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## **Development of a White Pepper Decorticator machine to replace manual process and boost white pepper production**

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### **ABSTRACT**

Pepper Peel-O-Matic is designed to hasten the process of producing white pepper. White peppercorns are obtained from fresh pepper berries that undergo a series of process. The most critical parts are soaking and rubbing, of which are done manually. The pepper Peel-O-Matic is a machine with 3 combined processes of rubbing, cleaning and sieving in order to reduce labor intervention. The usage of the pepper Peel-O-Matic able reduce the soaking period to 6 to a maximum of only 9 days, compared to the current soaking period of 14 to 20 days. Apart from that, it also caters to a much hygienic process as compared to the current practice of hand-rubbing or foot-shearing. This machine consists of a hopper for the feeding of pepper berries with a series of sprinkler to assist the rubbing process. The rubbing mechanism consists of two discs and a vibration sifter for the separation process. This invention can increase the production of white pepper by more than 50% compared to the traditional method and its output quality is found to be similar with the commercial method.

### **KEYWORDS**

White Pepper, Decorticator machine, Peppercorns, Agricultural machinery

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## INTRODUCTION

According to Director General of Malaysian Pepper Board, the current global consumption of pepper is projected to be at 387,000 tonnes against production of 333,500 tonnes, thus indicating a shortfall of 53,500 tonnes. Based on market validation conducted, it was found that the number one problem that the pepper farmers are facing that contributes to this vast shortfall is the lengthy period and tedious production process of the white pepper.

As of current, one of the crucial steps in producing white pepper is the soaking process and it takes about 17 to 22 days, making the total processing days 20 to 25 days, in total. Longer soaking days will assure higher percentage in obtaining the utmost premium quality (Creamy white pepper) peppers compared to shorter soaking duration. Soaking process is to encourage the enzymatic retting of the outer skin of the berries to reveal a lighter coloured surface which is known as the white pepper. Premium quality (creamy white) pepper are distinguished by the inexistence of any black dots and a creamier coloured surface of the berries which is usually obtained with the longest soaking duration and vigorous rubbing.

Apart from that, subsequent crucial steps involve heavy manpower for rubbing of the skins(pericarp) off the peppercorns, which is done by foot-shearing or hand rubbing, and as well as cleaning process. The above conventional method is time consuming and causes the low productivity of white pepper and is not hygienic. Therefore, this machine has been invented to increase the productivity and hygiene of the white pepper product.

Technology generally ensures a brighter future as much research and studies are being undertaken worldwide. However, in this field no machine has been invented in Malaysia to assist in the production of white pepper according to Malaysian Pepper Board (MPB) Sarawak. This technology is very important in order to increase the efficiency of white pepper production in Malaysia since Sarawak and Johor are the main producers of white pepper in the country. Sarawak is the largest pepper producing state in Malaysia which accounts for 98 % of the total black pepper production in Malaysia. The remaining 2 % is produced by other states such as Johor in Malaysia. Malaysia is one of the largest producers of white pepper according to the International Pepper Community (IPC). In the world ranking, Malaysia is the fifth largest producer in 2011.

PEPPER PEEL-O-MATIC is designed to hasten the process of producing white pepper. White peppercorns are obtained from fresh pepper berries that undergo a series of process. The most critical parts are soaking and rubbing, of which are done manually. The Pepper Peel-O-Matic is a machine with 3 combined processes of rubbing, cleaning and sieving in order to reduce labour intervention. The usage of the Pepper Peel-O-Matic able reduce the soaking period to 9 to a maximum of only 11 days, compared to the current soaking period of 17 to 25 days. Apart from that, it also caters to a much hygienic process as compared to the current practice of hand-rubbing or foot-shearing. This machine consists of a hopper for the feeding of pepper berries with a series of sprinkler to assist the rubbing process. The rubbing mechanism consists of two discs and a vibration sifter for the separation process. This invention can increase the production of white pepper by more than 50% compared to the traditional method and its output quality is found to be similar to that obtained through the conventional method. This machine is the product of an extensive research that was conducted for 4 years and it has been awarded with awards such as the Finalist of Anugerah Harta Intelek Negara 2014, Gold Medal and Honor of Invention from Korea in the International Engineering Invention and Innovation Exhibition.

