Der Tropenlandwirt, Zeitschrift für die Landwirtschaft in den Tropen und Subtropen
91. Jahrgang, April 1990, S. 51 – 64

Cassava: Gari Technology makes Progress in Nigeria's Agro-Industrial Development

Cassava: Fortschritte der Gari Technologie in der agro-industriellen Entwicklung Nigerias

by Isiaka Idowu[1]

1 Introduction

Cassava (*Manihot esculenta* Crantz) is a staple food crop which provides more than 50% of the calorie requirements for more than 200 million people in sub-saharan Africa. It supplies over 70% of the daily calorie intake for millions of Nigerians (IITA 1985; NRCRI Briefs on Cassava). Since the introduction of cassava from Southern America, its original home, many years ago, it has often played a vital role in alleviating famine conditions in Africa by providing a sustained food supply when other crops failed. According to PURSEGLOVE (1968) and NGODDY (1974), cassava was introduced into Nigeria in the sixteenth century by the Portuguese slave traders via Warri.

Cassava has the recognized advantages of adapting to diverse environments and farming systems. It requires few production skills and limited inputs – stays in the ground for up to 18–24 months until required for consumption; and remains relatively drought tolerant, surviving four to six month of dry weather (IITA, 1985). In all considerations, its importance in the rural farm economy and food security is well established.

Cassava contains hydrogen cyanide in tubers and leaves in the form of cyanogenic glucoside which releases poisnous HCN on hydrolysis when tissues are destroyed. No acyanogenic cassava variety has been reported but the level of the HCN varies with variety. In Nigeria, the average yield of cassava on traditional farms is 8,600 kg/ha compared to the potential level (40,700 kg/ha) – that is, the yield obtainable under optimal farm management conditions (IDOWU, 1988, pp. 2–3). The low cyanide varieties below 10 mg/100 g of fresh cassava are generally low yielding compared to the high cyanide varieties – above 20 mg/100 g of fresh

[1] Dr.-Ing. agr. Isiaka Idowu, International House, International Institute of Tropical Agriculture (IITA), P. M. B. 5320, Ibadou, Oyo State, Nigeria

cassava (HAHN, 1984, p. 14). In order to make the cassava roots innocuos for human consumption, and to improve palatability, the roots must be processed to various edible products. One of these products is „Gari" – a staple food, the main form in which cassava is being consumed in Nigeria. It is, however, important that the processing method be used with low HCN varieties.

The decline in imported food stuffs due to the Federal Government's ban on several food items (i.e., Wheat, maize and rice) and recurrent drought in the northern parts of Nigeria has resulted in cassava/gari growing in popularity as food staple. Consequently, the demand for gari is constantly growing in rural areas as well as in the cities which are growing ever more hungry for instant foods. This has led to a keen interest in the industrialization of gari processing.

The price for home-made gari is increasing constantly, and it is considerably higher in urban areas due to additional transport costs for the cassava roots and products, and the intermediate trade involved. This makes the market for gari highly competitive with little being paid for the added value of processing.

2 Utilization of Cassava and the Importance of Gari in the Diet of Nigerians

As mentioned earlier, cassava's food utilization in Nigeria is mainly in the form of gari and to a lesser extent, cassava paste or flour (fufu or lafiun). However, there is a wide variety of other cassava products with potential for human consumption.

Cassava can be eaten in its fresh form by boiling, frying or roasting cassava pieces. Normally, cassava and its products are generally not eaten alone, even by the poorest families in both rural and urban areas. It is usually served with soup and gravy. Thus, the cassava part of the meal provides carbonhydrates, and the soup or gravy, which may contain leafy or fruity vegetables and animal products, are responsible for minerals, vitamins, fiber and protein.

Gari is claimed to be the only African-made truly instant food (EKPERE et al., 1986, p. 21). It can be eaten in a number of ways. As the most convenient food, gari is extremely popular with boarding homes, including schools. Among students, gari is eaten as a quick relief for hunger by simply soaking it in water and adding sugar and some milk. Apart from serving it as a snack, gari can be combined with meat or fish or egg souce to make a one-dish meal. It can also be combined with cowpeas and other bean preparations (IDOWU, 1980, pp. 21–22 and KWATIA, 1986, pp. 7–8). For a main meal, gari may be dampened with cold or hot water or stirred into boiling water to make a thick porridge called „eba".

