until the number shown is constant. Calculation of water content can use the formula equation (8):

$$KA\ (\%) = \frac{(W - W1)}{(W - W2)} \text{ X } 100\% \quad (8)$$

Notes: W is cup and sample weight, W1 is weight of cup and dry sample, and W2 is empty cup weight.

2.2.8. Weighting Factor

The weighting factor used to analyze the data is using the Bayes method as a determinant of the effective rotational speed for use in milling machines. The Bayes method is one of the methods used for decision making by taking a statistical approach to perform induction inferences on classification problems (Sihotang, 2017). The Bayes method was developed to solve problems in making decisions by determining the value of the probability of an event with the value of evidence or evidence obtained from facts related to the object under study. The Bayes method of equations can use equation (9):

$$P(Ci|X) = \frac{P(X|Ci) \,.\, P(Ci)}{P(X)} \quad (9)$$

Notes: X is data with an unknown class, Ci is the data hypothesis X is a class specific, P (Ci|X) the probability of the Ci hypothesis based on the condition x, P(Ci) is probability hypothesis Ci, P(X|Ci) is the probability of X under these conditions, P(X) is the probability of X is the same for all classes.

3. Results and Discussion

3.1. Abrasive Roll Type Hotong Polishing Machine

The hotong seed polishing machine is a machine designed to peel the skin from the hotong seeds and separate the skin from the seeds that are polished. This polishing machine has several types, one of which is the Abrasive Roll type. This type of machine is a modification of a sorghum polishing or peeling machine. This machine is designed with the aim of meeting the needs of milling hotong seeds before the next stage, namely flouring. The polishing machine in the study can be seen in Figure 1.

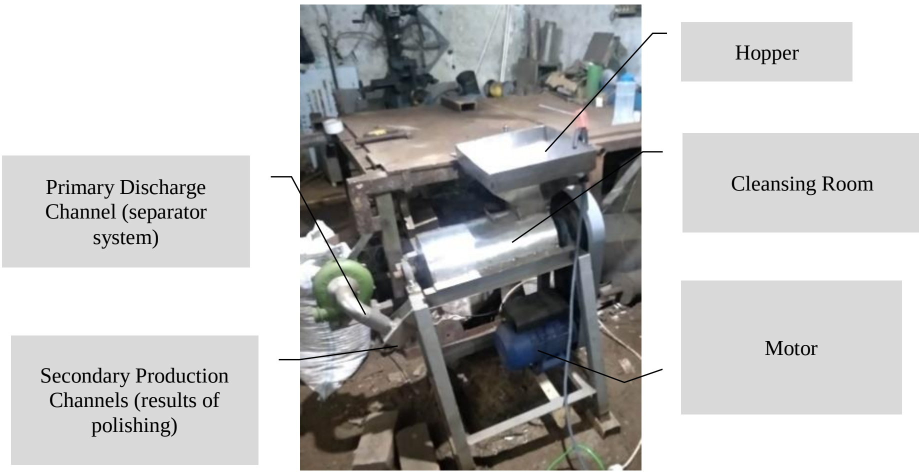

Figure 1. Abrasive roll type hotong polishing machine

The Abrasive Roll type hotong seed polishing machine has several parts or machine components including the hopper which is used as the entry point for the trial material, the polishing unit in the form of a grinding stone roll formed with a rough or uneven surface which is used as a peeler for the hotong seed skin, the supporting frame which is used as the foundation for the polishing machine and dampens vibrations generated by the machine, the power distributor, the driving force in the form of an AC 1 HP 1410 rpm motor, and a separator system. This type of polishing machine works with relatively fast rotation and low milling pressure so that the temperature increase is smaller.

3.2. Physical Characteristics of Hotong

The material used in this research is hotong, this plant comes from Sulawesi which is usually used as a substitute for rice because it has a high carbohydrate content. The stems of the buru hotong plant have clay characteristics, the drier the buru hotong plant that has been dried, the less clay it will have. The panicle itself is a continuation of the stem which grows branches which at the end of its position make it more compact in shape. This branch consists of water-shell colonies whose contents are buru hotong seeds (Pratiwi, 2008). The characteristics of hotong or panicle seeds are different from the characteristics of rice seeds both in size and density and moisture content of the material (Susanto, 2006). The hotong seeds used in this study can be seen in Figures 2.

