ADAPTATION OF FATECO PLANETARY ROASTER FOR ROASTING GARI

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SUMMARY

The objective of the research study is twofold: Firstly, to assess the possibility of using the planetary raoster to roast gari, and secondly, to develop a modified design that will yield a better product in terms of quality and quantity.

The report outlines the traditional method of roasting gari and its associated problems.

The report then describes the roaster. Feasibility assessement tests were carried out and they showed that;

(i) The stirrers rotate at 20.4 rpm
(ii) The roasting capacity of the roaster is 35 kg/hr.
(iii) Not all the samples attained the standard colour of gari.
(iv) The swelling capacities of the gari obtained from the roaster met the required standard as given by Ghana Standards Board in Ghana standards for Gari.
(v) The particle size of products obtained from the roaster is about the same as that obtained from the Cassava Processing Demonstration Unit, (CPDU), Pokuase.

The results indicate that modifications recommended in the concluding part of this report, when adopted will produce a good gari roaster.

1.0 INTRODUCTION

Gari is a product obtained from cassava after passing the cassava through different processes. The fresh cassava is peeled, washed grated and allowed to ferment. Thereafter, the fermented cassava mash is dewatered, disintegrated, sieved and roasted into gari. The gari is then graded and packaged.

Roasting is about the most important unit operation among the orthers involved in the production of gari. This is due to the fact that roasting is the process that actually transforms the sieved cassava mash from the raw state to a finished or roasted state called gari.

Roasting comprises garification and dehydration. Garification involves heating the sieved mash to gelatinize while dehydration causes the gari to harden gradually. Traditionally, roasting is done in an aluminium pan mounted on a three legged mud stove and heated with fuelwood. The women sit by the fire and manually stir continuously using a calabash or plywood cut to size as the stirrer. Intense heat is employed to gelatinize the mash. After gelatinization the intensity of the heat is reduced to allow for dehydration. This is achieved by pulling out some of the fuelwood from the mud stove. At the end of the roasting, the gari becomes light or creamy yellow in colour and crispy in texture.

The technology as just described appears very simeple, but in reality is difficult and tiresome. It has its own associated problems, some of which pose a great danger to the health of the processors. The heat and smoke may cause headaches, bodily pains, fever, heat rashes, diarrhoea, reddening of eyes, watering of eyes, profuse sweating and even miscarriage in some women (Amoa-Awua et.al. 1991).

To develop a technology that will relieve the women of the problems associated with the traditional method, a planetary grain and legume roaster purchased from Farmers Technical Services and Training Centre (FATECO), was used for roasting gari on trial bases. The roaster is shown in Fig.1.

<u>The Planetary Roaster</u>

This roaster consists of the following:

(i) 5mm thick cylindrically shaped mild steel roasting pan.

(ii) A pair of stirrers which rotate in the horizontal plane and set at 180^{o} apart.

(iii) A vertical driving shaft onto which the stirrers have been bolted.

(iv) An assembly of a bevel gear system. This reduces the speed as well as changes the drive from horizontal to vertical.

(v) An electric motor and a gear box.

The roaster has three speed reduction units. The first is a gear box and the second is a belt drive. The final reduction is by the bevel gear assembly.

The roasting pan has a gate on the circumference of the cylindrical surface and is on the same level as the bottom of the roasting pan. After roasting, the gate is opened and the stirrers push out the product.

The roaster is heated by means of wood shavings, but fuelwood could also be employed to heat it.

