DEVELOPMENT OF POST HARVEST MECHINERIES FOR CASSAVA TO SUPPORT FOOD DIVERSIFICATION IN INDONESIA

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ABSTRACT
Indonesia is rich in carbohydrate food sources such as tubers and seeds. In term of tubers, cassava has great potential, because beside of the production is quite high and still can be improved further, can also be processed into flour and then processed into various foods that are well known to the public, such as bread and noodles. In Indonesia, the development of cassava commodity not only to meet domestic demand growth, but also the considerable export potential. In the last five years Indonesia continues to increase cassava production. In 2009 production was 22 million tons, while in 2010 was 23 million tons, and then in 2011 was 24 million tonnes. Cassava production in Indonesia is largely generated in Java (56.6%), Lampung (20.5%) and other provinces in Indonesia (22.9%). Common problems in planting cassava is low productivity and income. Low productivity caused by not applying correctly cassava cultivation technologies such as fertilization. Statistics shows the harvest area reduce 10% in ten year, the yield increase 57% and the production increase 41%. Food diversification is one of the agriculture ministry program. Indonesia is rich in various food sources, both carbohydrates and protein. For carbohydrates, in addition to rice then there are many other foods that can be selected, other food sources with substantial production are maize, cassava and sweet potato. Cassava is a potential resources of carbohydrates that able be processed immediately, cassava also can be processed into a various food products such as cakes, bread and noodles. Indonesian Center for Agricultural Engineering Research and Development developed a set of machinery to process cassava into modified cassava flour which can be processed further as many kind of food such as noodle, cake and bread. The machineries have been adapted test in cassava farmer. A set machinery for cassava processing contains slicer, dryer and miller.
I. INTRODUCTION

Indonesia is rich in carbohydrate food sources such as tubers and seeds. In term of tubers, cassava has great potential, because beside of the production is quite high and still can be improved further, can also be processed into flour and then processed into various foods that are well known to the public, such as bread and noodles.

In Indonesia, the development of cassava commodity not only to meet domestic demand growth, but also the considerable export potential. In the last five years Indonesia continues to increase cassava production. In 2009 production was 22 million tons, while in 2010 was 23 million tons, and then in 2011 was 24 million tonnes. Cassava production in Indonesia is largely generated in Java (56.6%), Lampung (20.5%) and other provinces in Indonesia (22.9%).

Common problems in planting cassava is low productivity and income. Low productivity caused by not applying correctly cassava cultivation technologies such as fertilization. Statistics shows the harvest area reduce 10% in ten year, the yield increase 57% and the production increase 41%.

Cassava demand has increased from year to year, as a result of increasing population and increasingly diverse uses of cassava, from the food industry to biofuel. Meanwhile, the harvested cassava have a tendency to decline, so increasing yield becomes very important in order to increase the production of cassava.

Food diversification is one of the agriculture ministry program. Indonesia is rich in various food sources, both carbohydrates and protein. For carbohydrates, in addition to rice then there are many other foods that can be selected, other food sources with substantial production are maize, cassava and sweet potato. Cassava is a potential resources of carbohydrates that able be processed immediately, cassava also can be processed into a various food products such as cakes, bread and noodles. Indonesian Center for Agricultural Engineering Research and Development (ICAERD) had developed a set of machineries to process cassava into flour (i.e modified cassava flour) that able to produce various of processed food and to design the mini mill to produce mocaf capacity of 10 tons
/ day. A set of machineries which is required in mocaf processing is slicer, fermentors, press machine, dryers, miller and sieving.

II. METHOD

Mocaf processing process flow and design capacity of processing Alsin mocaf presented in Figure 1.

<table>
<thead>
<tr>
<th>Flow of process</th>
<th>Flow of material</th>
<th>machine</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh cassava</td>
<td>Ubi kayu segar 10 ton</td>
<td></td>
<td>10 ton ubi kayu segar</td>
</tr>
<tr>
<td>Pealing and washing</td>
<td>Pealed fresh cassava ± 8 ton</td>
<td>manual</td>
<td></td>
</tr>
<tr>
<td>Slicing</td>
<td>Fresh sliced cassava ± 8 ton</td>
<td>Slicer</td>
<td>1 s.d 1.3 ton/hr</td>
</tr>
<tr>
<td>Fermentating</td>
<td>Fermented cassava chip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressing</td>
<td>Fermented cassava chip</td>
<td>Pressing machine</td>
<td>1 ton/jam</td>
</tr>
<tr>
<td>Drying</td>
<td>Dried cassava chips 2-3 ton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milling</td>
<td>Flour</td>
<td>Miller</td>
<td>Capacity 2.5 ton/day or 300 kg/hour</td>
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<tr>
<td>Sieving</td>
<td>Flour, mesh &gt;100</td>
<td>Siver</td>
<td>Capacity 2.5 ton/day or 300 kg/hour</td>
</tr>
<tr>
<td>MOCAF</td>
<td></td>
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</tbody>
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Gambar 1. Flow chart of MOCAF Processing
III. RESULT