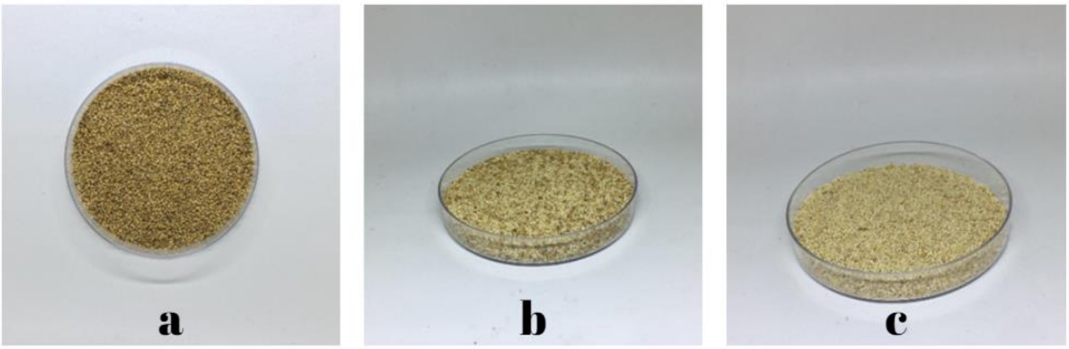

Figure 2. Hotong seeds : (a) have not been milled, (b) have been polished but not sifted, (c) have been polished and sifted

The characteristics of hotong seeds that have been released from their panicles will look like in Figure 2 (a), have a light brown color which is caused by the color of the skin of the hotong seeds themselves. Figure 2 (b) shows an example of hotong seeds which have been milled three times but have not been sifted. The milled and sifted hotong seeds can be seen in Figure 2 (c). Unsifted milling has an unclean result because there is still a mixture of seeds that are still not milled, this can result in poor flour quality. Hotong seeds that have been milled and sifted have cleaner and smoother results so that the flouring process can produce better flour quality values.

3.2.1. Hotong Dimensions

This study obtained results in the form of the largest diameter, smallest diameter, thickness, and weight of the hotong seeds. A total of 10 samples were measured with a caliper and weighed using an analytical balance designed to measure small masses in the sub-milligram range. Hotong dimensions can be seen in Table 1.

Table 1. Dimensions of hotong at 12.5% water content

Sample	The biggest diameter (a), (mm)	The smallest diameter (b), (mm)	Thick (c), (mm)	Weight per Grain (g)
1	1,97	1,43	1,25	0,0016
2	1,84	1,31	1,05	0,0019
3	1,73	1,30	1,06	0,0015
4	1,80	1,39	1,08	0,0017
5	1,87	1,32	1,01	0,0014
6	1,91	1,46	1,24	0,0017
7	1,85	1,34	1,06	0,0015
8	1,89	1,40	1,17	0,0017
9	1,91	1,42	1,22	0,0018
10	1,82	1,38	1,10	0,0017
Average	1,86	1,38	1,12	0,0017
Mean Geometric Diameter (d) = $\sqrt[3]{1{,}86 \times 1{,}38 \times 1{,}12}$ = 1,42 mm				

Based on the data in Table 1, it can be seen that the largest average diameter (a) is 1.86 mm, the smallest average diameter (b) is 1.38 mm, the average hotong seed thickness (c) is 1.12 mm, and the average weight per hotong seed is 0.0017 g. The calculation of the average geometric dimension (d) obtained is 1.42 mm.

3.2.2. Terminal Velocity

This terminal velocity is where an object is at rest or when the acceleration is zero which is caused by the sum of the drag and buoyant forces equal to the downward gravitational force so that the total force value on the object is zero. Measuring data using a terminal velocity measuring machine requires a tool, namely an anemometer as a measure of speed at the threshold point of the material. The machine can be set the rotation speed so that it can balance the material at the threshold point. Then the data can be obtained through the hole where the speed is measured. The ingredients measured were skin, hotong seeds with skin, and hotong seeds without skin. The terminal velocity value can be seen in Figure 3.