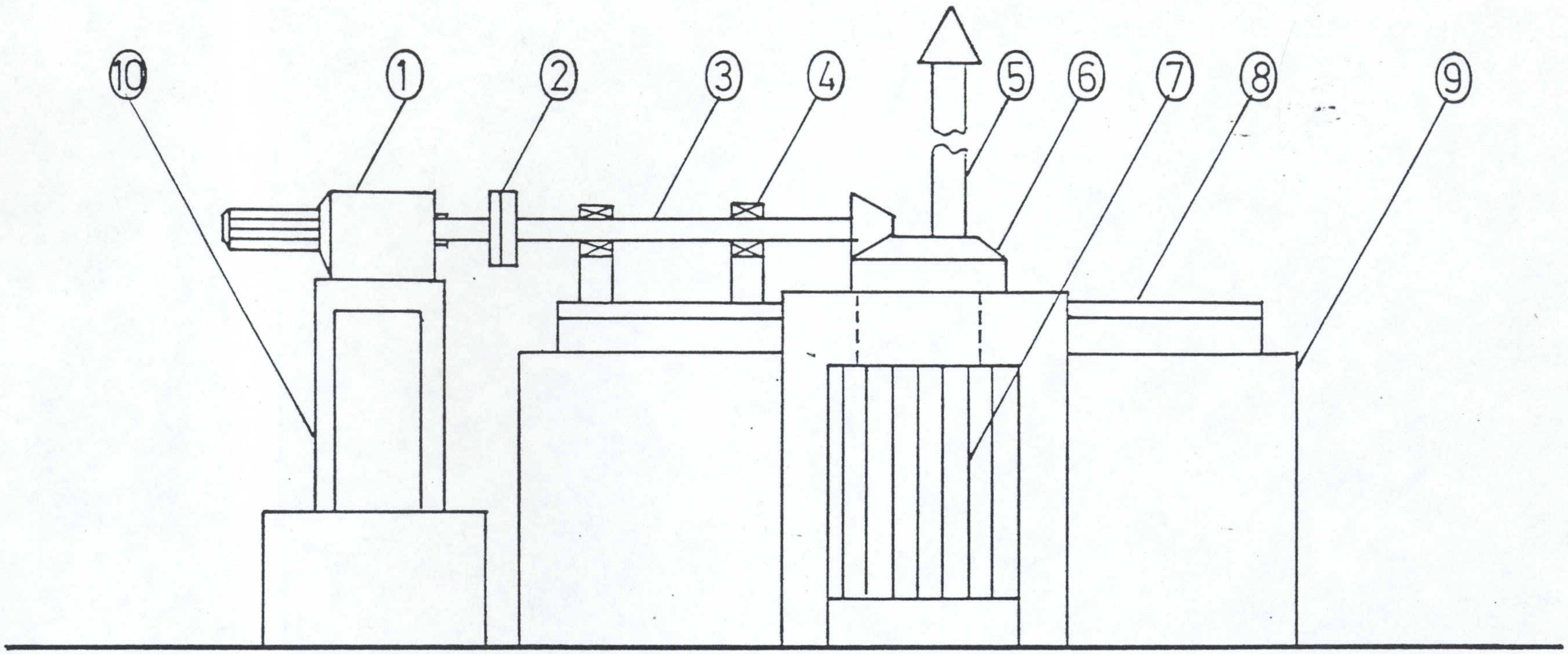


FIG. FRONT ELEVATION OF PLANETARY ROASTER

Nº	
1	ELECTRIC MOTOR & GEAR BOX
2	PULLEY
3	DRIVING SHAFT
4	BEARING
5	CHIMNEY
6	BEVEL GEAR ARRANGEMENT
7	FIRE PLACE
8	ROASTING PAN
9	STOVE
10	SUPPORT

2.0 MATERIALS AND METHODS

To assess the feasibility of using the roaster to roast gari, several tests were conducted with different weights of the sieved cassava mash. This was to enable one to determine the quality of the gari and the roasting capacity of the roaster. The corresponding time for each trial batch was recorded.

2.1 Moisture

This was determined by the oven dry method using 5gm sample at 105^{o}C for, 4 hours.

2.2 Colour

This was determined by visual examination against the standard colour of light or creamy yellow as given by Ghana Standards Board in the Ghana standard for Gari.

2.3 Swelling Capacity

A 100ml measuring cylinder was used in determining the swelling capacity. The measuring cylinder was filled with gari up to the 25ml mark. The cylinder was then filled with water up to the 100ml mark and inverted a number of times to ensure proper mixing of the gari and water. The mixture was then allowed to settle and swell to a constant volume. The swelling capacity was calculated as the percentage increase in volume.

2.4 Particle Size

A sieve of about 1.25mm aperture size used for grading gari at the Cassava Processing Demonstration Unit, Pokuase of the Council for Scientific and Industrial Research, was used for determining the particle size. It was calculated as a percentage of particle which passed through the sieve.

3.0 RESULTS AND DISCUSSION

The quality of gari as stated in the Ghana standard - Gari, by Ghana Standards Board is as follows:

(i) The product should be light or creamy yellow in colour.
(ii) The product should be dry and crisp.
(iii) The particle size of the product should be nearly uniform.
(iv) The product should swell to about three times its volume when soaked in water.
(v) The product should be clear and not contain dirt or any extraneous matter.
(vi) The product should be slightly sharp and sour rather than bland to taste without any peculiar odour.
(vii) The product should preferably have a low fibre content
(viii) The cyanide content of the product should not exceed 20 p.p.m.