Indonesia's dependence on wheat products are very large, but almost the entire production of wheat are imported. The average total wheat imports in Indonesia (fresh and processed) is 5.46 million tons / year and flour consumption continues to increase each year (Anonymous, 2008). Based on Indonesian Central Bureau of Statistic data, the consumption of wheat in 2003 was 19.8 g / capita / day, increased in 2006 to 22.6 grams / capita / day and in 2008 the consumption of wheat reached 38 g / capita / day. Currently cassava processing technologies developed to produce Modified Cassava Flour (MOCAF) that can be used as a substitution of wheat. In MOCAF processing, certain processing stages required to remove the distinctive aroma of cassava. MOCAF found not only be used as supplementary material, but can be directly used as a raw material of various kinds of food, such as noodles, bakery, and cookies. Center for Agricultural Engineering Research and Development at 2011 has developed MOCAF processing machines, they consist of slicer, press machine, hammer mill, and sieving machine.

MOCAF Machines construction

(a) Slicer

Slicer machine is mainly made from stainless. The slicer consists of 8 pieces of stainless blades that are stick to a stainless plate which has diameter 50 cm and 10 mm thick. For simple maintainanance purposes, the knife blades are attached to the plate using nuts & bolts. The plate is rotated vertically by an 8.5 HP diesel engine using V-belt and pulley transmission. The designed capacity of slicer machine is 1000 kg/hour and expected thickness of cassava slices is about 2-4 mm. Slices with a thickness of less than 2 mm will cause a lot of released starch, while thick slices will prolong the drying process. Observation of effect of rotation and space of knife to slice thickness distribution was analyzed by measuring 20 sheets of slices as samples taken at random.
(b) **Press machine**

Press machine has function to reduce the excess water on the fermented cassava slice. A horizontal hydraulic press type is utilized for this purpose. A horizontal type was selected as this type was designed for 2 strokes of forward movements. The first is pressing for reduction the water content and the second is pushing out the pressed slices from press box. The main components of the machine are a square press box, piston and frame. The press box has dimension is (685 x 435 x 265) mm made by 3 mm thick of MS sheet covered with 1.8 mm thick of SS sheet. This machine was designed to have working capacity of pressing 50 kg wet slices in 3 minutes.
The hydraulic silinder was designed to give pressure force of 20 MPa. This available standard part of hydraulic silinder has diameter of 50 mm with maximum stroke 800 mm and effective stroke 550 mm. The frame of the machine was made from UNP 50 steel and UNP 80 steel.

(c) **Hammer Mill**

Hammer mill machine is utilized for milling the dry chips into flour. The main components of the machine are inlet hopper, milling space, static hammer bars, rotated hammer bars and screen. The area of contact with food material is made from stainless steel. The main frame is made from UNP steel 50. The static and rotated hammer bars are made from stainless steel rectangle as. The screen is made from perforated 60 mesh stainless plate. There are 2 hammer mills used in this plant, each has capacity of milling 175 kg dry chips/hour.

![Figure 3. Hammer mill](image)

(d) **Sieving machine**

Sieving machine is used to sieve flour of 100 mesh size. The accepted market standard for MOCAF flour is 80 - 100 mesh (SNI 7622:2011). The type of sieving machine applied in this plant is the octagonal rotated screen. This type of sieving machine has been widely applied in traditional flour mill.
The machine construction is made mainly from stainless materials, especially for parts which have direct contact with the product. The UNP steel is used as the framework construction materials of the machine. The main parts of the machine consist of feeder, sifter, pressure brush, outlet, engine and reduction gear. The hexagonal shifter is rotated using the power from a 24,5 HP diesel engine with the transmission from chains, reduction gear, belt, pulley. The percentage of flour produced as much as 69.76% mesh size 80. It was pointed out that the flour results miller complies expected target is at least 80 mesh. White degrees on average is 93.8%. White degree requirement according to ISO 7622: 2011 is a minimum 87%, so that the resulting flour has met the quality requirements of Indonesian Standard of MOCAF.

![Figure 4. Sieving Machine](image)

**IV. CONCLUSION**

The test results mocaf mini mill goes well, the performance and capacity of 10 tons / day, the capacity is calculated from the weight of fresh cassava as input in plant mocaf. Mocaf processing machines that have been engineered on the activities of FY 2011 is penyawut with a capacity of 1.3 tons / hour, presses with a capacity of 1 ton / hour, two penepung units with a total capacity of 350 kg / h and a sieve with a capacity of 500 kg / h.

Cost of each machine is $ 30 / kg for penyawut machine; USD 27 / kg for pressing machine; Rp 108 / kg for penepung machines and Rp 136 / kg for sieving machine. Mocaf production cost reduction targets through the application of this technology can be achieved when the price of cassava Rp 600 / kg. With this price level, the application of mocaf processing
machines can lower the cost of production of dry chips of 0.34% or Rp 2,359 / kg; mocaf and lower production costs by 31% or Rp 2,893 / kg. The value of B / C ratio is 1.66 and ROI in 2 years.

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