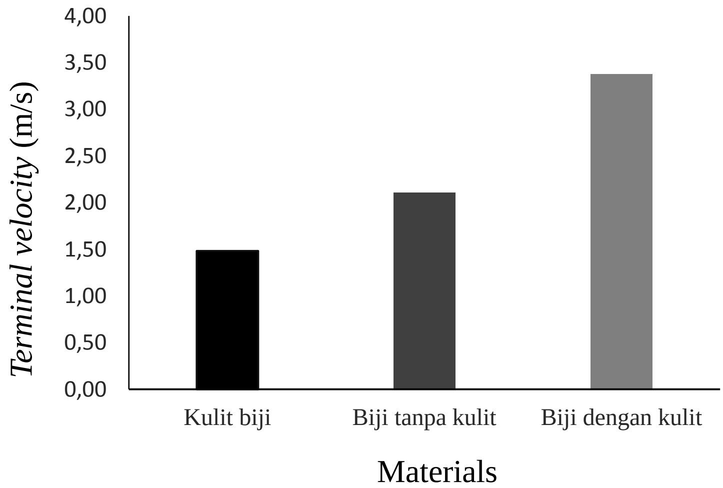

Figure 3. Terminal velocity graph

Based on the data in Figure 12, the terminal velocity data on the skin is obtained, which is 1.48 m/s. The terminal velocity value for the seeds with the skin was obtained at a value of 3.38 m/s, while the value for the seeds without the skin was 2.11 m/s. The highest terminal velocity was obtained in seed samples with skin. this is due to the increase in the weight of the skin attached to the seeds. The higher the weight on the sample, the higher the terminal velocity value obtained. The recommended use for hotong seed coat (skin) is at a terminal velocity value of 1.75 m/s, for hotong seeds without skin is at a value of 2.5 m/s, while for hotong seeds with skin more than 3.7 m/s. the use of wind speeds that exceed the recommended number can result in the carrying of unwanted material.

3.3. Polishing Machine Performance

3.3.1. Polishing Capacity

Milling capacity is the amount or amount of material milled (kg) per unit time (hours). If more and more hotong seeds are milled in a short time it will show that the capacity achieved will be higher, and vice versa if the hotong seeds are milled a little, the capacity achieved will be lower. Hotong seed polishing was carried out using an Abrasive Roll type hotong polishing machine with each sample being carried out three passes and three repetitions. This polishing machine was tested using different engine speeds, namely 806 rpm, 940 rpm and 1128 rpm. The polishing capacity value can be seen in Table 2.

Table 2. Polishing capacity

Rotate speed (rpm)	Initial Weight (g)	Final Weight (g)	Time (s)	Average Yield (kg/jam)
806	500	318,33	590,33	3,05
940	500	280,33	478,33	3,76
1128	500	269,67	467,67	3,85

Table 2 shows the polishing capacity data at speeds of 806, 940 and 1128 rpm. The speed of 806 rpm resulted in an average capacity of 3.05 kg/hour. The polishing machine with a speed of 940 rpm obtained an average yield of 3.76 kg/hour. The rotational speed of 1128 rpm shows an average capacity of 3.85 kg/hour. The highest polishing capacity obtained using an abrasive roll type polishing machine occurs at a rotational speed of 1128 rpm with an average capacity value of 3.85 kg/hour. Meanwhile, the lowest polishing capacity was obtained at a rotational speed of 806 rpm with an average value of 3.05 kg/hour. Based on Table 3, it can be concluded that the rotational speed of the machine can affect the polishing capacity. This is because a higher rotating speed can peel the skin on the seeds faster. Another factor that affects the milling capacity is the inclination angle of the polishing machine. The angle of inclination used during the study was 1°. The value of one capacity is 3.85 kg/hour. The use of a 1° inclination angle in the milling process can increase the thrust on the beans being milled due to gravity on the slope of the surface, so that a modification is needed to the frame to increase the inclination angle or add a driving screw to obtain a faster time.