The largest white pepper production area in Malaysia is situated in Betong division in Sarawak. Betong division is also home to the 'No. 1 Premium/Creamy White Pepper' that is widely exported around the globe. The white pepper that are marketed consists of two categories, which are the green label and the premium 'creamy' label. Though they are of the same kind they differ in terms of its quality. The premium 'creamy' label consists of peppercorns of diameter 4 mm and it does not have even a speck or small black dot on its surface, This small black dots are usually due to the unstripped outer skin of the berries and therefore affected the quality of the pepper berries produced. Apart from that, the colour of the premium white pepper is creamier than the normal green label ones. The difference in colour is due to the extent of soaking period with the soaking of berried to produce the premium ones being longer of about 3 to 4 days more compared to the green label pepper. The difference in market price of the premium label to the



green label white pepper of about 20% is the main reason why most pepper farmers are targeting to produce premium quality white pepper compared to green label.

The main industry among the people in Betong, of which most are the Iban native group, is the production of pepper. The pepper industry is a 'cottage industry' and it consist of family members working. The Ibans mostly stay in a 'Rumah Panjang' or a longhouse, which is a long, narrow building, consisting about a minimum of 10 'large rooms' housing 10 families and can go up to 30 'large rooms' with 30 families.

The Ministry of Higher Learning of Malaysia acknowledge the innovation and its capability in bettering the lives of the pepper farmers with the introduction of technology to their current manual process and with the recommendation from the Malaysian Pepper Board Betong division, RUMAH PANJANG MELABU BAIR, which is situated in Ulu Layar, Betong Division in Sarawak was chosen as a test ground to test the efficiency and performance of the PEEL-O-MATIC machine with the upgraded capacity of 100 kg/hr from its previous lab prototype of 50 kg/hr.

## MATERIALS AND METHOD

Seven pepper farmers of the Rumah Panjang Melabu Bair were chosen to conduct the testing and provide data collection.



*Figure 1: With the residents of Rumah Panjang Melabu Bair, Ulu Layar, Betong, Sarawak*

### White Pepper Berries

The White Pepper berries used for the testing of the Peel-O-Matic machine is of the 'Sri Aman' breed. The pepper berries were harvested and soaked in the nearby river for 10 to 13 days depending on the rate of berries maturity during harvesting. The berries that are partially ripe (small tiny dots of red visible) were soaked for 13 days and the mature berries with 80-90% of its skin in red/orange color were soaked for 10 days.





Figure 2: The nearby river where the pepper berries were soaked. The berries are usually places in gunnies and each gunny would weigh about 40kg.

### **The Pepper Peel-O-Matic ('White Pepper Decorticator') Machine**

The Pepper Peel-O-Matic machine is made up of the following units: main body frame, pepper inlet funnel/hopper, auger, water inlet and outlet, water pipeline, 2 units of electric motor, double-layer sieving tray, water tank, abrasive rubbing discs, abrasive disk door and 4 units of castor wheels with lock.

#### **Frame and Body Cover**

Weight of the 2 units of electric motor and the abrasive rubbing discs were considered in designing the frame. Stainless Steel was used for its main body frame and cover for strength and rigidity due to load of component parts and the shaking/sieving motion during the operation. The use of stainless steel is also to prevent rust due to its constant in-contact with water during the operation process.

#### **Pepper Inlet Funnel/Hopper**

Stainless Steel square opening that decreases in size giving a square pyramid outlook, connecting to a hollow cylinder portion also made out of stainless steel that ends at the opening of the rubbing compartment.

#### **Auger**

An auger made out of PE plastic is needed to assist the smooth flow of berries into the rubbing compartment.

#### **Abrasive Rubbing Disc Holder and Cover**

Round stainless steel holder and cover that holds the rubbing disc components in place. The rubbing disc cover is detachable by removing the lock on the right side of the disc cover.

