A prototype cassava grater for use in Ghana, based on studies of existing graters

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SUMMARY

The two main types of cassava graters used in Ghana, manual and power-operated, are described. Of the latter there are two kinds, cylindrical and disc, the performance, constructional details and costs of which are illustrated and compared. Developed from mechanical concepts inherent in existing cylindrical graters, a prototype grater, incorporating new features, has been designed and constructed and is also illustrated in this Note. Tests indicate that the prototype is more sturdy, gives a fairly high rate of production and is easy to operate.

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RÉSUMÉ

LARTEY, B. L.: *Un prototype de râpe à manioc pour utilisation au Ghana, dérivé d'une étude des râpes actuellement en usage.* Les deux principaux modèles de râpes à manioc utilisés au Ghana, celui à main et celui à moteur, sont décrits dans cette étude. De la râpe à moteur il existe deux versions, à cylindre et à disque, et leur rendement, leur mécanisme et leur coût sont illustrés et comparés. Partant du principe mécanique employé dans les râpes à cylindre actuelles, on a imaginé et construit un prototype de râpe incorporant des éléments nouveaux comme décrit dans cette contribution. Les essais ont prouvé que ce prototype est plus robuste, qu'il a un taux de rendement assez élevé et qu'il est d'un emploi aisé.

Introduction

Of the many roots and tubers which are used for food in Ghana, roots from cassava (*Manihot esculenta*) appear to be the most important of all. According to a household budget survey conducted by the Central Bureau of Statistics in Accra in 1963, cassava is the most widely consumed staple in many of the large towns of southern Ghana. Cassava also enters into the export trade in a number of processed forms. However, the volume of its processed products which are used locally or exported is limited by the unavailability of suitable equipment for mass production. One piece of such equipment is the cassava grater which performs a bulk-reduction operation in the processing of the root crop.

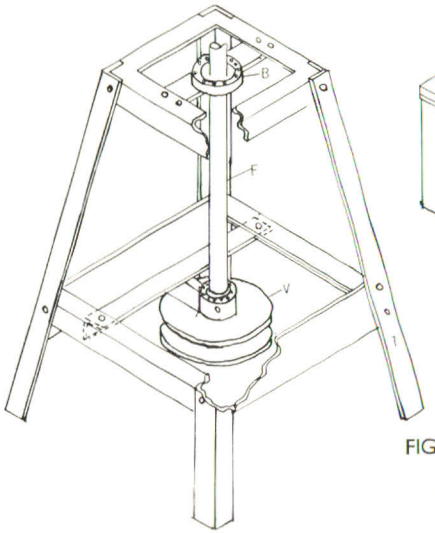
This paper describes a prototype grater which is relatively inexpensive to construct but efficient in grating the roots. The design and construction of the machine was based on improvements derived from existing graters.

Types of cassava graters in use

Two main types of graters are in use in Ghana. These are manual and power-operated, there being two kinds of the latter: cylindrical and disc graters. Within the power-operated group variations in design, power source, transmission and materials of construction occur, especially between cylindrical types.

The manual grater

This is a crude machine which consists of a galvanized metal sheet with nail-punched holes, the jagged ends of the holes being used as the grating surface. In cross-section the equipment is a flanged dome. Grating with this equipment is time-consuming, a skilful person being able to grate between 40–50 lb/h (18–23 kg/h). The grater is used by most rural processors because it is cheap and easy to construct. However, because the grater is difficult to clean after use, foods lodged in the punched holes become foci for microbial growth and subsequent food contamination.