Of the requirements mentioned above, the first four can be altered by roasting. Therefore, samples of the gari were analysed for particle size, colour and swelling capacity.

3.1 Determination of Speed of Stirrers

Table 1: Speed of Stirrers

No. of Revolutions	Time (min)	Speed (rpm)
101	5	20.2
101.5	5	20.3
102	5	20.4
102	5	20.4
102	5	20.4
102.5	5	20.5

The speed in revolution per minute (rpm) was determined using the formula :

$$\text{Speed} = \frac{\text{No. of Rev.}}{\text{Time (min)}}$$

From the table above the average speed = 20.4 rmp. There was no standard speed with which this value could be compared, but the fact that at this speed the stirrers could stir the sieved mash and got it roasted into gari means the average speed is suitable for roasting gari.

Table II: Weight of Sieved Mash, Roasting Time, Swelling Capacity, Particle Size and Colour of Gari

Wt. of Sieved Mash (kg)	Roasting Time (min)	Swelling Capa. (% increase in vol.)	% of Parti. passing thro' 1.25mm sieve	Colour
5.2	10	210	82	Grey Brown
6.5	12	168	63	Brey Brown
13	20	215	91	Dirty Cream
13	21	188	63	Dirty Cream
13	20	240	87	Dirty Cream
13	20	228	87	Creamy White
13.8	23	256	87	Creamy White
20	38	280	75	Dirty Cream
20	36	220	83	Creamy Yellow
20	38	220	83	Dirty Cream

3.2 Roasting Time

From fig.2 an increase in the weight of the mash results in a corresponding increase in the time required for roasting.

The non-uniformity of the time recorded to the same weight of sieved mash can be attributed to the heating of the roasting pan. On the whole it was very difficult controlling the heat and the timing for re-fueling the roaster is another factor, but the differences arising are negligible.

For all the tests recorded above, the sieved mash was fed into the roasting pan in portions. In the first trial which was not recorded, the whole trial batch was fed into the roasting pan and the product came out as big lumps. With this experience the subsequent ones were fed into the roasting pan in bits and this yielded good products.