#### **Abrasive Rubbing Discs**

Rubbing discs consists of one unit of movable rotating component and a stagnant component. The Stagnant component of the rubbing discs is the one that is attached to the machine itself, while the moving component is the one attached to the cover.

#### **Sieving Tray**

The double-layer sieving tray consists of stainless steel tray with 2 different mesh sizes with the bigger 4 mm mesh on the top layer and the smaller 3mm mesh at the bottom.

#### **Water Tank**

The Water tank is made out of stainless steel and it has a water outlet gauge on the right side of the machine (when faced front with disc cover positioned front). situated at the bottom and its function is to



collect used water from the cleaning and sieving process and can be recycled back to the top of the machine (inlet).

#### Castor Wheel

Heavy-duty rubber castor wheels are used for this machine to ensure no breakage or tear after numerous usage of machine.

#### Water Pipeline

There is water pipeline on the top of the pepper inlet/ hopper, following the shape of the stainless-steel pepper inlet. The pipeline has small holes at every 1 inch distance to encourage water flowing in the form of spurts out into the inlet pathway. The water pipeline with holes of 1 inch distance between each other is also situated on the top part of the sieving mechanism to encourage the removal of the berries skin and assist in cleaning of the berries after the rubbing process. PVC pipes are used as the water pipeline in this machine.

#### Electric Motors

One unit of the electric motor is used to move or rotate the rubbing discs and it is useful for a smooth operation as this is the most crucial part of the machine. A 0.5 hp motor is used to rotate the rubbing disc of 100 kg/hr capacity machine and at a speed of, suitable for the load, speed and whole system.

