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An Automated Peeling Machine for Large Scale Industries

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Introduction

Cassava, *Manihot esculanta crantz*(syn. *manihot utilisima* pohl), is a dicotyledonous perennial plant belonging to the botanical family Euphorbiaceae. It is a starchy root crop that is grown almost entirely in the hotter lowland and the tropics. The crop grows easily, has large yields and is little affected by diseases and pests thus, the areas under cassava cultivation are increasing rapidly. It is the main source of energy for between 200 and 300 million people Africa now produces cassava than the rest of the world combined with biggest increase from 22% to 35% (of African total production) in Nigeria and 4% to 8% in Ghana (IITA, 1997 and FAOSTAT, 2004). Development of various machines for processing cassava is now receiving attention in many cassava producing nations especially in Nigeria, China and Brazil. Some researchers Olukunle (2005), Olukunle et al (2006); Odighoh (1983) and Sherrif et al (1995) made appreciable research attempts on the properties of cassava as well as on design of appropriate mechanical devices and systems for cassava handling and processing. To design efficient and effective equipment for peeling cassava tubers, certain factors need to be known. Cassava root is usually elongated, has depressions and crevices along its length and tapers to one end. In most cases, the middle part has a fairly constant diameter. Whereas the head end has a relatively larger diameter, the tail end has a considerably smaller diameter when compared with the middle part.

Material and Methods

The cassava tubers *(Manihot utilissima)* used for the experiment were acquired from a local farmer around FUTA community. The tubers planted one and a half years before harvest; these were newly harvested and adopted for the peeling experiment almost immediately after the purchase. Remaining tubers were placed in shades to prevent tuber dehydration. The research work was carried out in January when the moisture in the soil and that of the tuber is low. 100 samples of similar weight in each size ranges were selected for each peeling process and for each of the machines. 10 samples of similar weight in each size ranges were also selected as control experiment. A variety of tools and instruments were used to carry out different measurements on the root tubers. A tap rule was used to measure the length of roots while the diameter of the roots was measured using a pair of vernier caliper. The weight of root before peeling, after peeling and weight of peel were measured with an electronic weighing balance. Time of operation was measured by stop watch while the residual peel was removed by kitchen knife.

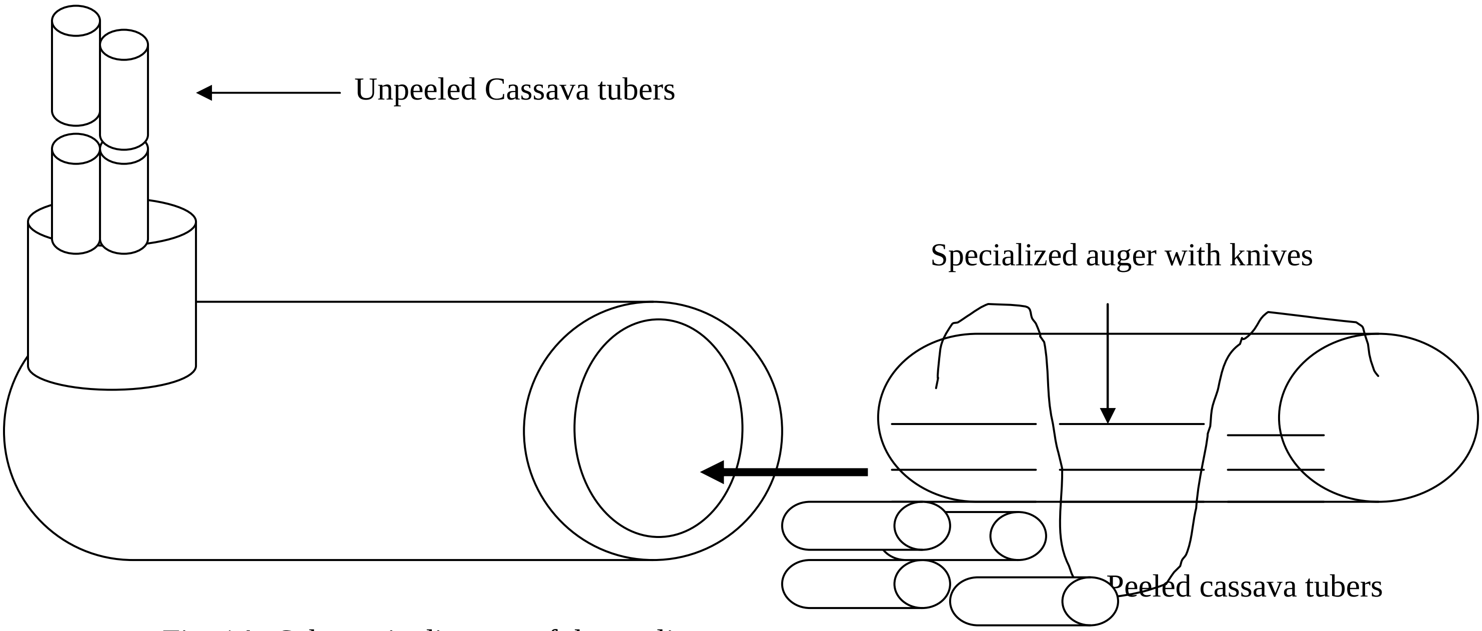

Fig. 1A: Schematic diagram of the peeling process.