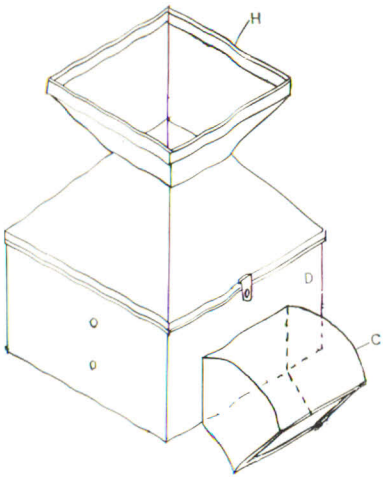
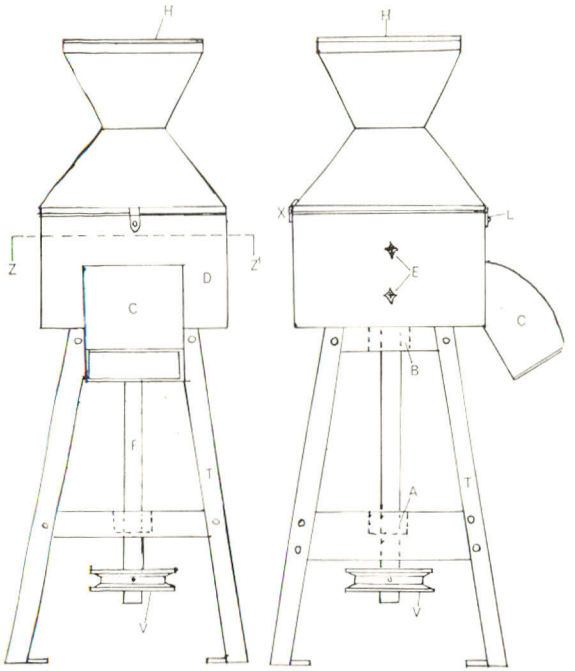
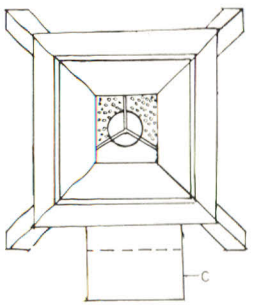


FIG. 2B





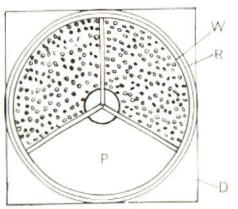
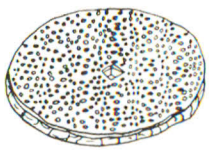


FIG. 2A



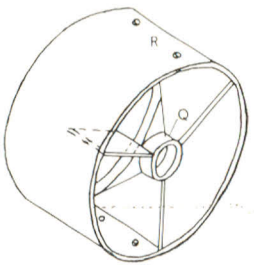


FIG. 2C

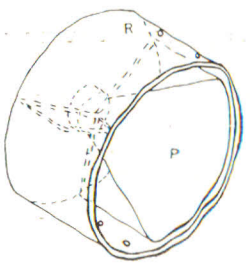
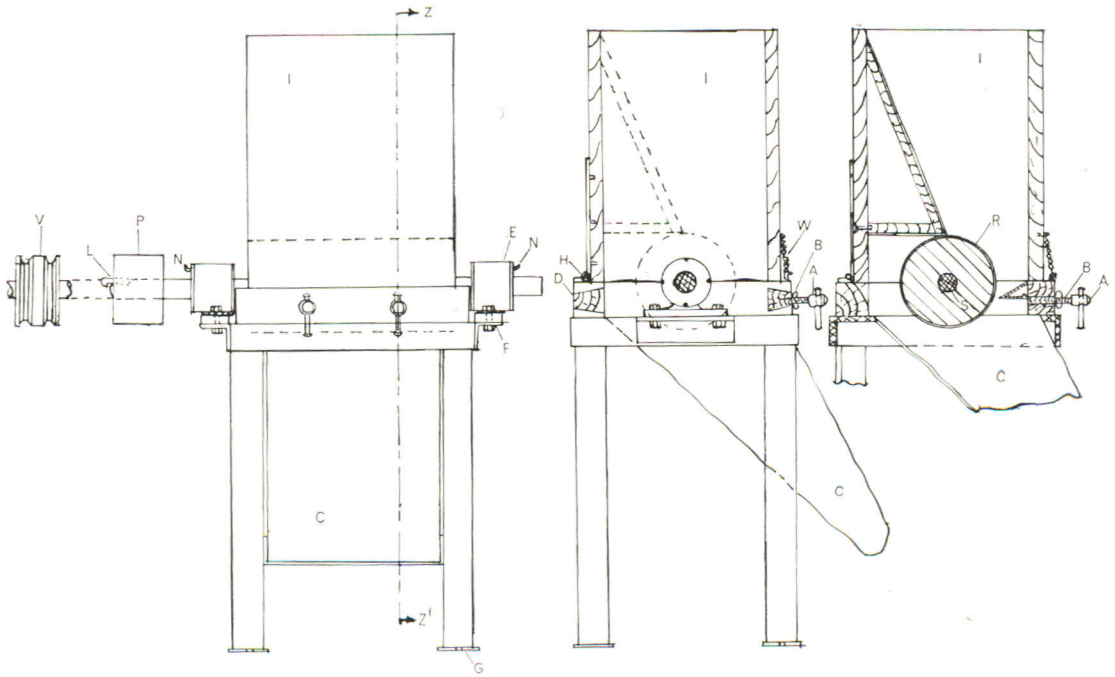


