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The Experimental Study of Cassava Peeler Machine with Flexible Blades and Rollers

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Abstract

Cassava peeling technology is believed to be able to support the cassava processing industry. Many cassava processed products require stripping techniques so that they can improve quality and add value to the processed cassava products. Stripping of cassava peel is done with a one-process system, as well as a flexible cassava steering system with a horizontal direction trajectory. The stripping process starts from the tip to the base of cassava with a horizontal one-way path. The blade angle is mounted in a circle to adjust the diameter and shape of the cassava.

The test results show that the cassava peeler can peel the skin of relatively straight-shaped cassava, which has a diameter between 3-5 cm and a length of 20-25 cm. Steering rollers can function as the booster of cassava during the stripping process. The transmission system by using a chain can move the steering roller as a whole.

Keywords: *Cassava Peeler, Steering roller, Transmission*

1. Introduction

The development of cassava productivity in Indonesia over the past five years has tended to increase by greater than 3.84%[1]. In Indonesia the use of cassava as a source of food is 58%, industrial raw materials 28%, export commodities (in the form of cassava) as much as 8%, feed 2%, and the remaining 4% as agricultural waste[2]. Products produced from cassava processing include direct processed products (boiled cassava, chips and tape). Intermediate products from cassava are (cassava flour, tapioca flour, fermented tapioca flour. Cassava processing products as raw materials for processes include (a) dextrin for textiles, plywood adhesive paper, and the chemical / pharmaceutical industry, (b) citric acid for food and drink, (c) monosodium glutamate, (d) sorbitol, (e) mixed feed, (f) glucose for food and drinks and, (g) bioethanol[3].

Processed cassava products have a broad spectrum, producing various types of derivative products for the food, pharmaceutical, chemical, building materials, paper, and biofuel industries as their industrial trees[4]. The development of the cassava processing industry must be supported by appropriate technology so that it can be competitive and more competitive. Cassava peel is an upstream technology that is believed to have a vital role to support the cassava processing industry. So that it can produce processed cassava products with good quality and add value.

Processed cassava products that require cassava stripping techniques include chips, tape, cassava, modified cassava, cassava flakes, and pregelatinized starches. The current cassava stripping technology, in general, is conventional, so that businesses, especially in the processed cassava field, will have difficulty increasing their productivity. In general, cassava has a diameter of 2-10 cm and a length of between 10-50 cm. The shape of the cassava is elongated and irregular. Cassava contains about 60% water, starch 25-23%, as well as protein, minerals, fiber, calcium, and phosphate. Cassava plants consist of the outer skin, inner skin, cambium layer, core, and fruit flesh. The layer to be stripped is in the outer skin layer and the inner layer in the form of cortex so the layers are bonded together and a little hard.

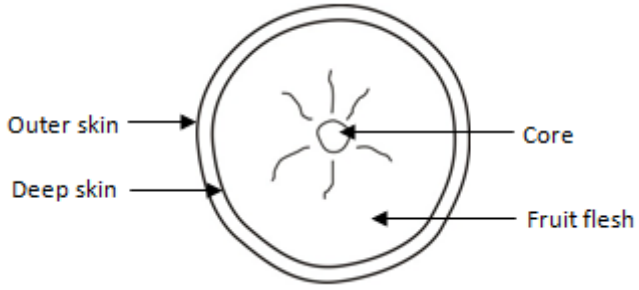

Figure 1. Layer of Cassava

The operation unit of cassava processed products include peeling, grating, bowling, drying, milling, pressing, sieving, extrusion, and frying. Peeling is a major problem in the processing of cassava because (a) diverse varieties of cassava, (b) physical components of cassava have irregular shapes and sizes, and (c) layers of cassava peel consist of two layers namely outer skin and skin. Besides cassava produces 15-20% of skin waste for every kilogram and has high crude fiber content. Further processing of cassava peel as a source of edible fiber is an alternative in the effort to utilize cassava peel waste. Cassava stripping mechanization has been developed in several countries, to get a prototype of the machine but with a low production capacity. Testing of cassava peels with conventional tools obtained an average capacity of around 30-35 kg/hour. This conventional stripping has a long time and low productivity.