3 Hydrogen Cyanide Detoxification by the Gari Process

Processing of cassava roots into gari involves a combination of methods such as harvesting, peeling, grating, fermenting, pressing (dehydrating), depulping (disintegrating), semidextrinizing (gelatinizing), frying (roasting), sieving, and bagging. Fermentation for 3–5 days, under natural conditions, before processing into gari reduces the total HCN 83–96%. Fermentation liberates the hydrocyanic acid at low pH and develops the characteristic flavor of gari. It is carried out first by cassava bacteria (*Corynebacterium manihot*) that attack the starch with the production of lactic and formic acids, and then by a fungus (Geotricium condida) that acts when the pH has fallen to about 4.2, increasing the acidification and producing the characteristic gari aroma (GRACE, 1977, p. 86 and HAHN, 1984, p. 14). The gari process is the best known detoxification process (see Tab. 1). The total HCN in gari is reduced 83 to 98% when stored for four months under ambient conditions and in „eba", a cooked form of gari, the total HCN is reduced almost 100% (HAHN, 1984, p. 14).

Tab. 1: Cyanide detoxification by the gari process

Process	Material	HCM (ppM)	% Detoxification on peeled root
–	Whole cassava root	306	–
Peeling	Peel	660	–
	Peeled root	184	0
Grating	Slurry	104	16.92
Dewatering after	Cake	52	71.74
Fermentation	Pressed juice	86	53.26
Roasting	Gari	10	94.56

Source: KWATIA 1986, p. 7

4 Traditional Gari Technology and the Associated Progress

Processing cassava into gari for household consumption and for sale is a major task of women, particularly in villages. Farmers normally harvest cassava tubers from their farms to be processed by their wives. Some women cultivate and/or purchase whole cassava fields from farmers and then organize both the harvesting and processing. Quite often, additional hired labor is used.

Peeling and Grating

The roots are peeled by hand and ground down on a home-made rasp (perforated tin sheet). A growing number of households have adapted the use of locally produced mechanical grater powered by a small petrol engine. In larger processing depots, diesel powered graters are used.

Pressing and Fermenting

Following grating, the dough is packed loosely into fiber bags or baskets and covered with a piece of sacking. The liquid is pressed out by placing boards on top of the bags, piling 100 to 200 kg of stones on top. Dehydration takes place over two to three days during which period fermentation occurs. In Eastern Nigeria, this fermentation period is often eliminated. But, in the South Western Nigeria, it is essential, in order to satisfy local tastes. Alternatively, and preferably, a local press stand made of steel beams and powered by a 20-tonne hydraulic jack is used. This system can press out the water in four bags (about 200 kg) of gari mash in under 15 minutes. A good dewatered cassava mash has a moisture content of approximately 40–50%.

Depulping

After dewatering, the lumpy cake is broken by rubbing between palms and sifted to remove excess fiber from the semi-pulverized material.

Frying

The material is then roasted or fried. The roasting process, otherwise known as garification involves a slight dextrination which improves influence on its digestibility. Fryers range from the traditional shallow earthenware in which the gari is continually stirred with a piece of calabash to prevent burning over a wood fire, to the use of a large fabricated-steel, flat-bottom set in a cement lock fire chamber complete with a smoke pipe. Stirring continued until gelatinized or toasted grains are formed.

Sifting

The product is again sifted to obtain uniform grains of gari after which it is further dried and packed into fiber or polythene bags for sale. For good storability, gari should have a moisture content of between 6 and 12% (KWATIA, 1986, p. 6). For further comparison, Tab. 2 illustrates the sequence of operation and the corresponding changes in moisture content of various gari products.

Table 2: Gari processing and changes in moisture content (%)

Operation	Product	Moisture %
Grating	Slurry (pulp)	60 – 65
Fermentation	Fermented pulp	–
Dewatering (centrifuge)	Cake	47 – 50
Roasting	Semi-dry gari	30 – 35
Final drying	Gari	8 – 10

Source: KWATIA 1986, p. 7

In order to provide an idea of the marginal added value of processing cassava to gari in relation to the net farm income of a small-scale producer, the income statement of an average cassava farmer who processes 1 tonne of cassava tubers to gari in Oyo State, Nigeria is presented in Tab. 3. In a situation where a net operating margin of N 90.00 might be acceptable to a domestic producer who has relatively low overhead costs, an industrial processing of cassava to gari will not be viable unless there are significant savings and higher level of investments.