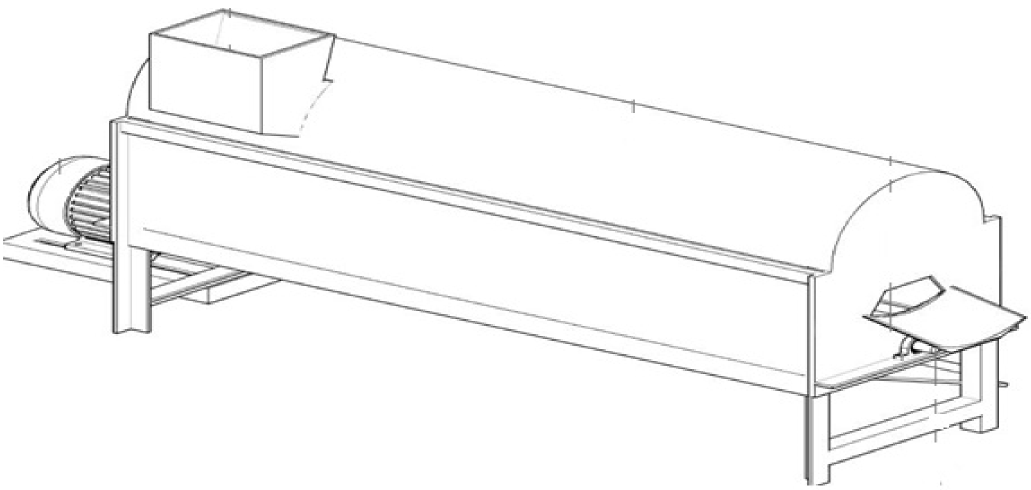

Fig.1 Automated Cassava peeling machine

Results and Discussion

The modifications introduced into this design are commendable. Each producing desired effects on the peeling process. The increase in length of the peeling tool and hence the residence time of tubers within the peeling chamber influenced the peeling process remarkably. The peeling tool was increased in length from 1.2 m to 2.4 m. This permitted more contact with the peeling tool as the tuber moves through the peeling chamber.. Soft - elastic material on the tuber monitor introduces higher slippage, which is required to increase the residence time of tubers in the peeling chamber. Thus the outer layer and part of second layer were removed in one pass of the tubers through the first peeling chamber. This represents an appreciable improvement on the previous designs. Tubers were presented in three categories of both length and diameter. Length of 20 – 25 cm and diameter of 8 – 10 cm produced an efficiency of 79.5% and a capacity of 95 Kg/hr respectively at a brush speed of 1200 rpm and auger speed of 150 rpm. The functional efficiency (Peeling efficiency) was highest in cocoyam but lowest in cassava. However minimum efficiency of 75.5% was recorded with cassava peeling and a maximum peeling efficiency of 95.2% was obtained with cocoyam. Other parameters affecting the performance of the machine include auger speed, brush speed and moisture content of tubers. The speed of the metering device influenced the peeling process significantly at constant or variable speeds of the auger and brush. The speed of the metering device determines the residence time of the tuber in the peeling chamber. Tuber damage and peeling efficiency were also influenced by the speed of the metering device. The machine is recommended for immediate commercialisation and utilisation for large scale entrepreneurs.

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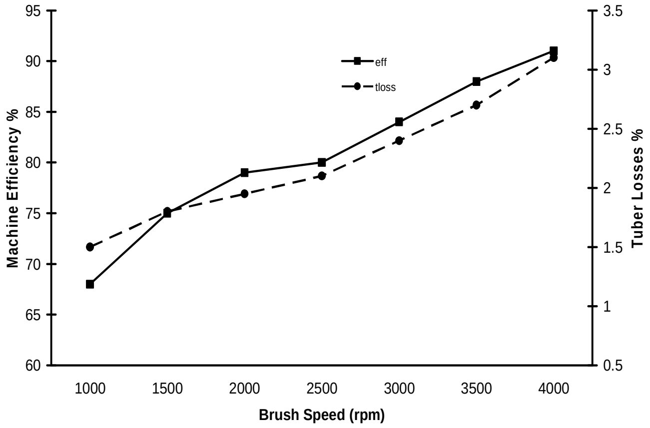

