

Evaluation of Cassava Processing Equipment developed by ESARC in Uganda.

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1. Objective of evaluation of equipment:

The ESARC team, together with researchers of the National Cassava and Post-Harvest Programs of NARO, has made some serious efforts to introduce new Cassava processing technologies for Uganda. As the need of processing 'bitter' cassava was a high priority in the period '95-'98 due to the outbreak of the Cassava Mosaic Virus and therefore the shortage of 'sweet' varieties the team initially focused on small equipment. More recently the emphasis has been on the setting up of in-come generating, sustainable cassava processing enterprises operated by farmers, groups and commercially oriented individual farmers. Powered driven equipment enables people to process bulky cassava in a more economically way providing them with a income and high quality cassava flour.

The ESARC team and a few dedicated metal workshops in Kampala and Soroti developed and kept modifying the equipment. Several farmers' groups made feedback and recommendations for modifications during the on-farm test phase. The metal workshops are well motivated in modifying the current designs and are trying to market the models themselves during trade and farmers shows. Main objective remained to come up with appropriate and affordable equipment for farmers, providing them with an incom-generating activity.

This equipment evaluation was carried out to document the current existing processing equipment, identify shortcomings and made recommendations for further improvements. The tests were conducted late '99 at Namulonge (IITA's Research Station) and with assistance of the dedicated staff of Tonnet Enterprises in Kampala.

2. The need to modify equipment by ESARC during '97-'99

Various important reasons to keep improving and modifying the equipment:

- Ideas and recommendations obtained from abroad (e.g. West-Africa, Brazil, Vietnam and literature)
- Recommendations made by metal workshops and farmers during construction and processing process
- Need to reduce construction costs and availability of materials
- Need to improve processing performances

New ideas and findings made through doing research

3. The range of Equipment currently available in Uganda



MK 1 Cassava Grater

Design developed by IITA's Post-Harvest Engineering Unit, Ibadan, Nigeria. This model has been widely promoted in West-Africa among IITA partners (i.e. Sasakawa/Global 2000) as a better alternative for the local models graters used throughout West-Africa. Grating surface is a punched metal sheet wrapped on a cylinder/drum. The specially designed hopper shape was designed to guarantee safe and fast feeding. The grater can also

be used to process fruits (i.e. pineapple) to extract juice.



MK 2 Cassava Grater

First modified prototype developed by ESARC team and SAIMMCO Soroti. The hopper was re-designed to allow faster feeding without using sticks and/or operator's hands. The engine is lowered to reduce noise and make the model more stable.



MK 3 Cassava Grater

This model is based on the MK 3 but constructed with stronger materials and welds in order to reduce vibration and improve durability. The hopper shape was further improved to reduce the particles of the cassava meanwhile maintaining its "non-intervention" feeding system. The hopper is mounted on hitches allowing easy and quick access to the metal grater drum for cleaning and check-ups.



MK 4 Cassava Grater with Metal drum

These 2 models are similar to each apart from the grating drum. The overall construction is simplified and reduced in order to reduce costs, construction weight and ease maintenance and cleaning. MK 5 is equipped with a metal drum with hacksaw blades based on a Brazil model.



MK 5 Cassava Grater with Wooden drum

The wooden grater is based on a Vietnamese design using a wooden drum with small 'nails'. The nails, 4-6 mm long are made out of electric cable wire. This nail grater should produce a finer cassava mash (i.e. starch).



MK 6 Horizontal Disc Grater

This model was designed to improve further the feeding of tubers as the previous models still needed additional operator's assistance (incl. the risk of injuries and accidents). The disc is fitted with hacksaw blades and the top-lid can be easily opened for inspection and cleaning. The unit powered by a 4 Hp lane mower engine with a gear reduction to increase traction. Due to the high speed this model should be ideal for starch processing.



IITA Chipper

This design and the Chipping disc is developed by the IITA PHEU in Nigeria. It can be electric driven or attached on the Power Grater. Chipping cuts out the dewatering operation but unfortunately is only appropriate for processing of sweet Cassava varieties as it does not reduce the HCN levels considerable. Dried chips dry within 2 sunny days and can be further processed into high quality flour, animal feed and snack products.



Power Chinner/Slicer



This ESARC's model is equipped with a 3.5 Hp Petrol engine, speed reduction to improve the chip quality and thickness. This model can be mounted with a slicing disc for processing both cassava and sweet potato. Dried sweet potato is common staple food and practice in Teso, Eastern Uganda.

4. Testing Proceedings and Results

Test Proceedings

The capacity of each machine was measured by processing 100 kg peeled Cassava by one single operator. The Cassava, PDB, 18 months old was soaked 1 for logistic reasons. Night. Samples of the various flours, chips and slices were taken to analyze the cyanide levels of the final product. Particle distribution was determined with simple household sieves as more sophisticated sieves were not available. The Starch was screened through a cloth similar used for cassava screening in Vietnam, using approx. 25 liters of water/batch. 1 Kg of wet grated cassava was screened and the 3 fractions (course, finer and starch) were oven dried and afterwards weighted to calculate the starch recovery efficiency. Dry matter content of the fresh roots: 31%. Max rpm of Petrol engine: 3150 rpm.



