A MANUALLY OPERATED CASSAVA GRATING MACHINE

By

E.U. ODIGBOH

Department of Agricultural Engineering
University of Nigeria, Nsukka

(Manuscript received March, 1982)

ABSTRACT:

The design and development of a manually operated cassava grating machine prototype are presented. The prototype grater is shown to be easy to operate at 30 - 45 rpm to give a product whose quality is as good as that from motorized graters at a throughput of 125 - 185 kg/h. The prototype grater is a powerful alternative to the sedentary drudgery and pain-inflicting process involved in the traditional grating method.

1. INTRODUCTION

After peeling, the next unit operation in gari production is the grating of the peeled roots. Traditionally, grating is done by manually rubbing the peeled roots against a roughened surface, usually of perforated 3mm thick pice of galvanized mild steel sheet on a wood or metal frame. But, manual grating is tedious, time consuming and usually involves scrapes and bloody injuries to the fingers of the operator. As a result, manual grating of cassava leads to non-uniform particle sizes as well as substantial losses arising from the inability of the person to hold small pieces of cassava roots for grating. Happily, there now exist various. Versions of mechanical graters which are driven by electric motors or small internal combustion engines.

In fact, it may be said that cassava grating has been effectively mechanized; our local artisans are now able to fabricate the above-mentioned types of mechanical graters which are found in common use alongside the popular corn mills in village squares and markets. Nevertheless, manual grating of cassava is still largely practiced in the villages and hinterlands which account for a preponderant percentage of the gari produced in Nigeria.

The prototype grating machine described in this paper has been developed to cater for this major group of gari producers who have no access to electricity and/or lack the resources or know how necessary for an internal combustion engine. This is necessary to improve the wholesomeness of gari from the peasant producers [1].

2. DESCRIPTION OF THE PROTOTYPE GRATING MACHINE

The photograph of the prototype grating machine is shown in Fig. 1. It consists of a 100cm dia grating drum of 25cm width. The curved surface of the drum is covered with 3mm galvanised mild steel plate which is punched to give grating points similar to that used by the peasant gari producers. But, the grating points so made are uniform in size and are uniformly distributed and spaced on the surface to give about 5 grating points per square centimeter.

The design details are presented in the sketch of Fig. 2. The grating drum (A) is mounted on a frame through an axial shaft on bearings (B). At one end, the drum shaft carries an eleven- tooth spur gear (C) which is in mesh with a larger

gear (D) with 115 teeth. The shaft of this gear (D) is connected by a 1:2 chain drive (E) to the detachable handle (F) such that one complete rotation of the handle produces half a rotation of gear (D). This means that for one rotation of the handle, the grating drum rotates 115/(2x11) or 5.23 times.

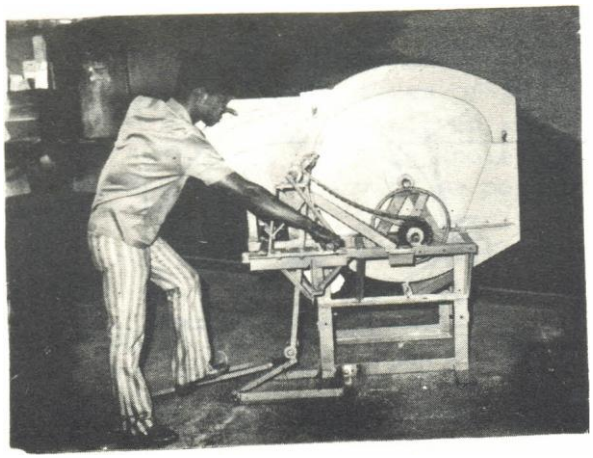

Fig. 1 Photograph of Prototype Manual Cassava Grating Machine

As shown in fig 2, there is also a foot-pedal arrangement (G) connected to the shaft of the handle to assist in turning the handle to rotate the grating drum

The hopper (H) is designed such that the peeled cassava tubers are presented for grating at 5-15° above and below the horizontal diameter of the grating drum. There is an adjustable board (I) to limit the grating action zone to a value that offers a grating resistance which the operator can easily overcome when the hopper is full.

Inside the hopper, at the base of the action zone is located an adjustable wedge (J) which holds the cassava tubers for grating. The wedge adjustment also determines the largest particle size of the resultant gari mash. If the top surface of the wedge were projected to intersect the grating surface, it would make an angle, θ with the tangent to the grating surface at the line of intersection, as shown in Fig, 3. This angle θ, known as the nip angle, is quite critical. Its value must be such that the cassava tubers are not drawn in to form a wedge that would foul or produce undue resistance to the rotation of the grating drum. At the same time, the nip angle must be sufficient to ensure that the smallest pieces of the last. Cassava tubers in the hopper are completely grated. In the prototype grater, the value of the nip angle found to be most satisfactory is 61°, but it may be varied between 55° and 65°.

A brush denoted by K in Fig. 2 is set to be in light touch with the bottom-most portion of the' grating drum.

Its function is to brush off particles of the grated cassava from the drum so as to always present an unclogged and sharp grating surface at the grating action zone. The grating surface has a shield (L) all round to avoid accidental contact with it during operation.

3. PERFORMANCE OF THE PROTOTYPE GRATER

To operate the grater, the adjustable board is pushed all the way down to shield the grating surface from the cassava tubers in the hopper. Then, the grating drum is rotated, under no load, to achieve a comfortable rpm. The adjustable board is then gradually pulled up to expose a grating surface which the operator feels comfortable with as the rpm of the grating drum settles down to some constant value. This operating rpm of the grating drum naturally varies with different Operators as it largely depends on the strength of the operator. It is better to operate at a low rpm which can be maintained for as long as is needed to complete the desired grating job.

