Performance of Cassava Peeling Machines in Nigeria: a Review of Literature

Oyedele Tobiloba1*, Kilanko Oluwaseun1 and R.O. Leramo1

1Department of Mechanical Engineering, Covenant University, KM. 10 Idiroko Road, Canaan Land, Ota, Ogun State, Nigeria
Corresponding Author; oyezsenior@gmail.com

Abstract-
A review is done on the indigenous cassava peeling machines made in Nigeria. Cassava is a very important cash crop that can be processed into more than a thousand products. One of the most important unit operations in cassava processing is peeling and its importance can never be overemphasized. Some of the other unit operations in cassava processing have already been successfully mechanized. To all engineers who have been involved in equipment design of cassava globally, cassava peeler has remained a serious problem to them. This study presents the functionalities, prospects, performance assessments and limitations in some of the indigenous cassava peeling machine. Some of the machines that have been made are the knife edge type peeler, double and single gang peeler, automated peeler, etc. Evaluated in this paper are there unique advantages and functional parameters, such as the speed of the machine, output size, efficiency of peeling and tuber loss. The machines have an operational speed ranging from 40 to 700rpm, output capacity ranging from 10.4 to 725kg/h, peeling efficiency ranging from 48.8 to 92.0% and tuber loss ranging from 2.5 to 42%. Peeling efficiency decreases as the speed of all the machines evaluated increase. There was also an increase in the loss of tuber and output capacity as the speed of the machines increases. With an improved cassava peeling process, there is a possibility that cassava cultivation will be encouraged and other uses of cassava will be harnessed. Part of what will be affected are better product quality as there will be minimum loss in tubers and an increased processing time.

Key words: Cassava, Peeling Efficiency, Output Capacity, Performance, Reaction Time, Brushing

1. Introduction
Among many developing tropical economies today, Manihot esculenta Krantz also known as cassava has become a very essential crop. It is a mono specie dicotyledon seasonal crop that falls to the botanical family of Euphorbiaceous. Cassava is grown mainly in Brazil, China, Philippines, Thailand, Malagasy, Malaya, Indonesia, India and tropical parts of Africa like Nigeria and Ghana [1]. Cassava roots as well as other tubers like yam structure the most staple nourishment crops in tropical Africa and are key to the daily carbohydrate demand in the diet of this region. One very important quality of this root that has made it an important food security crop mostly among low-income countries is its ability to grow fully well in poor soil and another
important quality is its inherent ability to stay for long period of time in the soil even after maturity without undergoing degradation of some kind. Olukunle (2005) in his work reported that due to technological advancement, production of cassava was required in so many areas so as to help in its use in the oil and gas sector, quick industrialization and for remote trading [2].

Cassava is an economic important crop which was in the 16th century brought from south America into central Africa. Nigeria being the highest producer of cassava later had the root crop brought into the country from islands of Sao Tome and Fernando po in the seventeenth century and has since become widely distributed throughout the country [3]. Nigeria produces about 34million tonnes of cassava root on a yearly basis and this has made them the largest producers of this root followed by China. Despite being the largest producers, most of our farm produce are consumed locally and based on statistics gotten from FAO of the United Nations, Thailand is ranked number one among countries with the largest amount of cassava chips exportation. As at 2005, the exportation of Thailand alone amount to about 77% of the world’s exportation [4]. The 2nd, 3rd and 4th largest exporters of cassava root in the world are Vietnam, Indonesia and Costa Rica with a percentage of 13.6%, 5.8% and 2.1% [5].

Cassava is a seasonal root and this is one factor that has made people have interest in it. Though cassava is not the only seasonal crop as there are other seasonal crops like beans, cereal, grains, etc but cassava being a woody shrub has made it more preferable than others. Cassava is so rich in carbohydrate and has more starch than other crops. There are more than a thousand end use that can be gotten from Cassava [6]. Not all part of cassava is edible enough to be eaten like the outer part of the root which is made up of corky periderm that must be peeled off and also the cortex that contains cyanogenic glucose very toxic to man [7]. Cassava has multiplicity of end use and being a high energy carbohydrate root, its usage encompasses a wide variety of product. The starch that can be gotten from it is needed by so many industries such as the food industry using it as a supplement, the pharmaceutical industry using it as a binder and even nonfood industries like tile manufacturers who also make use of the starch as a binder. The roots during cultivation are found just below the soil surface and always appear in clusters. There length ranges between 30cm to about 120cm and in diameter from about 4cm to about 15cm [8].