Jimoh and Olukunkle[5] have developed a cassava peeling machine consisting of rollers with a diameter of 200 mm and a length of 900 mm. Shaft diameter is 25 mm which moves through the roller. The cutting blade has a length of 70 mm with an elevation of 30o and rises above the roller. The roller rotates and moves linearly when the stripping occurs with a collision system. The components of this peeling machine include hoper, frame, monitor and chute. The transmission system uses belts and pulleys, where the engine speeds are 100, 200, 300, 400, 500 and 600 rpm. While the engine capacity is between 76 - 442 kg/hour. The rotary motion of the blade will affect the peeling process during operation. This study concludes that there is damage to the cassava meat, and the classification of cassava species affects the performance of the machine so as to minimize problems during operation.

Ubaidillah S[6] developed the concept of cassava peeler, which has a circular blade type. This circular knife type cassava peeler consists of pipes, knives and pushing wood. Cassava peeler is suitable for cassava 37 mm in diameter. So the distance between the diameter of cassava with the outer blade diameter is 3 mm. This research concludes that cassava peeler needs further development to reduce fruit loss due to stripping.

This study aims to design and test the cassava peeler. The main components of this cassava peel include a cassava conveyor roll that acts as a booster and anchor the cassava during the stripping process. So that cassava remains on the stripping path. The knife used to cut the skin of cassava based on its contour. While the transmission part functions to move the roll simultaneously in the vertical direction. The driving source of this transmission is an electric motor, which uses an inverter as a speed regulator.

2. METHODOLOGY

2.1 Material

Fresh cassava in this study uses a length of between 15-25 cm and a diameter of 3-6 cm obtained from the Pati Technology Center area. Cassava prepared for the trial is cassava that is clean from the soil.

Figure 2. Skin of Cassava

2.2 Equipment

The main cassava peeling equipment unit consists of: a paring knife, conveying roller, and transmission. The delivery roller is installed in four stripping areas. The total number of delivery rollers totaled five pairs. In each stripping area, there are two pairs of conveying rollers, which are placed at the top and bottom. The material of the conveying rollers is Teflon coated with rubber. Eight paring knives, which are installed in the stripping area. Paring knives can be replaced when a knife wears. While the transmission system used is to use chains, which are interconnected to all components of the delivery roller.

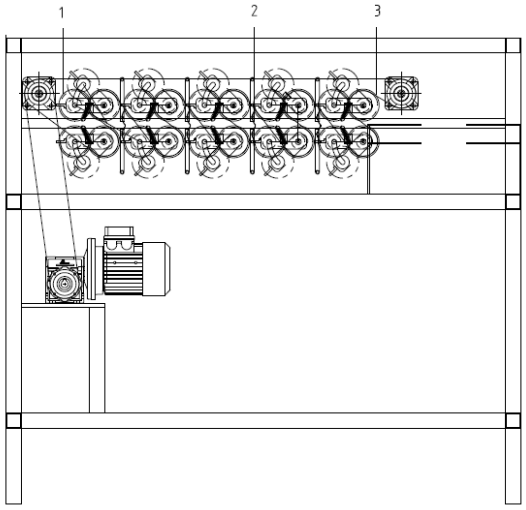

Figure 3. Schematic of Cassava Peeler.
1. Delivery Rollers; 2. Peeled knife; 3. Transmission

2.3 Procedure

The experimental procedure of this cassava peel is preceded by testing in one stripping area, to get the performance of a paring knife and roller so that it can function properly. The cassava peeling test is carried out by inserting cassava into the stripping area one by one with the steering system. The stripping process starts from the base to the tip of the cassava in the horizontal direction. Paring knives are arranged tiered with a certain angle and the position of the blade is flexible. The blade angle is mounted in a circle to adjust the diameter and contour of the physical condition of cassava. Stripping of cassava peel is done with a single-entry system. The cassava holder system is flexible and rotates with a horizontal single direction. The mechanism of cassava peeling is expected to be able to peel the cassava quickly each fruit. The mechanism of cassava peeling is designed and tested in the form of a prototype machine. The dimensions of the prototype machine are 1,350 mm in length, 603 mm in width and 1,227 mm in height. drive system with an electric motor, with a power of 1 HP, 3 phase voltage.