Test Results	Output (kg/hours) with one Operator	Estimated RPM (range) Of drum	Dry Matter Content of dried flour (%)	CN levels of dried final product	Partical distribution at low rpm		
					Fibers	Finer	Starch
Power Chipper	600	410-773	89	19.3	Fibers	Finer	Starch
Power Slicer	650	410-775	87	17.3			
MK 3 Power Grater	1050	860-1800	84	8	33..3	6.1	60.6
MK 4 Hack Saw Blade Grater	330	1100-1150	84	12	33.8	6.1	60.1
MK 5 Starch Grater	325	1100-1150	86	18	35.8	5.2	59.0
MK 6 Horizontal Disk Grater	-	1150-3150	83	7	25.3	6.4	68.3

Observations and recommendations for improvements:



improvements:

1) The cover of the chipping box should be wider: there is too little room for the chips to get out without breaking through impact with the rotating disc.

2) The RPM could be lower in order as now the best processing speed is when the engine runs on the idle speed.

Recommendation: reduce RPM disc by using a intermediate, second shaft with a pair of polly between the engine and disc?

3) The overall design could be simplified as the construction is still too big: no need for table at the top (why not incorporating a holder for a plastic basket?).

4) Current chipping discs are imported through the Post-harvest Engineering Unit, IITA, Ibadan, Nigeria and difficult and expensive to obtain. Therefore there is a strong need to establish a local source of a similar chipping plate in East-Africa as sweet varieties (and therefore chipping in particular) will become more important and popular among farmers and processors. The new fly-press installed soon at TONNET Enterprise in Kalerwe could be a good starting point for making them locally in Kampala although this requires technical assistance/guidance and financial assistance.

**MK 4 Hack Saw Blade Grater****Observations and recommendations for improvements:**

1) Current speed is too low; in stead of a speed reduction of 1:3 (max. 1100 rpm) a reduction of 1:2 or even 1: 1 will perform much better (higher capacity and finer product).

2) The guard is too close to the V-belt and pouly : needs enlargements and allowances for adjustment of the engine.

3) Make the cover/lid of the drum easier assessable by using a pair of hitches like MK2 and MK3. The inlet of the hopper should be narrowed according to the effective working width of the drum. The strips on both sides are now just blocking the tubers affecting the capacity of the machine. The feeding tray should be divided in 2



compartments by one guide/separator in the middle. As the speeds increase there is also a need to cover the top of the feeding tray as some tubers tend to shoot upwards/back.

4) Need to reduce the vibrations by:· reducing the cause of vibrations namely balancing the drum, shaft and pouly (e.g. counter- bolts for the locking of the pouly on the shaft rather than one single bolt)· incorporating 2 cross-angles in the support frame of the grater (lengthwise),· attaching 2 fixed wheels under the at outlet tray side and a two rubber shoes below the extended feet on the other side. The wheels will ease the movement of the machine and absorb vibrations. On this side we could make a handle bar (square bar in a bigger square bar, with locking pin and handle at the end)



5) The hacksaw blades looked to be strong and durable (hardened steel blades imported from Brazil) but during the last test with Shea Nuts two blades broke and came out. Questionable is the ease of replacements of the blades, as everything seems to be welded very firmly locked and hidden away; making it very difficult to carry out replacement/repairs.



6) Make the cover/lid of the drum easier to open by using a pair of hitches (like MK2 and MK3). The inlet of the hopper should be narrowed according to the effective working width of the drum. The guards on both sides are now just blocking the tubers and therefore affecting the capacity of the machine. As the speeds increase there is also a need to cover the top of the feeding tray as some tubers tend to shoot upwards/back (discussed with Joseph Kavuma).



Observations and recommendations for improvements:

1) During the tests at Sendusu the speed was set on 1075 rpm and the capacity and fines of the product was very low. After changing the poulies (1: 1 transmission rate) the speed went up to max. 3200 rpm. After testing the machine again at different speeds, between 1700 up to 3200 rpm, we observed a strong relationship between increased speed and quality. A good speed is 2500 rpm as at this speed the Cassava is going through the grater without assistance of the operator (e.g. pushing). With the speed set around this design is most likely the best machine among the MK grater family for starch and flour processing.



2) Need to reduce the vibrations by:· reducing the cause of vibrations namely balancing the drum, shaft and poulie (e.g. counter- bolts for the locking of the pouly on the shaft rather than one single bolt)· incorporating 2 cross-angles in the support frame of the grater (lengthwise),· attaching 2 fixed wheels under the at outlet tray side and a two rubber shoes below the extended feet on the other side. The wheels will ease the movement of the machine and absorb vibrations



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3) Enhance the accessibility of the wooden spacer as this one is still hidden under the feeding tray (by making the spacer wider; allowing the locking bolts to be situated further from the drum).

4) Make the cover/lid of the drum easier to open by using a pair of hitches like MK2 and MK3. The inlet of the hopper should be narrowed according to the effective working width of the drum. The strips on both sides are now just blocking the tubers affecting the capacity of the machine. The feeding tray should be divided in 2 compartments by one guide/separator in the middle. As the speeds increase there is also a need to cover the top of the feeding tray, as some tubers tend to shoot upwards/back.



5) The 'nails' are good attached in the wooden drum: approx. 3 millimeter above the surface and 7-8 nails per cm.



6) The guard is to close to the V-belt and pouly : needs enlargements and allowances for adjustment of the engine as the V-belt is some case touches the guard.