Tab. 3: Income statement of an average cassava farmer who processes one tonne as cassava tubers to gari in Oyo State, 1984

Gross sales of ten 20-kg bags of gari from one tonne tubers		N 400.00
Cost of one tonne of cassava tubers		150.00
Gross margin per tonne of cassava tubers		N 250.00
Less processing expenses:		
Peeling	N 30.00	
Grating/grinding	50.00	
Bagging and Pressing	10.00	
Sieving	20.00	
Frying	50.00	
Total cost of processing	N 160.00	
Net operating Margin or Net farm (cassava) income		N 90.00

Source: EKPERE et al. 1986, p. 29
NB: At this time, N (Naira) was officially exchanged for approximately DM 3,-

5 Historical Development of Mechanized Gari Processing Plants in Nigeria

Granted the relatively wide applicability of gari technology and that traditional gari producers are already familiar with most of the relevant aspects of the technology, it is important to constitute the locally available equipments into a package of processing technology which attempts to improve on the existing indigenous processing methods with the aim of reducing the drudgery of work, totally eliminating or reducing the HCN in gari, and to increasing its storability over long periods while retaining its taste and quality under hygienic conditions.

5.1 The Federal Institute of Industrial Research-Oshodi (FIIRO) *and the Newell Donford-England Conception of Gari Technology*

In the early fifties, the Federal Institute of Industrial Research Oshodi (FIIRO), in Lagos startet work on the conceptualization of technologies aimed at improving the traditional methods of gari-production in Nigeria. FIIRO's first concern was the development of a fully mechanized gari fryer. This attempt was not so successful because the chemical process of gari processing was not fully understood (IDOWU, 1980, p. 29). Consequently, FIIRO initiated a collaborative research with the Department of biochemistry of the University of Ibadan, Nigeria. Experimental work extended over a long period until 1957 when the first publication of results was made. Already in 1954, before the first publication of research results, the engineers at FIIRO had worked out detailed plans for a pilot processing plant. But, for lack of funds, the project was dropped. In place of a mechanized pilot plant, a simple processing technology was developed. One major component part of the technology was a mobile motor-driven gari grater, which to date, has replaced the home-made graters in many Nigerian villages. Another remarkable improvement in the traditional processing methods is the development and use of wooden screw press, its subsequent improvement using a locally constucted and one-man-operated iron screw press in place of heavy stones. Also, the use of improved pulp sifter and frying units (iron or sheet-metal instead of units made of earthenware) has started to gain ground among gari producers.

FIIRO's third meaningful contribution to gari processing technology was the development of multiple frying range consisting of four fryers in a row. However, this development compared to the motor-driven grater was not well received by the gari producers. Assuming a better knowledge of the chemical processes involved in gari production, FIIRO, in 1957 reactivated its plans on developing a prototype gari plant. The license for its construction was approved by Newell Donford Engineering Ltd., a British company that had specialized in the construction of dryers (NGODDY and KAPLINSKY, 1974).

The first gari pilot plant was tested in 1960. Improvements were continuously made on the plant until 1964 when a production capacity of 1 tonne per day was attained. In 1965, the 1 tonne per day pilot plants were tested on commercial level in Ijebu-Ode. But, in 1966, many of these plants were returned to FIIRO because of break-downs, particulary of fryers and the inability to fully utilize the plants' capacity due to insufficient supply of raw materials (cassava roots). By the end of the sixties, Newell Donford had produced a „garification" unit in which the two antagonistic processes-gelatinization and roasting were separated. This unit was subjected to modifications and at the end of 1970/71, the plant's production capacity was raised to 3 tonnes per day. The plant was used sucessfully by FIIRO, TEXACO company, and a few other commercial gari producers. Already in the mid-sixties, development efforts were initiated by FIIRO and Newell Donford to design a fully mechanized 10 tonnes gari plant – the Mark III Newell Donford plant. In 1975, the first Mark III plant was installed for the IDO (Ibadan) Cooperative farming and Produce Marketing Society Ltd.. The second plant was operated by Texaco Agro-Industrial Ltd. in Opeji, Abeokuta in 1978 (JONES and AKINRELE, 1976). According to ADETOBA (1979), the 10 tonnes per day plants was only producing 6 tonnes gari per day. Thus, experiences made with FIIRO and Newell Donford gari plants seem to suggest that a simple technology that attempts to upgrade the traditional techniques appears more appropriate and efficient than the fully mechanized technique considering the present situations in Nigeria.