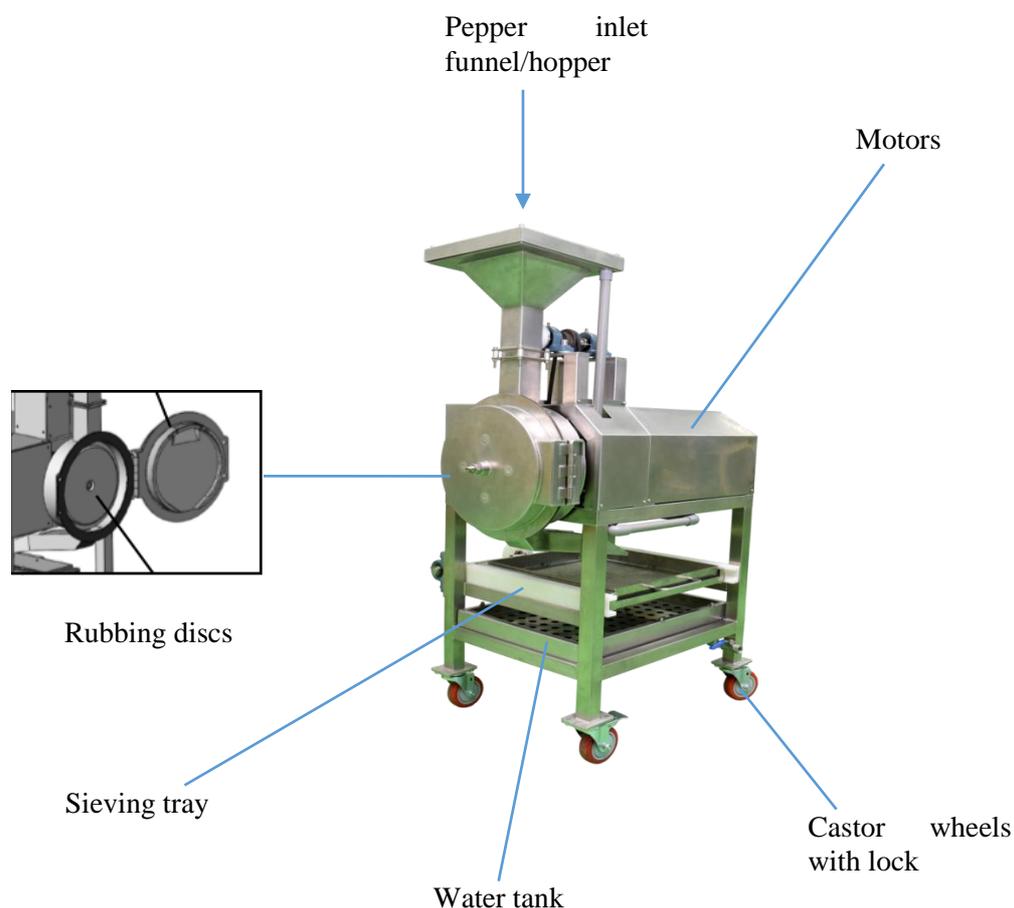


Figure 3: Components of the Pepper Peel-O-Matic machine

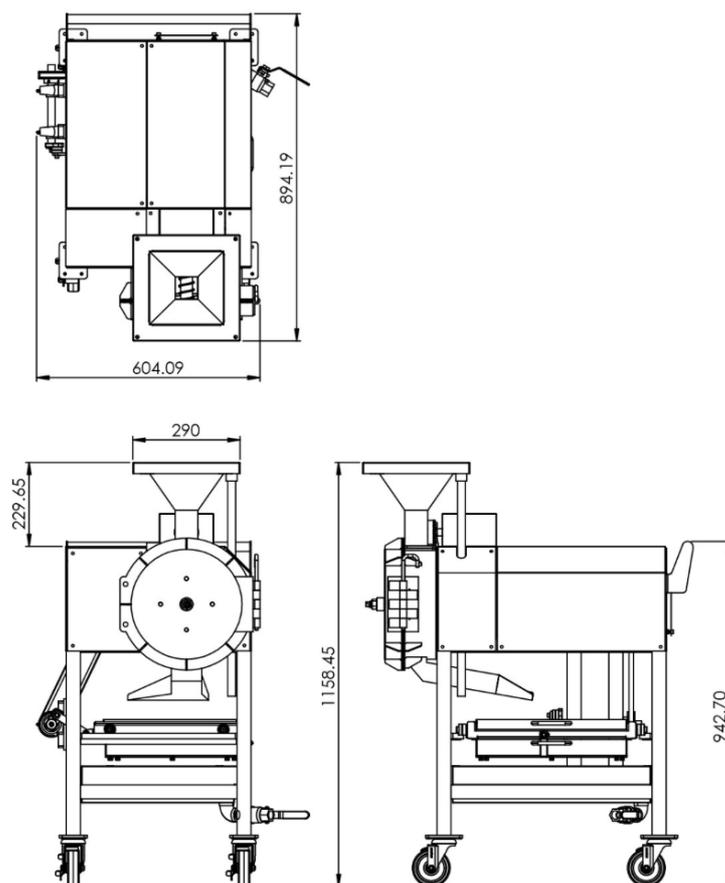


Figure 4: Overall dimensions of the 100 kg/hr Pepper Peel-O-Matic machine

## RESULTS AND DISCUSSIONS

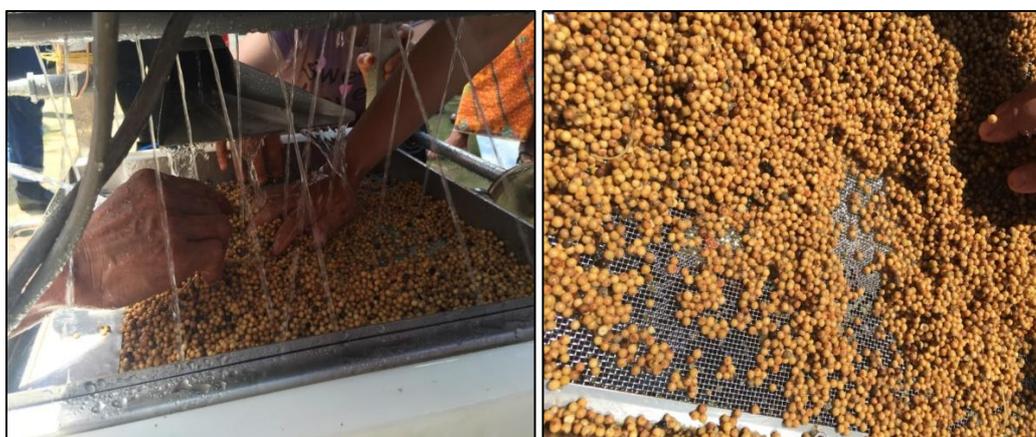


Figure 5: The Output of the Pepper Peel-O-Matic machine

The average output of the Pepper Peel-O-Matic machine is 80-100% Creamy White Pepper (as shown in Figure 5). This is mainly due to the fact that shorter soaking period ensures that the berries are not or at a low possibility that they are in contact with dirty water, thus providing cleaner berries. Shorter soaking period is possible with the use of the Pepper Peel-O-Matic machine compared to traditional method because the rubbing force needed to remove the outer layer skin of the berries is attainable with the machine and thus not require for the outer skin to be extra soft, as practiced for the manual production.

Table 1. Percentage Output of White Pepper Production with the use of the Pepper Peel-O-Matic machine (after 3 months)

NO	Name of Pepper Farmer	IC No.	No. of soaking days	Weight before soaking (kg)	Minus 30% of losses (skin, stalks etc)	Weight after soaking (kg)	Output (%)
1	Tuing ak. Gumba	770405-13-5423	10	50	35	18	51.4
2	Banyang ak. Aji	530523-13-6495	13	100	70	45	64.3
3	Merbai ak. Giri	621231-13-5749	12	50	35	21	60
4	Madil ak. Basik	410825-13-5169	12	40	28	15	53.6
5	Banyoi ak. Jalin	630505-13-6083	11	70	49	30	61.2
6	Richard Kadir ak. Giri	820621-13-5981	11	50	35	20	57.1
7	Entinggi ak. Giri	720131-13-5665	11	30	21	10	47.6

Table 1 shows one cycle of white pepper processing conducted by pepper farmers in Rumah Panjang Melabu Bair Ulu Layar using the Pepper Peel-O-Matic machine with average soaking days of 11 days, compared to the current conventional method practiced with a minimum of 17 soaking days.