2. Production and Utilization of Cassava
According to statistical reports by the FAO of the United Nations, the total amount of cassava produced in the world amounted to about 230 million tonnes in the year 2010 [4] and this made it an increase of 25% compared to the amount of production in the year 2000. Nigeria became the world largest producer of the root crop in the year 2010 when out of the 230 million tonnes produced in the world, they contributed about 37 million of it. Following Nigeria in Africa were Democratic Republic of Congo, Angola, Ghana and Mozambique occupying the 5th position [4]. The estimated average worldwide yield of cassava in 2010 was 12.4 tons per ha. The lowest yields are in African countries and the highest yields are in Asian countries. In India, the maximum yield was 34 tons per hectare [4].

Production of cassava by capital data goes to show how important cassava in Africa is. Angola led the 726 kg per capital production in 2010, followed by the 563 kg per person production by
Ghana that are sufficient to fully meet the carbohydrate requirements of the people in their countries.

In African development, Cassava plays five significant roles which are: agricultural reserve crop, rural staple food, source of generating fund for both people in the rural and urban areas and lastly it serves as raw material to so many industries [9]. About one-third of is mainly used in South America as animal feed, preceded by human consumption and production of starch. In continents like Asia, the fresh roots is mainly for consumption followed by exportation to the European Union who use them to make animal feed. Of late, its use in the production of biofuel is on the increase [10]. From 2010 FAO statistics, Cassava is Mozambique's primary crop and it contributes to a great extent more than 40% of the total energy requirement the human needs [4].

2.1 Mechanization of Cassava Processing

The mechanization of cassava processing by engineers of the Federal Institute of Industrial Research Oshodi (FIIRO) started in the early 1960’s [5]. Prior to that, the processing of cassava into local staple foods was done manually in which case; long hours and much energy were expended only to turn out small quantities of product. Having realized the need for improved methods of making cassava product in large quantities so as to meet the increasing demand for domestic use, FIIRO engineers designed the first mechanized gari processing machine [5]. This machine was licensed to Newell Dunford Engineering of the United Kingdom for fabrication. Efforts have since been directed towards meeting the challenge of full mechanization of cassava processing.

Cassava mechanization was initiated in the early 1960s by engineers from the Federal Institute for Industrial Research (FIIRO) located at Oshodi [5]. Before that, cassava was handled manually when processing it into local staple food. This manual way only turn out little of product after expending much human energy and also longer hours of production. FIIRO engineers decided to design the first mechanized gari processing machine in 2006, after considering the impact of the needs for improved methods to make cassava product in large quantities in order to meet the growing demand for home usages [5]. FIIRO got licensed to manufacture the machine by Newell Dunford Engineering in the United Kingdom. Ever since then, efforts have been made to tackle the challenges of complete cassava mechanization. A 610 ton per day processing plant was built by Newell Dunford Engineering in the 1970s. The peeler used by Newell Dunford Engineering (NED) UK was a revolving eccentric drum which resembled a conventional concrete mixer except that it had an abrasive inner lining. Roots rubbing against the lining and against one another accomplished the peeling effect and water was continuously sprayed into the peeler to wash out the peels [5].

Agbetoye [11] developed a hand-fed single and double gang peeling machine that achieved its peeling through the use of a rotary brush. This was done in a collaborative effort between IITA and FUTA. This machine after testing had more than 8% of its useful flesh wasted with a machine efficiency that was less than 80% with unsatisfactory output yield that was described unacceptable by the authors. The maturity (age) of the root greatly affected the output of the
machine as cassava roots that were peeled same day of harvesting peeled better than those that have spent some days after harvesting [12]. This also underlines the need for a thorough study of root properties with a focus on age and variety. Olukunle et al. [12] had the roots cut into slices longer than 10 cm otherwise they would be difficult to be handled properly. The selffed peeler also reported a peel retention of up to 16 percent which made it unfit for end products such as garri and cassava flour.