3. RESULTS AND DISCUSSION

The process of making a cassava peeling machine includes, first the delivery roller consisting of four areas. These four peeling areas have the same components and functions. But the position of the attached blade has a different angular layout. On the surface of the conveyor rollers made of rubber, made a grip that serves as a grip of cassava so that the cassava moves to follow the rotating conveyor rollers. The upper conveying rollers have vertical direction movements that adjust the groove, the aim being to follow the shape and diameter of the cassava, while the bottom bottom delivery rollers are static.
The next part is a paring knife which is designed to peel the skin of cassava as deep as 0.5 - 1.5 mm. The position of the attached blade adjusts to the diameter of the cassava. Four units of knives attached to the test equipment, each knife unit will peel on both sides of the outer diameter of cassava. This knife is also mounted in four positions, namely upright 90^o, 45^o angle, 180^o angle, and 225^o angle. The position of the knife is aimed at peeling the cassava peel on all its outer edges. The material used for paring knives is stainless steel. This stainless steel material has advantages in terms of strength, stiffness, and ductility and is not corrosive. The transmission used in this cassava peeler prototype is using a chain. Each chain is connected sprocket on each shaft roll propulsion. This chain system also rotates simultaneously, so that the shaft rotates at the same time. The making of the cassava peeling machine is shown in figure 4.

Figure 4. Cassava peeling machine

3.1 Cassava Peeler Testing Results

The speed and stability of the stripping thickness are important factors to determine the capacity and performance of the cassava peeling machine. Besides, the determination of the size and shape of cassava also needs to be considered before carrying out the testing process of the cassava peeler. The results of the cassava stripping machine test show that the conveying roller can pull cassava when inserted at the beginning of the stripping process, then the conveying roller pushes the cassava when the stripping process takes place. The upper conveyor roll moves flexibly up and down. During the stripping process, the conveying rollers can grab the cassava, so that the cassava can move straight.

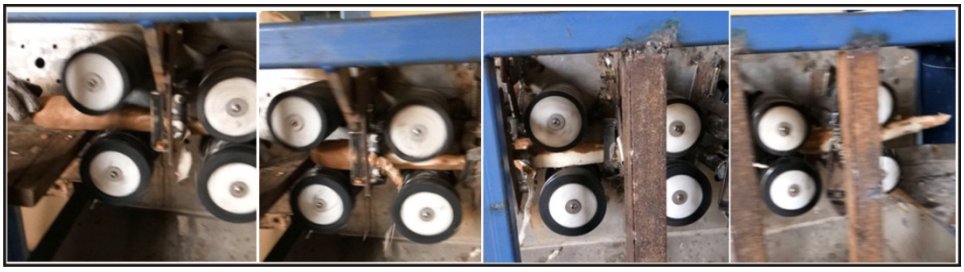

Figure 5. Testing Results of Cassava Peeler

During the cutting process, the depth of the blade position can be adjusted to the thickness of the cassava skin. The results of testing with the condition of long-shaped straight cassava, cassava skin can be peeled on the sides of the cassava. The skin of the peeled cassava is at the tip to the base of the cassava, but during the stripping process the knife has not been able

to follow the shape of the cassava, so the thickness of the skin of the peeled cassava is not perfect. While the depth of the blade will affect the ability of the thrust of the steering roller. The deeper the strips of cassava peel are, the greater the thrust needed from the steering roller. So we need a sharper blade material to obtain a more perfect stripping process.

The results of Table 1 show that not all shapes and sizes of cassava can be stripped. Ubikayu which has a large diameter at the base, and has a short shape is difficult to do the stripping process. Steering rollers and paring knives cannot function properly, so the cassava stops in the stripping area. The ideal cassava for stripping is relatively straight-shaped cassava, which has a diameter between 3-5 cm and a length of 20-25 cm.

Table 1. Results of Machine Cassava Test

Hasil Pengujian Ubi Kayu				
No	The condition of cassava	Diameter (cm)	Peel time (s)	Results of skin peel
1	Long and crooked	2-4	-	The roll cannot deliver cassava to the blade
2	Large and short diameter	5-6	-	The distance between the roll is not enough to deliver cassava to the next roll.
3	Long and straight	3-5	2	Most cassava skin can be peeled with a knife attached

4. Conclusions

In general, the cassava peeler can operate, but improvements are needed, especially on the delivery roller and paring knife. The use of pneumatic technology can be an alternative to be applied, especially in the conveying roller. Meanwhile, the guide rollers at the top and bottom must be able to grip the cassava well. Rubber material specifications must be able to adapt to wet cassava conditions. The blade material is an important thing to pay attention to because the depth of the incision of the cassava peel affects the driving force of the conveying roller. Therefore, the sharper the stripping knife the delivery roller works, the lighter it will be. In addition, the flexibility of the paring knife is important, so that the paring knife can adjust the shape and size of the cassava.

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