Fig. 2 : Weight of seived mash against roasting time

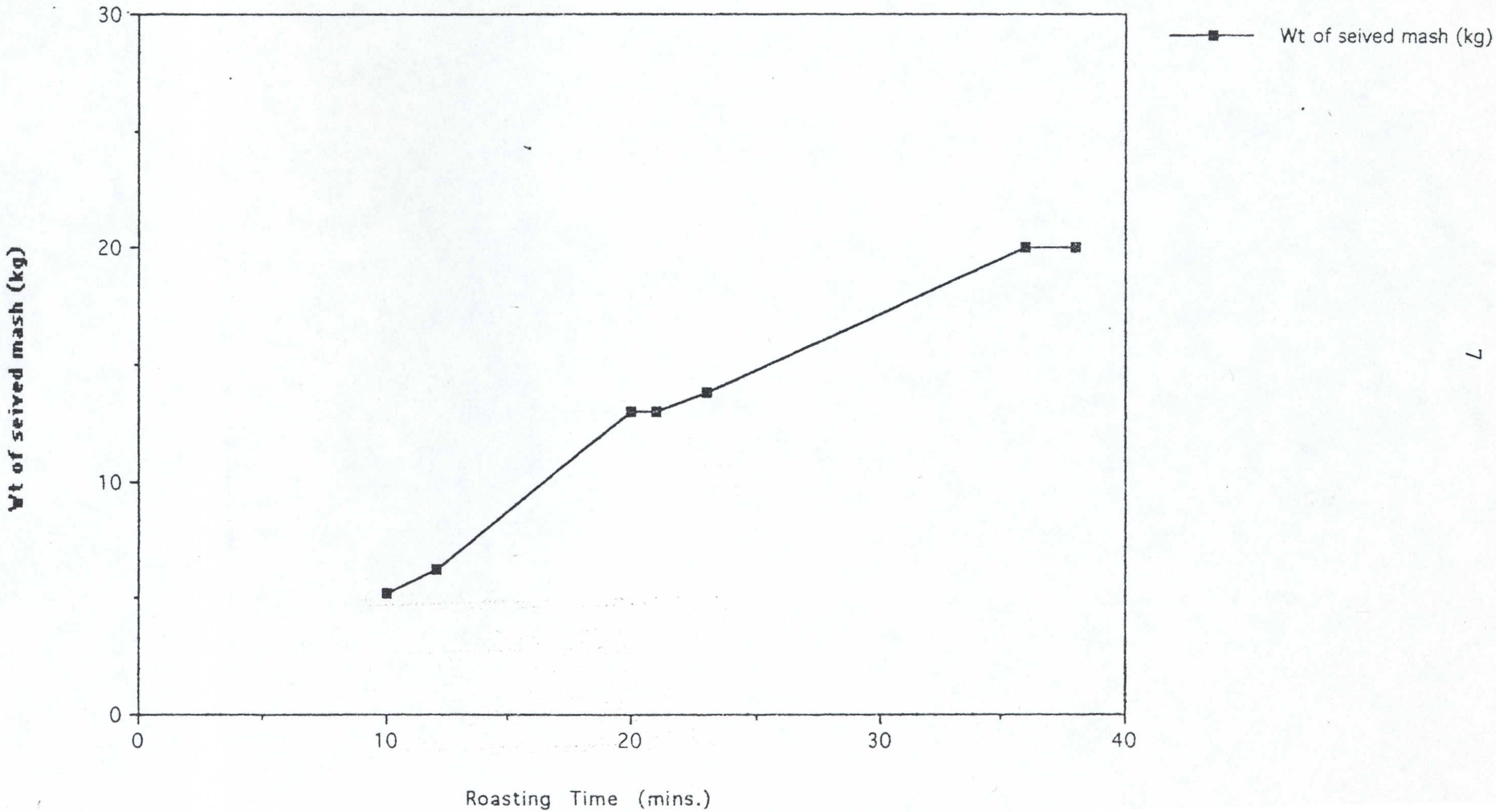


Fig. 3 : Swelling capacity against weight of seived mash

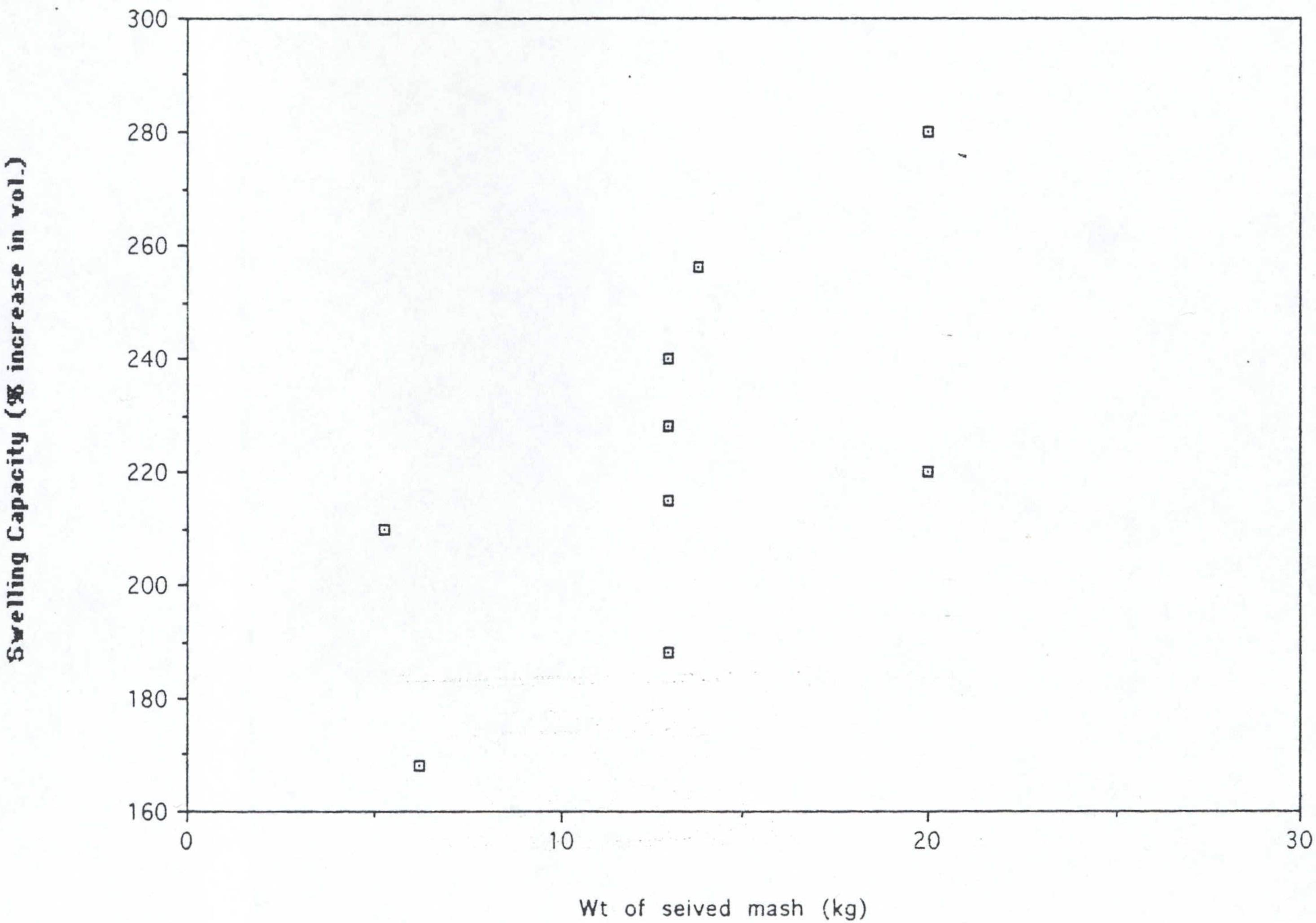


Fig. 4 : Swelling capacity against roasting time