2.2 Cassava Peeling
Peeling involves the removal of a thin layer (usually called the peel) from a stock. The stock may be fruit, root or tuber, and wood or even metal [13]. It is essential to remove the peels of cassava roots as it is known that the concentration of cyanogenic glucoside responsible for cassava toxicity is highest in cassava peels. For industrial or human use, the processing of cassava roots involves various operations, of which peeling is important. Peeling efficiency affects the quality of the product as it results to some unwanted contents if not properly peeled. In certain cases, peeling may be unnecessary, particularly if cassava is used as animal feed [14]. Cassava peeling has been practiced as much as when cassava was formed, but from sharp stones and edges of wood to simple household knives, the peeling instrument has evolved over time. This makes it difficult to peel a large amount of Cassava root [14]. The cassava peel has two categories, namely the outer layer also known as the periderm or cork tissue and the inner layer also known as the cortex, according to [11]. Cassava roots differ in weight, size and shape and this has made peeling process difficult to achieve. The properties of the cassava peel also vary from one peel to another and these variations include its thickness, texture and strength of root flesh adhesion. A cassava peeling machine that can efficiently peel all roots from different sources is therefore difficult to design because of the large differences in root characteristics. Several studies have been conducted suggesting that peeling can be classified in two ways which are the manual peeling and mechanized peeling. These two classes of peeling can be further grouped into different methods which can be seen in table 1.

| Table 1: Classification of peeling |
|-----------------------------------|
| Manual peeling | Mechanized peeling |
| Hand peeling | Abrasion peeling |
| | Chemical |
| | Steam |
| | Flame |

2.3 Manual Peeling
Cassava peeling is still majorly carried out manually. The effectiveness is low and not suitable for commercial purpose [15]. Women and adolescent girls, however, usually take part in the root peeling. Peeling at the rate of 8 hour / person can yield cassava of about 350 kg / day [16]. Peeling is usually done by hand with a knife at village level. The peel is slit along one side of the root then the knife and fingers are used to roll back the peels from the fleshy fraction of the root. This method is used in all different varieties of cassava root found. In some difficult varieties of peels, the two layers of peel are chopped off with a knife just as a pencil is being
sharpened by gradually removing the peels a step at a time. This procedure is less satisfactory because some of the flesh and the peels are usually removed leaving some of the skins to be left on the root. Manual peeling using knives causes a lot of the skin of the cassava where most of the cyanide resides to be removed. It is also slow and labor intensive but research results have shown that this method still yield the best result [17].

2.4 Abrasive Peeling
The abrasive type peeling machine works on the principle abrasion. Peeling is achieved when the cassava comes in contact with an abrasive material. The abrasive material rubs off the peel from the cassava. A spring loaded cassava peeling machine with 5 spring loading points equally spaced at 140 mm intervals was been designed by [18], which is located along the knife length with a spring rate of 2.193N / mm at the spring loading points. Cassava was then put into the machine in different root sizes the height of the bed was adjusted to accommodate cassava of different sizes. However, the results showed that 15% of broken root was obtained and the machine having a peeling efficiency of 98.8%.

Three designs of cassava peeling machines (model I, II and III) were designed by [19]. In Model 1, an oil cylindrical tank was mounted on a shaft with an opening of 200 mm to 150 mm so that cassava could be loaded inside the cylindrical tank. The cylindrical oil tank had approximately two-third millimeter diameter holes on each square cm of the surface punched on it. In the cylindrical tank or drum, rotation was carried out at 40rpm with cassava roots with some preknown amount of inert material like pebbles that contains quartz or 3.2-4.8 mm pieces of hard quarry stones inside the drum. The rubbing process removed the peels from the cassava tuber, which eventually resulted in a perfect and even peel. Then water was sprayed to remove the fine abraded peels so as to prevent the abrasive surface from fouling and blunting. Balls of expanded metals have been used as replacement in model II. The third model had 4 cylinders which were abrasive and was installed inside the drum were peeling is to be done. The four cylinders rotated about their axis and were rotating 4 times the rpm of the main drum through the meshing of some gear arrangements.
Table 2: classification of abrasive peeler

| Continuous Abrasive peeler | Batch Abrasive Peeler |
|---------------------------|-----------------------|
| In this method of continuous abrasion, the unpeeled roots are first cut into equal length size and are put inside the spinning drum which has 2 shaft in it with same direction of rotation but at varying speeds while the cassava roots rotate in the opposite direction on an inclined surface with a knife arrangement, which peels progressively. | The cassava roots re not required to be be cut before peeling can be achieved in the abrasive batch type of peeler. The peeling drum which is mounted on a shaft rotating at a predetermined speed has the cassava inserted into it. So as to aid peeling, introduced into the drum are inert elements that are abrasive. As the peeling drum turns the cassava root side-to-side and up- and- down movement of the peeling drum enables the cassava roots to be almost completely peeled. The abrasion process is enhanced by continuous spraying of washing water on the roots. The use of mechanical peelers is dependent on the through-put and the cost of the machine compared with labor wages for peeling by hand. |