Fig. 2A. Disc grater: front view (top left); end view (top right); plan (bottom left); section Z-Z^1 (bottom right).

Fig. 2B. Isometric views of the main body and stand of the disc grater.

Fig. 2C. Grating disc (top right); bottom view of inner vessel (left); top view, ditto (bottom right).

Key to Figs. 2A-2C. *A:* bearing at bottom. *B:* bearing at top. *C:* chute. *D:* rotor housing to hold *R*. *E:* screws to hold *R* to *D*. *F:* connecting shaft. *H:* hopper for feeding. *L:* locking device. *P:* platform for feed landing. *Q:* top-bearing cover. *R:* inner vessel. *V:* vee-belt pulley. *T:* stand. *W:* rotating disc. *X:* hinge.



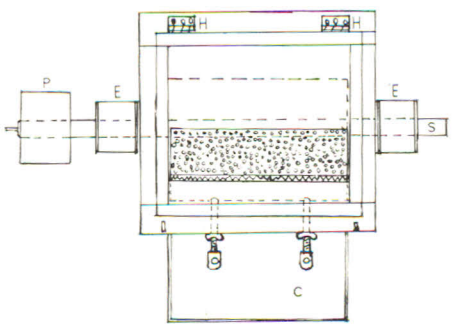


Fig. 3A. Prototype cylindrical grater: front view (top left); end view (top middle); sectional view through Z-Z^1 (top right); plan (bottom).

Key to Figs. 3A–3D. *A:* adjustment device for grating clearance. *B:* butterfly adjustment lock-nuts. *C:* chute for collection of grated material. *D:* dove-tailed base plate. *E:* enhoused roller bearings. *F:* angle-iron support for bearings. *G:* ground plate 3½ in square. *H:* hinges to hold box-like hopper (*I*) to base plate (*G*). *I:* Input hopper. *L:* locking pin for pulley. *N:* nipple for greasing. *P:* pulley for flat belt, 4 in wide, 6 in dia. *R:* roller block with perforated tin sheet, 14½ in, 8 in dia. *S:* shaft, 2 ft 11 in long, 1½ in dia. *W:* wire spring to hold *I* firmly to *D*. *V:* vee-belt pulley (optional).

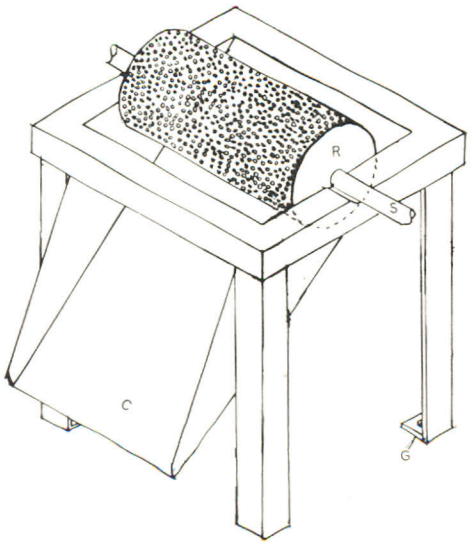


Fig. 3B. Prototype cylindrical grater: isometric view of the stand and roller.