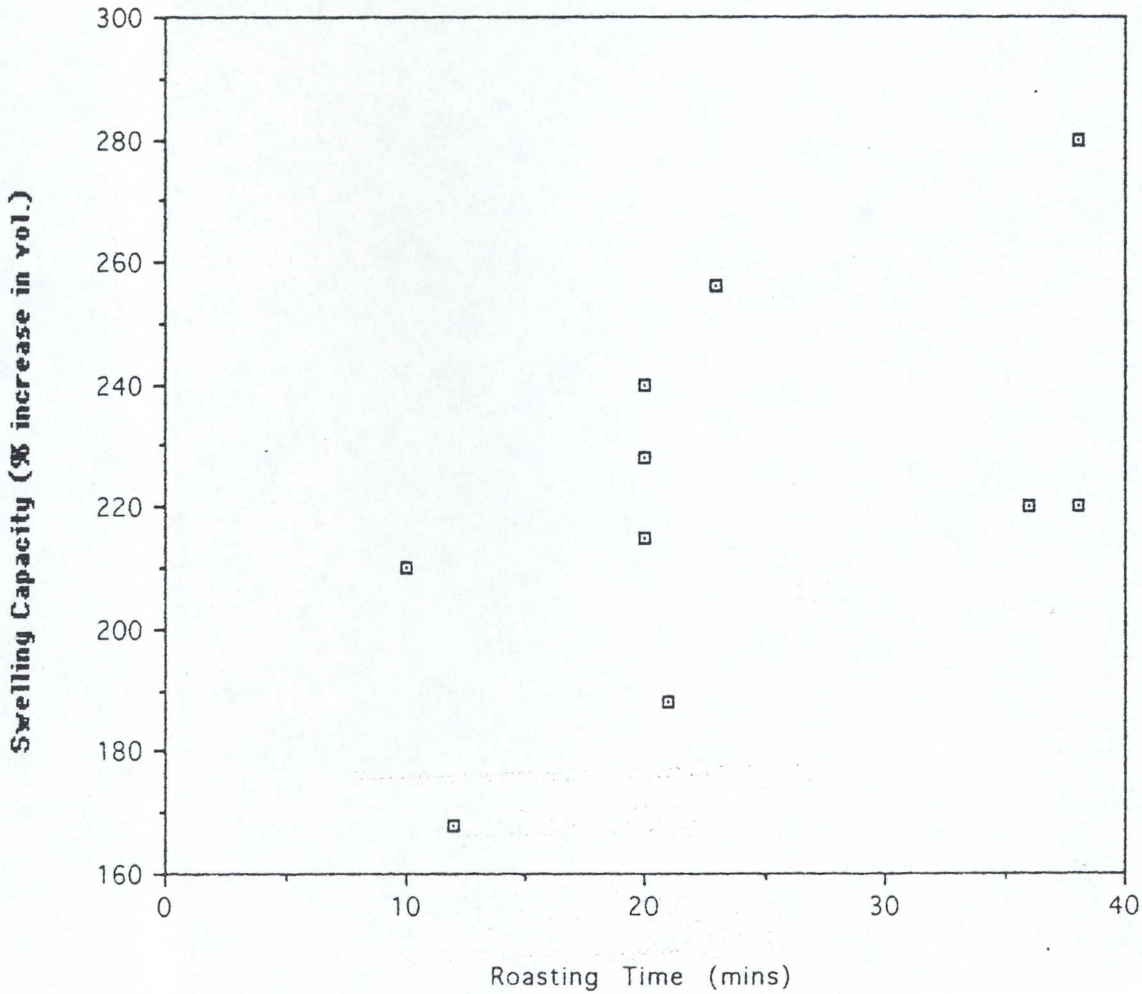


Fig. 5 : Particle size against weight of seived mash

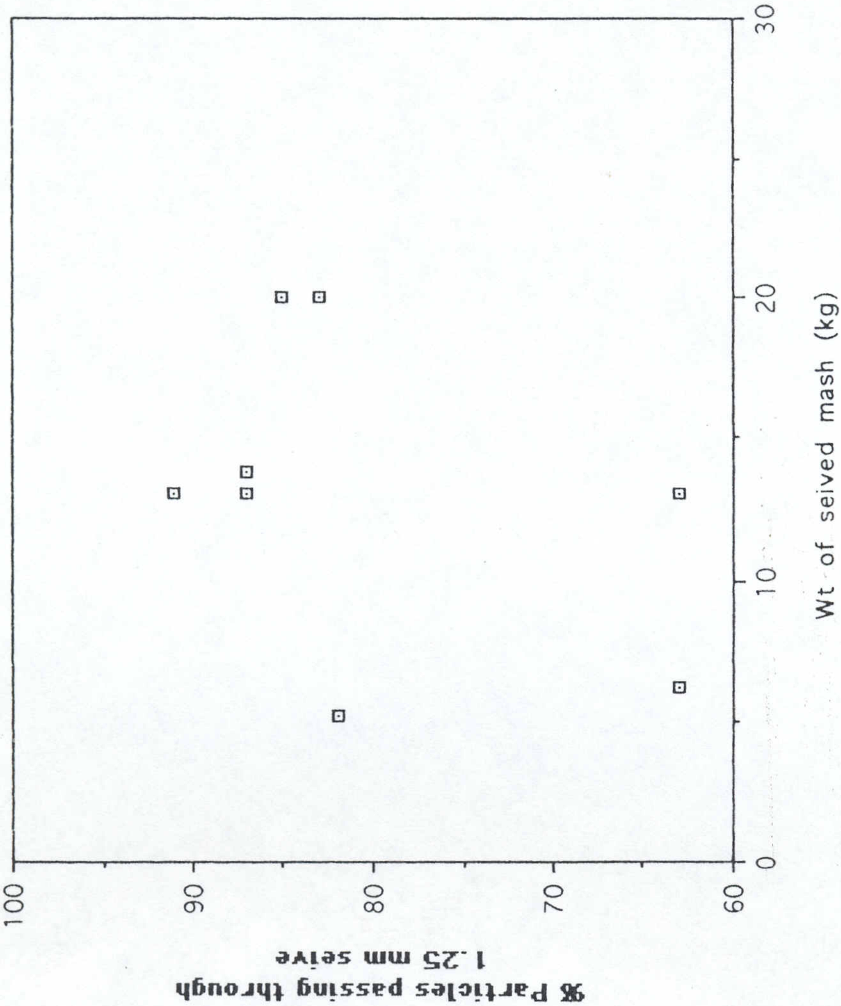


Fig. 6 : Particle size against roasting time

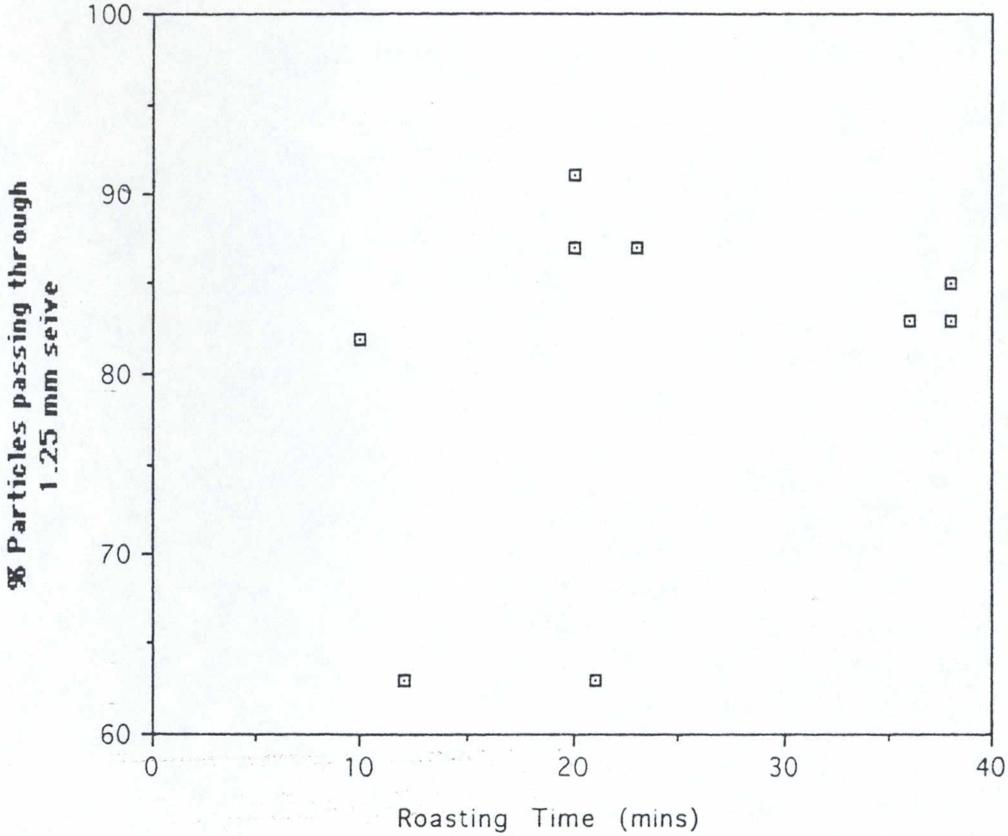