Therefore, with comparison by using the Pepper Peel-O-Matic and allowing an average of soaking days to be 11 days instead of 17 days of minimum soaking days in current conventional practice, this will contribute to an increment of 64.7% in white pepper output production. Besides reducing soaking days, labour intervention is also replaced with the use of the 3 in 1 mechanism instilled in the Pepper Peel-O-Matic machine (rubbing, cleaning and sieving). The output of the machine is a higher quality product that is also of a much hygienic source. The nett income each farmer can obtain for one batch of white pepper processing cycle at current conventional practice (17 soaking days) will also be doubled.

Table 2: Income Comparison of 1 cycle of White Pepper Production

Manual Production	Production using Pepper Peel-O-Matic machine
Processing days of 20-25 days = 1 batch	Processing days of 20-25 days = 2 batches
1 batch = 8 gunnies X 40 kg/gunny = 320 kg 30% loss for every batch, □ Nett Weight = 224 kg/batch	2 batches = 16 gunnies X 40 kg/gunny = 640 kg 30% loss for every batch, □ Nett Weight = 448 kg/batch
Income of 1 cycle of white pepper production, as of January 2018: 224 kg X RM 40/kg = <b>RM 8 960</b>	Income of 1 cycle of white pepper production, as of January 2018 448 kg X RM 40/kg = <b>RM 17 920</b>



Based on Table 2, 1 cycle of white pepper production using the Pepper Peel-O-Matic machine would double the income of the pepper farmers compared to when using the manual method. With that, it can be deduced that the invention of the Pepper Peel-O-Matic machine is capable to improve the socio-economic of the pepper farmers.

## **CONCLUSIONS**

The invention of the Pepper Peel-O-Matic machine was found deemed in providing an alternative to the current manual production of White Pepper, which is a much hygienic and also capable of producing higher quality pepper. The use of the machine can increase the production of up to 67% from the current manual process.

## **ACKNOWLEDGEMENT**

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## **REFERENCES**

Nil.