Fig. 2: Effect of Brush speed on Machine Efficiency and Tuber losses at constant Auger Speed of 300 rpm , 60 % MC, Day 1 and 2.0 Peel thickness

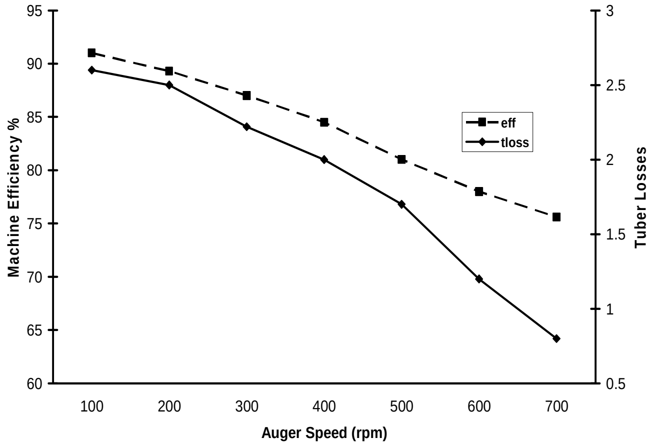

Fig. 3: Effect of Auger Speed on Machine Efficiency and Tuber Losses at constant brush speed of 2500, 2.0 mm , 60 % moisture content and Day 1 after harvest.

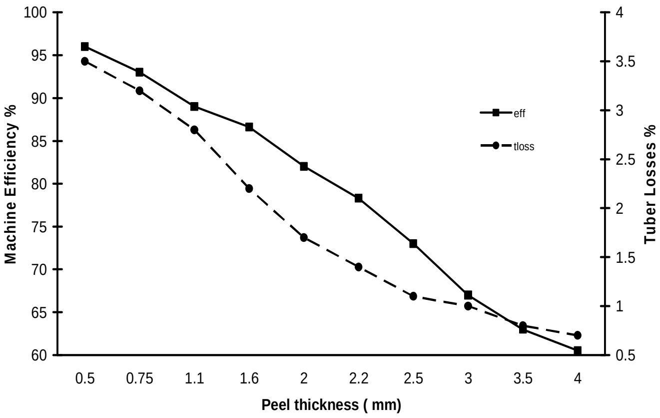

Fig. 4 : Effect of Peel thickness on Machine efficiency and Tuber Losses At constant auger and brush speeds of 300 rpm: 1500 rpm, Day 1and 60 % MC

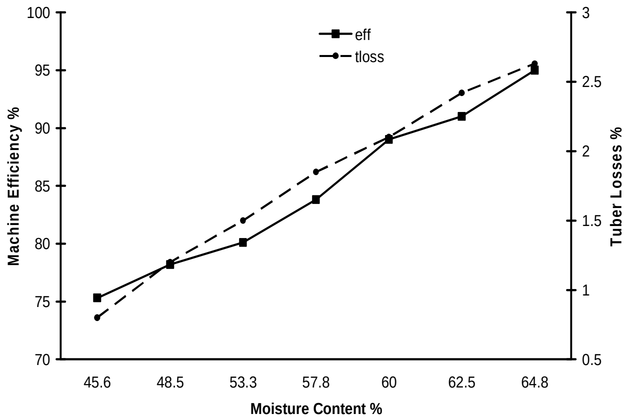

Fig.5: Effect of Moisture Content on Machine Efficiency and Tuber Losses At Constant auger and Brush Speeds of 300: 2500 , Day 1, 2.0 Peel thickness and

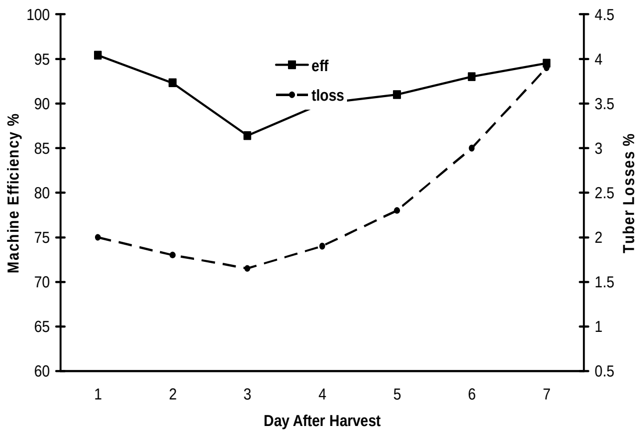

Fig.6 : Effect of Day after Harvest on Machine Efficiency and Tuber Losses at auger: Brush Speeds of 300:2500, 2 mm and 60 % MC.