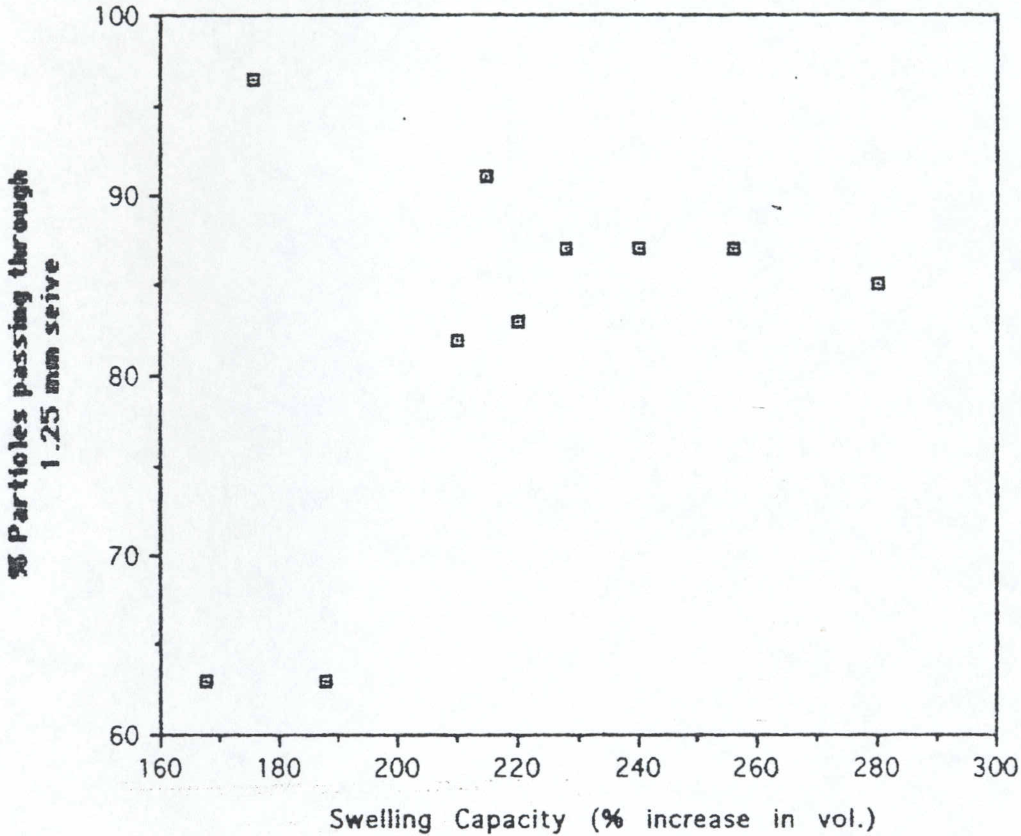


Fig. 7 : Particle size against swelling capacity



The stirrers were not able to stir and scrape the mash at the corners of the roasting pan. This is because a gap of 25mm and 30mm exist between the ends of the stirrers and the walls of the roasting pan respectively. The stirring was therefore aided by manually scraping the corners of the roasting pan. This cannot be blamed on the roaster design because it was not designed for roasting gari.