3.3.2. Refining Yield

Yield shows the percentage of results from the comparison of the final weight with the initial weight of milling then multiplied by 100%. The yield value can be seen in Table 3.

Table 3. Polishing yield

Rotate speed (rpm)	Initial Weight (g)	Final Weight (g)	Time (s)	Average Yield (kg/jam)
806	500	318,33	590,33	63,67
940	500	280,33	478,33	56,07
1128	500	269,67	467,67	53,93

Based on the data in Table 3, the milling yield data were obtained at speeds of 806, 940 and 1128 rpm. The average yield obtained at a rotational speed of 806 rpm is 63.67%. The rotational speed of 940 rpm obtained an average yield of 56.07%. The average yield of a polishing machine with a speed of 1128 rpm is 53.93%. The average value of the highest milling yield using an abrasive roll type polishing machine was obtained at a rotational speed of 806 rpm with a value of 63.67%. Meanwhile, the lowest milling yield was obtained at a rotational speed of 1128 rpm with an average value of 53.93%. Based on Table 4 it can be concluded that the rotational speed of the machine can affect the milling yield. The higher the rotational speed of the machine, the lower the resulting polishing yield will be.

Another factor that affects the yield value is the friction between the roll and the cylinder surface. The distance between the roll and the cylinder surface used is 3 mm, using this distance a yield value of 53.93% can be obtained. The friction that occurs in the polishing process is due to the rotation of the roll in the opposite direction to the surface so that the skin on the hotong seeds can be peeled off, there is also pressure between the seeds which can increase the friction obtained. This can cause the seeds to be crushed, so it is necessary to modify the appropriate distance between the roll and the surface in order to produce a better yield value.

3.3.3. Scattered Losses

Loss of scatter is the value of the quotient between the weight of the scattered hotong seeds and the weight of the scattered hotong seeds, then multiplied by 100%. This scattered shrinkage is one of the important calculations to find out the loss or profit on the use of the machine. Scattered losses can be obtained by taking the scattered hotong seeds and seeds that are not accommodated during the milling process. Scattered shrinkage values can be seen in Table 4.

Table 4. Scattered losses

Rotate speed (rpm)	Initial Weight (g)	Final Weight (g)	Scattered Weight (g)	Time (s)	Scattered Losses (%)
806	500	318,33	5,10	590,33	1,02
940	500	280,33	5,76	478,33	1,15
1128	500	269,67	6,45	467,67	1,29

Based on Table 4, there is data from the scattered shrinkage of the hotong polishing machine at speeds of 806, 940 and 1128 rpm. At a speed of 806 rpm the scattered shrinkage results were obtained by 1.02%. Shrinkage scattered at a speed of 940 rpm obtained a result of 1.15%. then at a rotational speed of 1128 rpm it shows a scattered shrinkage of 1.29%. The highest value of scattered shrinkage using a polishing machine was obtained at a rotational speed of 1128 rpm with an average value of scattered shrinkage of 1.29%. While the lowest value is obtained with the rotational speed of 806 and the average value obtained is 1.02%. This is because the high rotational speed of the polishing rollers causes a lot of seeds to be thrown out through the axle hole in the cylinder cover and some are accommodated in the polishing cylinder. Based on the data obtained, the increase in speed in the flouring process has an effect on the resulting scattered shrinkage value. The more the rotational speed of the machine increases, the more scattered losses will be obtained.

3.3.4. Polishing Quality

The milling quality value can be obtained from the results of sieving using a 20 mesh sieve. This sieve is used to determine the milling quality value. If the hotong seeds that pass through mesh 20 are included as the grains that have been polished. The polishing quality can be seen in Table 5.