2.5 Chemical Peeling

The two types of chemical peeling reported in the literature are: the caustic (lye) peeling and the enzymatic peeling. Toker and Bayindirli [20] reported that in enzymatic peeling, the peel is attached to the root crop because of the presence of pectin, cellulose, hemicelluloses as polysaccharides. So if the cassava root can have its peel treated with glycohydrolases, it will result into enzymatic peeling. This kind of peeling is not used for roots or tuber crops such as cassava, yam or potatoes.

Adetan et al., [21] reported that lye peeling which is the common method manufacturing industries use to peel potatoes can also be used to peel cassava. Peeling here is achieved by making a hot solution of sodium, hydrogen and oxygen to form sodium hydroxide which helps to loosen the skin of the root when the solution is applied on it. Igbeka [14] argued some reasons why this method will not be suitable for cassava peeling due to:

a) Higher operating pressure, higher NAOH concentration, higher temperature and more time needed for immersion may be required for cassava tubers with tougher peels than the peels of potatoes.

b) This can lead to food poisoning because when the concentration of sodium hydroxide is high, the sodium hydroxide in the cassava root will need to be neutralize and the only way the base can be neutralize is by immersing the root inside an acid so as to form salt. This also can lead to more additional running cost.

c) This method usually results in the formation of dark color heat ring which usually appear in patches on the surface of the cassava flesh. So this will hinder the cassava to be processed into foods like garri since it will affect the appearance.
d) If the root is to be used for industrial starch production, this method of peeling will not work because it leads to the gelatinization of starch.

2.6 Steam Peeling
Floros and Chinnán [22] have reported that steam peels are widely used in the processing industries and this is because its high level of automation, accurate time, temperature and pressure control by electronic devices so as to reduce loss of useful flesh during peeling. Steam peeling is either batch or continuous operation and it involves putting some amount of the cassava root inside a pressure vessel and then subjecting them to a pressurized steam for like a minute or two. Steam pressure and temperature up to $150 \times 10^3 \text{ Pa}$ and $160^\circ \text{C}$ are common. The hot pressurized skin ruptures on sudden release of the high pressure [23]. Limitations of steam peeling include the unpleasant appearance of the resulting root especially the colour. Garcia and Diane [24] described the basic conditions in steam peeling treatment to include peeling condition pressure, exposure time and vacuum size, which is considered for interpretation of peeling efficiency. In his work, about 9 different combinations of peeling condition carried out were described.

2.7 Flame Peeling
Flame peeling has been used to remove the outer skin of various fruits, vegetables, tuber and root crops. It has been applied only to materials of extremely high moisture content. In such applications the moisture content of the fruit or vegetable material has a right amount of heat capacity which will make it to burn easily or remove the outer covering of the vegetable material. In flame peeling, direct flame that goes as high as 1000 degree Celsius or gases that are hot inside a rotating flame peeler act on the crop introduced inside the peeler. Heat causes the steam to have increased energy and this energy makes the skins to swell up. When the skin swells up, it can easily be washed away with water. This flame peeling is immediately followed by adding cold water so as to bring down the temperature quickly. The limitation encountered in this type of peeling is that when vegetable skin or coat is in direct contact with gases at extremely high temperature, the temperature of the main body of the vegetable material elevates to a point at which undesirable change occur [10].

2.8 Review of Mechanized Cassava Peeling Machines in Nigeria
Different approaches for mechanical peeling have been developed in order to peel cassava in batches or in large quantities. These mechanisms include abrasive conveyor belt, continuous process and batch abrasion. Many universities in Nigeria have helped played vital roles in the realization of an effective peeling machine. Few of these Universities are Federal University of Technology, Akure, University of Uyo, Akwa Ibom, Federal University of technology, Owerri and many others. University of Ibadan, PRODA and University of Nigeria started the design of a machine that will effectively peel cassava skin started in Nigeria as late back as 1970. Other research institutes in the country like the International Institute of Tropical Agriculture and National Center or Agricultural have also contributed a lot to solve the problem of cassava peeling. The machines below are what their combine efforts have yielded. Double and Single gang peelers, Double action cassava peeler, automatic knife Peeler, Abrasive rotatory drum peeler; etc. Of all the peeling machines that have been designed there is still a problem of high
amount of tuber loss. This has made research in this area to still be ongoing until a machine with a better efficiency has been gotten [25], [6].