5.2 The Product Development Agency (PRODA) and the Fabrication Engineering and Production Company (FABRICO) Technologies

The national disorder in the middle of the 1960s due to the Nigerian civil war led to a mass repatriation of citizens of Eastern Nigeria origin to their respective regions which invariably resulted to a foundation of a „think-tank" group on the side of the then „Biafran". This group comprised some of the scientists and technicians who had worked at FIIRO to develop appropriate and less sophisticating technologies for gari production, particularly for gari fryer. After the end of the Nigerian civil war, the government of the East Central State reactivated the efforts of the group and founded the Product Development Agency (PRODA). By 1970, this group had designed and produced a series of prototype plants.

A number of scientists who had worked with the „think tank" group returned to the then newly created Mid-Western State where they continued development work on the mechanization of gari production. This group formed a company known as the „Fabrication Engineering and Production Company (FABRICO), which later developed a motor-driven gari roaster. The toaster was first operated in Issele-Uku in 1971. The PRODA-FABRICO machines were simple, less expensive, and more appropriate than those of FIIRO-Newell Donford (NGODDY and KAPLINSKY, 1974). The component parts of the PRODA-FABRICO machines were designed using locally produced materials. In fact, they represented an improvement on the traditional production methods. According to NGODDY (1974), the two companies developed a roaster with 1 tonne gari capacity in an 8-hour shift. By contrast, the traditional technique remained a manual operation whereby the most popular innovation over the last 85 years remained the use of mechanical grater which has been described earlier. Continuous technology development and delivery work by PRODA and FABRICO has resulted in the development of a roaster with 3 tonnes gari per day (NRCRI-Briefs on Cassava, pp. 8–9; IDOWU, 1980, pp. 41–45). In the recent years, several gari factories using the equipment have been established in various states of Nigeria.

*5.3 The Rural Agro-Industrial Development Scheme (*RAIDS*) Improved Village Technology*

Further to the continuous development work done by FIIRO, PRODA and FABRICO, the Nigerian Government noted the need for a complementary growth of agro- and storage industries as a vehicle for promoting and sustaining agricultural development and growth. There was also a parallel drive to improve and simplify processing techniques. It was in response to these needs that the Rural Agro-Industrial Development Scheme (RAIDS) was established as a unit of the Federal Department of Agriculture and Rural Development (FDARD) in 1981. The need for Agro-Industrial Development arose from the increase in acricultural production particularly in the first generation Agricultural Development Projects (ADPs) where artificial food crops surpluses were created (RAIDS, 1988). RAIDS looked closely at the traditional processing systems to identify improved methods of upgrading the Gari-industry. The result is the RAIDS-Village Gari Production Process.

The Process

Weighing

The cassava tubers are weighed straight away at arrival on site. This is done in order to keep an accurate record of how much raw material is used for producing each kg of gari.

Peeling

Peeling the cassava tubers is the first processing operation. As there is no suitable machine available for this operation, hired casual labor (hand peelers) are used.

Washing

In order to eliminate extraneous matter (e.g., loose earth or soil) from the cassava tubers and finished products, the tubers are washed after peeling.

Grating

After washing, the tubers are turned into a mash in the grating machine. Cassava graters are usually belt-driven from a static dieselengine, typically a 5hP (3.7KW) Lister, and are available from local fabricators throughout Nigeria. This type of grater has a capacity of more than 500 kg tubers per hour and costs approximately N 400.

Fermenting

The mash is now ready for fermentation. This process gives the gari its desirable aroma. Depending on consumers'taste, a period of 2 to 3 days is usually long enough for fermentation. It is important that the mash does not come into contact with the air. This could be avoided by keeping the mash in a sealed container during fermentation or by stacking in polypropylene bags on a rack.

Dewatering/Pressing

Following fermentation, the mash has to be pressed to remove all the liquor. In the mash-dewatering stage, RAIDS has introduced a simple press using an hydraulic lorry jack to speed up the process and reduce much of the hard work. Manufacturing workshops are able to produce frames for the press. Alternatively, a „home-made" version of this system can easily be assembled from scrap vehicle parts for very much less cost. However, nothing smaller than a 30 tonne-jack should be used. The lower cross-tie of the frame schould be sunk into 15 cm concrete. 6 full bags (300 kg) of mash can be pressed within one hour.