Table 5. Polishing quality

Rotate speed (rpm)	Initial Weight (g)	Final Weight (g)	Time (s)	Average Quality of Polishing (%)	
				Polished	Not Polished
806	500	318,33	590,33	56,51	43,49
940	500	280,33	478,33	79,80	20,20

1128	500	269,67	467,67	74,12	25,88

Based on Table 5, there is data from the scattered shrinkage of the hotong polishing machine at speeds of 806, 940 and 1128 rpm. At a speed of 806 rpm the scattered shrinkage results were obtained by 1.02%. Shrinkage scattered at a speed of 940 rpm obtained a result of 1.15%. then at a rotational speed of 1128 rpm it shows a scattered shrinkage of 1.29%. The highest value of scattered shrinkage using a polishing machine was obtained at a rotational speed of 1128 rpm with an average value of scattered shrinkage of 1.29%. While the lowest value is obtained with the rotational speed of 806 and the average value obtained is 1.02%. This is because the high rotational speed of the polishing roller causes a lot of seeds to be thrown out through the axle hole in the cylinder cover and some are accommodated in the polishing cylinder. Based on the data obtained, the increase in speed in the flouring process has an effect on the resulting scattered shrinkage value. The more the rotational speed of the machine increases, the more scattered losses will be obtained.

3.3.5. Effectiveness of Skin Separation

The effectiveness of skin separation is obtained from the calculation of the percentage of dirt or skin that is still carried through the hotong seed dispensing channel during the milling process. The results of the skin that comes out will be sucked using a suction blower. The value of the effectiveness of skin separation can be seen in Table 6.

Table 6. Effectiveness of Skin Separation

Rotate speed (rpm)	Initial Weight (g)	Final Weight (g)	Total Skin (g)	Wasted Skin (g)	Skin Separator Effectiveness (%)
806	500	308,00	63,67	60,33	94,78
940	500	324,00	84,67	78,67	92,91
1128	500	323,00	95,00	87,00	91,57

Table 6 shows that on the hotong polishing machine there is data on the effectiveness of skin separation using different speeds, namely 806, 940, 1128 rpm. The speed of 806 rpm resulted in an effectiveness of 94.78%. Then at a speed of 940 rpm the effectiveness results were 92.91%. And the effectiveness results at a speed of 1128 rpm is 91.57%. Based on the results of testing the effectiveness of skin separation, the highest results were obtained at a rotational speed of 806 rpm with an average value of 94.78%. Meanwhile, the lowest value of the test was obtained at a rotational speed of 1128 with an average separation effectiveness value of 91.57%. The presence of skin or dirt on the hotong seeds which is carried over to the outlet is caused by accumulation in the outlet so that the skin that should be sucked in becomes blocked by the polished hotong seeds so that they can be carried into the outlet during the hotong polishing process using an abrasive roll type hotong polishing machine. Based on research data, the difference in results is relatively small because the hotong seed coat has a very light weight, so it is prone to being blown out through the axle hole and the hole in the hopper cover.

3.3.6. Electric Motor Power Requirements

Power requirement is a value obtained from the calculation of voltage and current in an electric motor. The machine used in this measurement is the abrasive roll at a rotational speed of 940 rpm. The value of power requirements can be seen in Table 7.

Table 7. Electric Motor Power Requirements

	Voltage (V)	Current (A)	Power factor	Power (Watts)
No burden	220	2,43	0,95	507,87
	220	2,41	0,95	503,69
	220	2,40	0,95	501,60
With loads	220	2,49	0,95	520,41
	220	2,51	0,95	524,59
	220	2,52	0,95	526,68

The abrasive roll polishing machine is driven by a single phase AC electric motor. Single phase electricity is usually used in home industries. The current and voltage values are obtained from the measurement results using a clamp meter. Based on the data obtained, the highest power value required for an electric motor without load is 507.87 watts, while the highest power value required for an electric motor with a load is 526.68 watts. The additional load on the tool will cause the required power requirements to increase

3.4. Data Analysis

The Bayesian method is a performance index-based decision-making method commonly used in management. By definition this method is a technique used for analysis in making the best decision from a number of alternatives. Decision making requires 20 respondents to determine the weight of the parameters used. The weighting table can be seen in Appendix 12. Bayes value can be seen in Table 8.