Odigboh [26] made an attempt to design a cassava peeler. The peeler was made up of 2 cylinders mounted parallel to each other. One of the cylinders was having knives which peel out the skin as the cassava moves through the length of the cylinder. The cassava had a peeling efficiency of 63% and a 21% loss in tuber. The machine could not peel all type of cassava as cassava with shorter length were not properly peeled and the cassava has to be sliced in order to get a better efficiency.

A spring loaded mechanical cassava peeler was also designed and fabricated by [18]. The machine was designed based on some mechanical properties of cassava which were earlier reported [17]. When the machine was tested, it recorded an efficiency of 98.8% with 15% broken tubers. Adetan et al. [21] did further works by developing a model that was able to predict the peel removal efficiency with 95.46% level of certainty. Akintunde et al. [27] did a cassava peeler design that works on the principle of abrasion. Cassava that were already soaked in water so as to soften the cortex was used to test the machine. The machine had 2 drums which were perforated and moving against each other. They recorded 83.0 % peeling efficiency and a 5.4% loss of tuber. However, tubers need to be sorted bases on their properties in order to get a peeling efficiency above 45% [28].

Agbetoye et al. [29] improved on an abrasive machine (fig 1) rotating at 200 to 3000 rpm with an output of 10.4kg/hr. The machine consist of a rotating drum covered with brushes, an auger and a guide to serve as a pathway for the movement of the cassava during peeling. The auger was rotating slower than the brush so as to give enough peeling time for the cassava to get peeled. The auger rotates at range of 120 to 450 rpm while the brush at 500 to 1500 rpm. Spring was incorporated into the design so as to take care of the different sizes of cassava. The improved design had a capacity of 410kg/hr which was dependent on both the speed of the brush and the speed of the auger.

The cassava peeling machine (fig 2) designed by Olukunle et al. [12] had a peeling efficiency of 77%, 8% loss of tuber and a capacity of 410kg/hr. The speed at which the Auger and brush moves affect the performance of the machine but a gear was introduced to maintain a constant
ration between them. The machine was seen to have a complex mechanism and a robust working procedure as compared to other machines. The machine was also designed to cater for cassava longer than 10cm as any cassava shorter than 10cm would be poorly handled during the process of peeling.

![Double action self-fed cassava peeling machine](image)

Figure 2. Double action self-fed cassava peeling machine [12].

An automatic cassava peeling machine has been developed by Jimoh & Olukunle [30]. Modification was made on the peeling tool of a cassava peeler that has been made in the past having its peeling principle by impact. The peeler has been assessed with cassava tubers of various lengths (100 - 300 mm) and different range of speed (100 - 600rpm). The output of the machine revealed 12-44% mechanical damage on the root, 50 to 70% peeling efficiency, 7.2 to 33% peel retention and a capacity that ranges from 76 to 442g/hr. Their result showed a better improvement over the manual method but the previous throughput capacity (549kg/hr and 1000kg/hr) of the machine reported by Sherrif et al. [31] was better than the improved one. Increase in speed of the machine led to an increased in the number of impacts which led to more mechanical damage. The quality performance of the machine increased slightly with larger tuber size and decreases significantly as the speed of the machine is increased. As the speed and tuber size was increased, there was also an increase in the amount of unpeeled part of the tuber. The amount of peel retention across all sizes was in the range 7.2 to 33% and this was than the previous work done by Sherrif et al. [31] who had a peel retention of 57.2%.

Three peeling machines grouped under type A, B and C were assessed by Olukunle & Jimoh [32]. Type a, automatic cassava peeling machine with an electric motor of 1.0 horsepower powering a peeling tool that was specially designed. The design was a cylindrical drum rotating and having peeling blades mounted round the drum just like an auger. These are shown in figure 3a and 3b below:
The type A was modified with longer peeling blades mounted on a larger barrel with a shorter peeling chamber. This modified machine was the type B and is shown in fig 4. The type C as shown in fig 5 is a machine that works on the principle of abrasion. The machine is made up of 3 rollers. The roller was perforated so as to give the expected abrasive action and was rotating at 7.0 rpm for effective peeling.
So as to obtain peeling time, efficiency of peeling, tuber losses and peel retention, the type A, B and C machines were evaluated using 150 gram, 550 gram and 1150 gram with varying speed ranging between 300 to 700 rpm. Olukunle & Jimoh [32] reported that when the speed increases to about 24.17% it leads to an increase in loss of tuber.