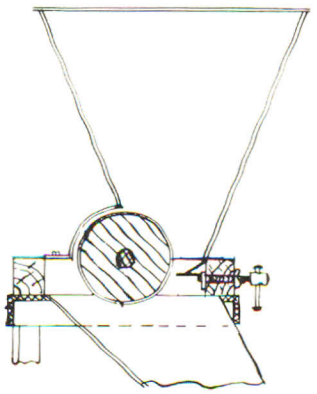


Fig. 3C. Prototype cylindrical grater: modification of the hopper, made of galvanized iron.

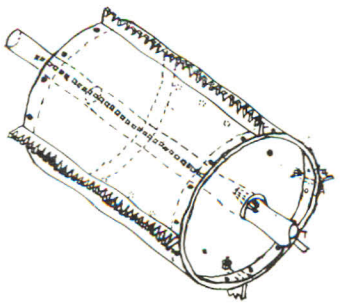


Fig. 3D. Prototype cylindrical grater: the drum. Note the six saw-teeth blades 60° apart.

The prototype cylindrical grater

The design of the prototype grater, shown in Figs. 3A–3D, was based on that of the cylindrical graters because they are easier to construct, they are sturdier, and give better performance. However, some design and constructional changes in the existing cylindrical graters were found to be necessary. In the prototype the grating rotor is covered with 1/16 in (1·6 mm) aluminium sheeting over which is clasped the perforated galvanized metal sheet. This facilitates the thorough washing of the rotor after use and prevents the juice from grated material seeping into the surface of the wooden cylinder. Polyurethane lacquer was initially considered as a more suitable protective coat for the wood as it is cheap and strong. But it could not be used because it is not readily available in Ghana. The grating rotor rotates at a constant speed of 1400 rev/min on a shaft 35 in (88·9 cm) long of $1\frac{1}{2}$ in (3·8 cm) diameter mounted on ball bearings. Unlike the other graters, the ball bearings of the prototype are fully enclosed to prevent splashes of water or juice getting into the motor. Grease nipples are also provided for the bearings.

To facilitate cleaning after use the hopper of the prototype is also lined with aluminium sheeting. Unlike most of the cylindrical graters which are permanently fixed at one place, the prototype is provided with a stand of angle-iron framework and is therefore movable, as shown in Fig. 3B.

Field trials

Limited field trials with the prototype grater were carried out to determine the throughput of cassava at a constant speed of 1400 rev/min. The time taken for the machine to grate a specific quantity of cassava roots was obtained by means of a stopwatch. It was found that an average of $\frac{1}{2}$ ton/h (500 kg/h) of grated cassava could be obtained, but that this quantity could be increased with the application of pressure on the feed in the hopper.

It was not found necessary in the trials to cut the cassava roots into pieces before feeding into the machine unless they were abnormally large. Further field trials are being considered when modifications in the design have been made. These changes will involve a new design of the grating rotor which will consist of a hollow metal drum on

which will be bolted cutting blades with serrated edges as shown in Fig. 3D; a truncated pyramidal hopper as in Fig. 3C; and a vee-belt transmission coupled to a motor as shown in Fig. 3A.

The present prototype grater costs about N₵100.00. Its advantages, in comparison with existing cylindrical graters, lie in the fact that (a) it incorporates an adjustable saw blade arrangement for controlling the particle size of grated material and can therefore be used to produce a finer or a coarser grated cassava for different cassava preparations; (b) contamination of grated foods is practically eliminated through the use of aluminium sheeting as coverings for the inside of the hopper and rotor; and (c) the bearings are waterproofed and are provided with nipples for regular greasing.

Scaled drawings of this and the other graters illustrated in this paper are available from the author, on request.

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