Table 8. Decision making using the Bayes method

Speed	Capacity	Yield	Quality	Scattered Shrink	Bayes Value
Weight	0,20	0,29	0,36	0,16	
806 rpm	1	3	1	3	1,91
940 rpm	2	2	3	2	2,38
1128 rpm	3	1	2	1	1,77

It can be seen from Table 8 that the decision making in this analysis can determine which rotation speed is the most optimal for use on a polishing machine. Based on the data, it can be seen that the weighted values for capacity, yield, quality, and scattered losses are 20%, 29%, 36%, and 16%. The highest weight is indicated on the quality parameter which is the most important to be considered in decision making followed by yield, capacity, and lastly scattered losses. After the weight value is obtained and entered into the formula. The speed of 1128 rpm gets three for capacity, one for yield, two for quality, and one for scattered shrinkage, with a bayes value of 1.77 being the lowest rating, which means it is not recommended to use this rotational speed. The highest rating can be seen at the rotational speed of 940 with a bayes value of 2.38 which means it is recommended to use this speed in order to get good polishing results. this is because the values at a rotational speed of 940 rpm get a constant number for each parameter and get the highest quality value.

The use of a rotational speed of 940 rpm on a polishing machine still needs to be further developed in terms of the distance between the roll and the surface in order to obtain a better milling yield. Then in terms of the angle of inclination also needs to be addressed to speed up the polishing time so as to increase the total polishing capacity. The value of the lost shrinkage on the polishing machine needs to be slightly reduced by improving the design of the cylinder cover and threaded holes so as to minimize the discharge of hotong seeds from the polishing machine.

4. Conclusions and Recommendations

4.1. Conclusions

Based on the results of the research and discussion in the previous section, it can be concluded that the analysis of the suitability of the polishing machine design with the characteristics of hotong seeds is found at a rotational speed of 940 rpm. The best milling capacity was at a rotational speed of 1128 rpm, the best milling yield and scattered shrinkage was at a rotational speed of 806 rpm, while the best quality was at a rotational speed of 940 rpm. The results of testing the effectiveness of skin separation with the highest value were found in the abrasive roll type polishing machine of 94.78%. the need for electric power on the polishing machine reaches 526.68 watts, the faster the rotation, the greater the power required.

4.2. Recommendation

A separator mechanism is needed between the hotong seeds that have been polished and those that have not been polished in the production line. For example, separation with a system that utilizes the terminal velocity value as a measure of suction power to distinguish between the hotong seeds that have been ground, which seeds have not been ground, and which are the skins. In testing machine performance, use a lot of material at least 3 kg per repetition so that the data obtained will be better.

References

[AOAC] Association of Official Analytical Chemist. 2005. Official method of analysis of The Association of Official Analytical Chemist, Arlington (US): The Association of Official Analytical Chemist, inc.

Darajat MY. 2008. Rancang bangun mesin penyosoh biji buru hotong (*Setaria italica (L) Beauv.*) tipe *abrasive roll* [*skripsi*]. Bogor: Institut Pertanian Bogor.

Herodian S, Sugiyono, Widowati S, Santosa BAS. 2009. Pengembangan Buru Hotong (*Setaria italica (L) Beauv*) Sebagai Sumber Pangan Pokok Alternatif. Seminar Hasil-Hasil Penelitian IPB; 2009; Bogor, Indonesia. Bogor. 1-15.

Kharisun A. 2003. Uji performansi mesin perontok hotong [*skripsi*]. Bogor: Institut Pertanian Bogor.

Maris FS. 2008. Uji unjuk kinerja mesin penyosoh juwawut tipe rol tunggal dan tipe rol ganda [*skripsi*]. Bogor: Institut Pertanian Bogor.

Pratiwi MA. 2008. Pemanfaatan tepung hotong (*Setaria italica (L) Beauv*) dan pati sagu dalam pembuatan *cookies* [*skripsi*]. Bogor: Institut Pertanian Bogor.

Sihotang HT. 2017. Perancangan aplikasi sistem pakar diagnosa diabetes dengan metode bayes. *Jurnal Mantik Penusa*. 1(1): 36-41.

Susanto. 2006. Uji performansi mesin penyosoh dan penepung biji buru hotong (*Setaria italica (L) Beauv*) [*skripsi*]. Bogor: Institut Pertanian Bogor.

Tuasamu Y. 2009. Toleransi hotong (*Setaria italica L. Beauv*) pendekatan anatomi dan fisiologi [*tesis*]. Bogor: Institut Pertanian Bogor.