Breaking up the cake (Disintegrating)

After dewatering, the mash will stick together forming lumps. It should be passed through the grater which breaks up the lumps ready for frying.

Frying

An improved frying method is a key to improved gari processing. The most significant improvement is the RAIDS – 2.4 m x 1.2 m flat-bottom pan fryer made of mild steel sheet, minimum thickness – 3 mm. This frying tray enables 2 women to fry up to 250 kg of gari in a 8-hour shift per day. The two women, tossing the gari constantly with paddles to prevent burning must be able to judge the frying time required for each individual batch (usually about 20 minutes). The tray should be unwelded as gari will stick in any welded seam and burn. Heat is normally provided from a woodfire. Although gas or oil burners can be used, they would, of course, make a significant difference to both capital and running costs. It is advantageous that RAIDS fryer tends to direct smoke away from the user as the fire chamber is furnished with a smoke pipe. The fryer seems appropriate for cost-effective group-owned processing.

Sifting

The fried gari is sifted immediately after frying to remove any coagulated lumps.

Cooling

After sifting, the gari is spread out on a polythene sheet to cool for 5–6 hours before it is put in bags ready for sale.

Based on the assumption that the entrepreneur would provide all start-up and working capital finance, RAIDS-capital and production costs' model shown below in Tables 4 and 5 attempts to demonstrate whether the project itself is likely to be profitable or not (see RAIDS Training and Information Brochure, 1987). In reality, it is likely that the potential agro-industrialists would raise a bank loan or overdraft cerntainly for the working capital, if not the fixed capital costs. Hence, this model should serve as a guideline to prepare a financial analysis in the light of entrepreneur's own particular financial circumstances.

Tab. 4: Capital costs

Buildings		Equipment	
Peeling shed	N 1,500	Vehicle	N 25,000
Grating shed	3,000	Grater and engine	3,500
2 frying sheds	4,000	2 fryers	1,500
Water supply	1,000	Weighing scales	3,000
Soak pit	100	Dewatering press	1,000
		Miscellaneous	500
TOTAL	N 9,600	TOTAL	N 34,500
+ 10 % contingency	N 10,500	+ 10 % contingency	N 37,950

Source: RAIDS 1987

Tab. 5: Annual production costs

Tubers (550 t.; N 80.00 per t.)	N 44,000	Labour required
Labour	32,900	
Bags	4,500	12 peelers*
Utillities	910	4 fryers*
Maintenance	1,989	1 foreman
Insurance	650	1 driver
Depreciation	5,128	2 graters/press operaters
Miscellaneous	1,500	1 general hand
TOTAL	N 91,577	* Casual workers on piece rate.

Source: RAIDS, 1987

NB: At this time, the value of Nigerian Naira (N) had fallen to DM 0,6.

6 Adolf Hubrich-Hamburg Industrial Processing Method

Adolf Hubrich is the name of a German machine-manufacturing firm in Hamburg. The firm had specialized in the fabrication of small and large scale industrial plants for the processing of cereals, roots and tubers, and other starch derivatives. One major field of activity of the firm is the processing of cassava tubers into animal feed (i.e., chips and pellets) as well as into human food products, for examples, baking flour, fufu, and gari. Hubrich's gari plant is not yet popular in Nigeria. However, it can certainly become a feasible innovation for Nigerias future agro-industrial business. Hubrich's industrial processing method (see fig. 1) is described in the following. The fresh harvested roots are being unloaded from the trucks into a water basin for pre-cleaning, removal of soil and other coarse dirt. Thereafter, the roots are peeled and sorted by hand. An inclined conveyor, equipped with a water spraying device for final washing takes the roots to a special disintegrator, which grates the roots with an optimal effect. After grating, the root slurry is squeezed out, releasing starchy water, a by-product, which can be collected in a basin. This starchy water can be washed and sun-dried, and thus be processed into technical starch for the use in textile factories and paper mills.