3.3 Swelling Capacity

Figs. 3,4 and 7 show the graphs of the swelling capacity against weight of sieved mash, roasting time and particle size respectively. In all the graphs there was no correlation between the swelling capacity and the other parameters.

For all the trials the cassava mash were taken through the same fermentation and dewatering conditions.

Therefore, the differences recorded in the selling capacities can be attributed to the degree of gelatinization and dryness. From the Ghana Standards on Gari, the product should swell to about three times its volume when soaked in water. This implies that the percentage increase in volume should be about 200%. Two samples did not meet this standard. The low swelling capacities of 160% and 188% recorded were due to the low level of dryness of those trial batches. Those products came out as big lumps and had to be milled. The size of the lumps actually affected the level of dryness.

3.4 Particle Size

Figs. 5,6 and 7 show that the factors that influenced the particle size of the gari are other than those shown on the various graphs.

From the same batch of cassava mash roasted at the CPDU, the average percentage of gari particles passing through a 1.25mm sieve was 83%. Records from table II show that the average percentage of gari passing through a 1.25mm sieve is 80.1%. The results show that there was not much difference between the particle size of the products from the CPDU and that obtained from the planetary roasters.

Only two samples recorded low values of 63%. This reflects the degree of lumpiness in these particular products. The possible cause of this is the timing for putting the sieved mash into the roasting pan.

3.5 Colour of Gari

From table II it is obvious that the colour of the gari is not influenced by the weight of sieved mash, the swelling capacity nor the particle size.

Frequent application of cooking oil or shea butter eliminated the effect of rust on the colour of the gari.

The different colours obtained other than the standard colour of light or creamy yellow can be attributed to the burning of the gari during the process of collection, especially when the quantity left is small. This is because the means of collection is inefficient. But when the collection was aided manually the colour improved. The colour of the gari may have also been affected by incomplete gelatinization.

3.6 Moisture

The moisture content of the sieved mash was 45%. The dewatering was done at the CPDU. Under the conditions there the average moisture content is 44%. The recorded moisture content of 45% was therefore satisfactory.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the test conducted on the roaster showed that it is possible to build a gari roaster based on a similar design.

The results showed that the average capacity of the roaster was 35kg/hr. which was higher than that of the manual roasting stoves at the CPDU. These were:

11.2kg/hr. for the small roasting pan and
31.3kg/hr. for the large rectangular roasting pan.

Comparing these figures one would raise the question whether it would be worth using this type of roaster. It is quite clear that the difference between the roasting capacities of the roaster and the rectangular roasting pan is quite small. But this cannot be blamed on the roaster because it was not designed to roast gari.

It is recommended that to modify the roaster into a gari roaster, the following will be required to develop a roaster that will produce gari with the standard quality:

(i) The size of the roasting pan should be increased to take in more dough. This has to be accompanied with a corresponding power rating of the motor. The actual power rating will be confirmed by design calculations which will be presented in another report. This will increase the capacity of the roaster.

(ii) The design of the roaster should avoid sharp corners along the base of the roaster. The stirrers should also be designed to have radius of curvature corresponding to that of the roasting pan. This is to ensure a smooth stirring process and avoid a situation where the stirring process has to be aided with manual scraping at the sides and corners of the roasting pan.

(iii) Reducing the stirring rate means reducing the speed of the vertical shaft carrying the stirrers. This is necessary to allow the sieved mash enough time to absorb heat and hence reduce the time for gelatinization. This will eventually increase the kg/hr. output of the roaster.

(iv) The system for heating the roaster must be designed to allow for effective control of the roaster temperature, especially during the period of drying of the gari. This will provide the opportunity to avoid burning of the product and to achieve the standard colour of gari.

(v) The design should include a mechanism that will allow for easy collection of the product after roasting. The test conducted revealed that most of the product got burnt when it was being collected.

(vi) Corrosion resisting material, preferably stainless steel or aluminium should be used instead of mildsteel.

A gari roaster is being designed based on the test conducted and the recommendations given above.

5.0 ACKNOWLEDGEMENT

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6.0 REFERENCE

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