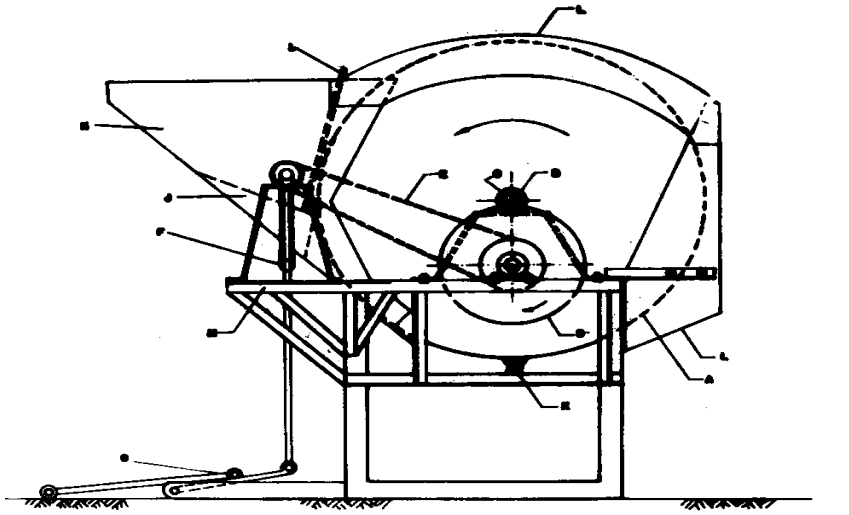

Fig.2. Side view of cassava grating machine
A, grating drum surface, B, driving shaft bearings, C, 11-tooth spur gear, D, 115-tooth spur gear, E, chain drive, F, detachable turning handle, G, foot pedal, H, hopper, I, shielding board, J, grating wedge, K, brush, L, drum shield, M, frame

It was found that at a grating drum rpm of 30 to 45, the prototype grater has a capacity of 125 to 185kg/h which is about the same as for a motorized grater powered by a 1.875KW (2.5 hp) electric motor or 4.5KW internal combustion engine. The quality of the product from the proto- type in terms of the uniformity of the grated mash particles is Just as good as that from the motorized graters. Thus, the performance of the manually operated gari grating machine compares very favourably with that of the motorized graters, while Costing much less to own and operate. It should be noted that the design compensates for the lower rpm of the manually operated machine (30 - 45 *rpm)* by the larger diameter of its grating drum which is 100_{cm} as against 20 to 25cm diameter of the motorized graters which are normally run at 500 to 700 rpm. Noteworthy also is the fact that 30 to 45 *rpm* of the grating drum means that the operator needs to turn the handle only about 6 to 9 times minute and the foot pedal arrangement is there to help. Due to the large size and mass of the grating drum, once a comfortable *rpm* is initially developed, it is easy to maintain during operation. Therefore, the energy demand from the Operator is such that can be supplied by the village women who are the traditional processors of much of the gari produced in Nigeria. And the beauty of it is that they are not required to have any specialized skill or knowledge to own, operate and maintain the machine.

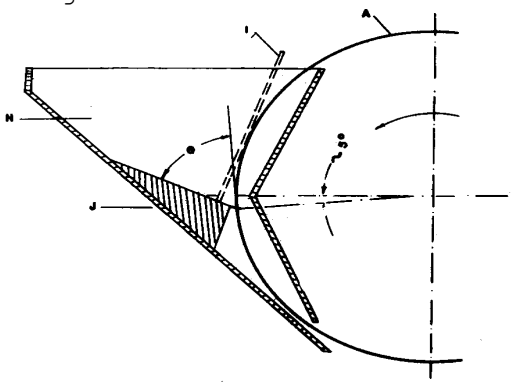

Fig 3. Sectional view of hopper showing rip angle θ lettered part as are as indentified in fig. 2.

4. CONCLUSION

Research and development aimed at the improvement of cassava processing techniques have often been criticized for favouring large-scale cassava producers and processors without considering the economic interests and needs of the greater majority of the peasant farmers (2). This manually operated cassava grating machine is therefore considered an important innovation that meets the needs of the peasant gari producer. Its main attraction *is* its technical simplicity. The prototype grater provides a powerful alternative to the sedentary drudgery and pain-inflicting process involved in the traditional gari grating technique. The output of the proto- type grater is many times more than the 2 to 5kg/h possible with the old traditional method; loss and wastage of useful tuber flesh inherent in the traditional method *is* eliminated; a greatly improved quality product, in terms of the uniformity of particle sizes of the resultant gari mash, is achieved and the product *is* infinitely more wholesome. It is hoped that it will be possible, in the near future, to make this manual grating machine available to most of the peasant gari producers in Nigeria.

ACKNOWLEDGEMENT

The fund for the design and construction of this prototype grating machine was provided by the defunct OFN which is hereby gratefully acknowledged.

REFERENCES

1. Odigboh, E.U., Cassava- Production, Processing and Utilization, Chapter 4 in Handbook of Tropical Foods, Chan, H.T. (ed). Marcel Dekker, Inc. N.Y., 1983, pp. 145 - 200.

2. Phillips, T.P., cassava Utilization and Potential Markets, IDRC Publication IDRC 020e Ottawa, Canada, 1974.