Gari consumers, particularly in South-Western Nigeria prefer the acid taste, and in order to obtain it, the gari is normally subjected to 3–5 days fermentation. Adolf Hubrich's firm has demonstrated and assured that the non-fermented product finds acceptance without objection, the more that it is known that the lactic acid, contained in the slightly sour product, takes a negative influence on the food product (HUBRICH'S FLOW SHEET, No. 57n). Instead of acidulating the slurry by fermentation, ascorbic acid or citric acid is added. Thus, the desired taste of the fermented home-made gari is obtained. At this stage, gari can be substantially improved by adding further trace elements to give the product additional nutritive substance of a high-quality human food. If, for example, mixed with additives such as calcium, protein, common salt, iodine and similar nutritious agents, it will develop to an excellent foodstuff for children and to invalid diet. Hubrich's technical conception permits to incorporate mechanical devices for applying such additives during the production process.

The dewatered and treated mash is subsequently conveyed to a gari fryer (gas- or oil-heated), where it undergoes a drying and also a roasting process, giving the product a similar taste to toast. The herein effected dextrination will further improve the nutritive quality and disgestibility.

After mechanical drying and roasting, the gari is pneumatically blown into a sifter for clasifying it in two grades-normal-sized and over-sized gari. From sifting, the gari enters the bagging or packaging lines, either being filled into bags or into small packages in consumers' sizes, ready for sale. The finished product is of such a nature that it can be easily stored over long periods without loosing its taste and quality. The type of plant described here has an input capacity of 500 kg roots/hour, or 12–15 tonnes/day (3–5 tonnes gari per day).