Because of the low speed at which the auger rotates and the mechanism of delivery, the rate at which the cassava peels increased as the speed of the abrasive peeler increased while for the type A and B peeler, as the speed increases, the peeling time decreases. For the abrasive type, low peeling efficiency was recorded with a high peel retention and tuber loses while for the type A and B, the peeling retention with the loses in tuber were low with a high efficiency of peeling and tuber losses.
Enyabine and Bassey [33] made a design of an abrasive cassava peeler as shown in figure 6. Ukenna and Okechukwu [34] made a modification on the design. The machine was composed of a transmission system that transmits power to the peeling chamber all mounted on a supporting frame. The peeling chamber was made up of woods of 0.69m in length. The wood has sharp edges as its peeling tool and were arranged to form a cylindrical drum.

In the peeling drum, peeling was achieved through the principles of shearing and abrasion. The driving shaft was also perforated and served as a channel through which water was passed into the machine. The water helps to soften the cassava for better peeling and also to wash the cassava. The machine was not a complex design with a very simple working mechanism. When the machine was operated at a speed of 64rpm for 25minutes, the capacity of the machine was recorded as 48kg/hr with 70% efficiency and tuber loss of 7.5% [33].

Fataroy steel industry limited designed a cassava peeling machine as shown in figure 7 below and sent it to NCAM for evaluation. The machine they fabricated is made up of 5 rollers. One of the rollers serves as the machine conveyor while the remaining 4 rollers serves as the device for peeling. The 4 rollers are made up of a perforated sheet wrapped around it. The efficiency of the machine was recorded at 72.21% with a tuber loss of 17.37% at a conveyor speed of 17.37%. The capacity of the machine was also recorded as 725kg/hr.
Ugwu and Ozioko [36] fabricated a cassava peeler and washer as shown in figure 8. The performance of the machine was tested over 3 feed rates. The first feed rate of 25 pieces recorded an efficiency of 72% at a revolution of 420 in a minute and 59% at a revolution of 380 in a minute. The 2nd feed rate of 20 pieces recorded an efficiency of 70% at a revolution of 420 in a minute and an efficiency of 380% at a revolution of 380 in a minute. The last feed rate of 15 pieces recorded an efficiency of 72% at 420 revolutions in a minute and an efficiency of 55% at a revolution of 380 in a minute. The best fit of the machine was difficult to ascertain since the machine was tested only over 2 speeds and the sizes of the cassava was not given.

Aji et al. [37] designed and constructed a cassava peeling and slicing machine (fig 9). The principle of peeling is abrasion. The cassava slides on the rough surface of the peeling drum and the cortex gets peeled out. Performance test on the machine was done and the machine was
recorded to have an efficiency of 66.2% with a machine capacity of 6.72kg/min. 8.52% was recorded as the amount of useful flesh lost during peeling.

Figure 9. An isometric view of the constructed peeling and slicing machine [37].

Ajibola and Babarinde [38] designed and fabricated a cassava peeling machine. The performance of the machine was tested on cassava with length ranging from 100 to 150mm. The machine achieves its peeling through abrasion mechanism. As the tuber comes in contact with the peeling drum, the tuber is rapidly bruised off. The machine efficiency was recorded at 80.1%.

3. Conclusion

From this review on cassava peeling machine, the following conclusions were made:

- All the machines designed so far are still unsatisfactory since they all have a problem of high loss in tuber during peeling and moderate peeling efficiency. This is due to the fact that cassava differ in property from one root to another.
- Unless there is an improvement in design it would be difficult for the already existing machine to be used for industrial application as most record peeling efficiency less than 50%.
- All the machines have their rotational speed ranging from 40 to 70 rpm except for the manual ones.
- The knife edge peeler type B had the highest amount of losses in tuber which was recorded between 25% and 42%.
- The machine with principle of abrasion at present seems to show great promise than machines with other principles.
- There were more losses in tuber between 18 to 26% as the speed of the machine increases.
- Only 2 cassava peeler can be recommended for Industrial use. The machines are the Fataroy peeler with a high output capacity of 725kg/hr and the automated peeler with an output capacity of 583kg/hr.
- Whenever the operation speed of the machine is increased, it leads to high amount of tuber loss with increase in output capacity.
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