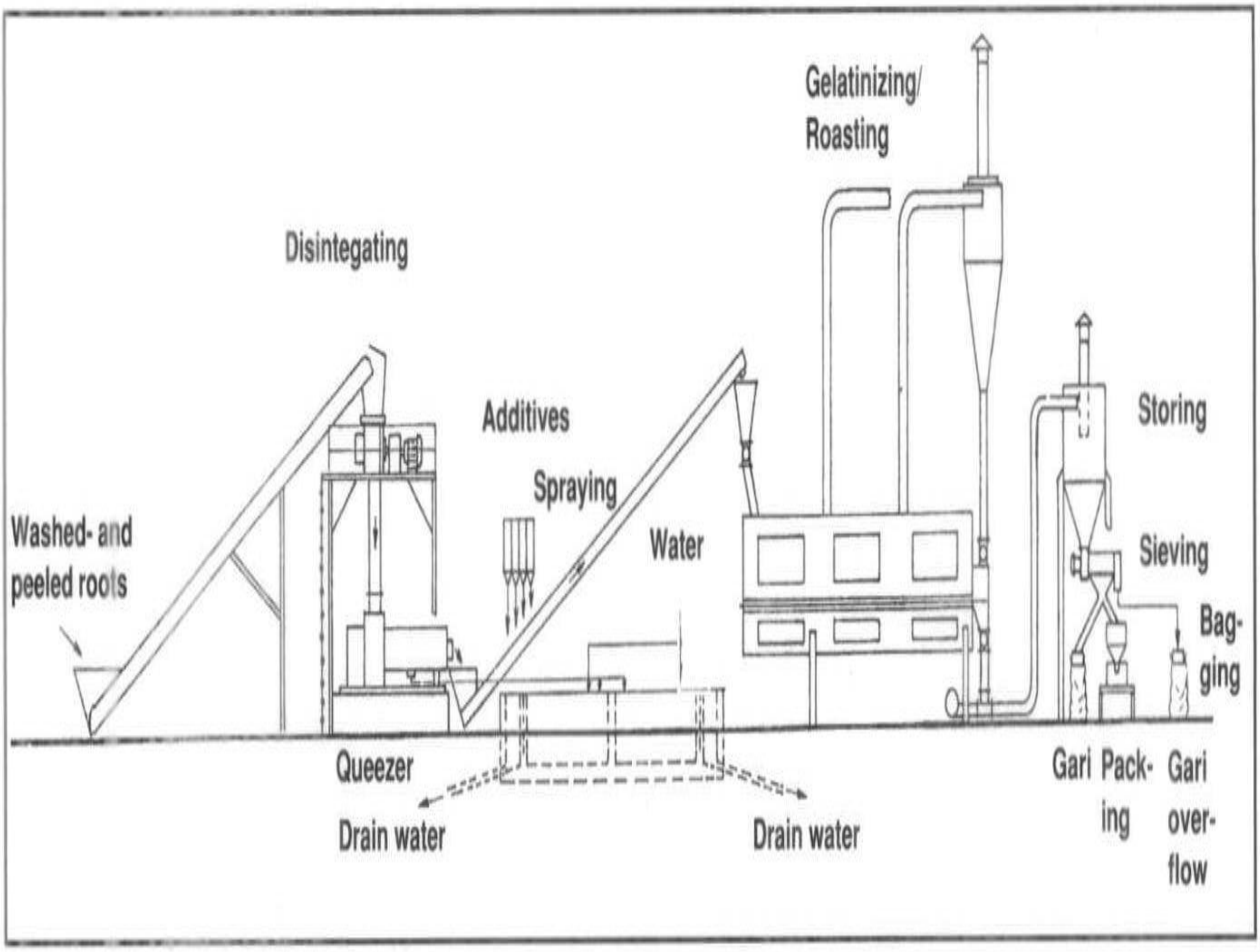

Fig. 1: Industrial production of Gari (500 kg roots/hour) [Source: Adolf Hubrich, Hamburg]

7 Concluding Remarks

A further improvement on the existing gari technologies perhaps in line with Hubrich's method will not only increase the input capacity (in tonnes of cassava tubers/day), but, also turn gari to be a first-class human food product. For economic considerations, especially with regard to short access distances between cassava fields and factory, and the manageable daily input capacity, it is reasonable, in the case of Nigeria, to rather decide for industrial plants of moderate capacity (about 3 tonnes gari/day) than for large plants. Such dimentioned factory can easily be operated and guarantees excellent return at the costs of a relatively low investment, possibly, at the level of a small farmers's cooperative. However, if the available funds allow for higher investments, it may be contemplated to implement two or more factories of this kind. In this respect, it is important that factories are located to cover a nuclear cassava plantation in easy reach of raw materials, and having access to different sales' markets for the finished products. The choice and adaptation of a particular processing method will necessitate that the elementary components of the processing plant have to be locally designed, and that only the manufactured machinery and accessories which are not locally available are to be imported. This, in our opinion, can bring about a progressive change, and in deed, is a probable step forward in promoting a rural agro-industrial scheme in Nigeria as well as for investments of the private sector with most favourable prospects for quick amortization.

8 Summary

Cassava (*Manihot esculenta* Crantz) is a staple food crop of paramount importance in the tropics. It provides more than 50% of the calorie requirements for more than 200 million people in sub-saharan Africa. It supplies over 70% of the daily calorie intake for millions of Nigerians.

Cassava requires relatively few production skills and limited inputs. While remaining relatively drought tolerant, it can stay in the ground for up to 18–24 months until required for consumption.

Hydrogen cyanide is present in the entire cassava plant, particularly in its tubers in the form of cyanogenic glucoside which releases poisnous HCN on hydrolysis when the tissues are destroyed. The level of HCN varies with variety. In order to make the cassava roots innocuous for human consumption, the roots must be processed into various edible, storable and marketable products. One of these products is Gari, Nigeria's most popular staple food in rural areas as well as in the cities. The gari process is the best known detoxification process.

Gari can be served as an instant food or as a snack. It can be combined with meat, fish, or egg souce, or bean preparations to make a one-dish meal.

With cassava/gari growing in importance, efforts were made already in the early fifties to rationalize and mechanize gari production in Nigeria. The early attempts were not so successful because the chemical process of gari processing was not fully understood, and because the peculiar production conditions and possibilities for the technologies in Nigeria were not ade-

quately considered. This paper highlights the major attempts in historical sequence with their results, and finally illustrates the Adolf Hubrich's industrial processing method, whose major components can be modified and adapted to suit Nigeria's future agro-industrial business.

Zusammenfassung

Cassava (*Manihot esculenta* Crantz) hat als Lebensmittelpflanze große Bedeutung, sie deckt mehr als 50% des Kalorienbedarfs für mehr als 200 Millionen Menschen in Afrika südlich der Sahararegion. Hinzu kommt, daß sie einfach anzubauen ist, 18–24 Monate bis zum Verzehr im Boden verbleiben kann und relativ trockenresistent ist. Die Cassava-Wurzeln werden zu zahlreichen Gerichten verarbeitet. Das populärste Produkt aus Cassava für den Verzehr ist „Gari", das gut lager- und handelsfähig ist und dessen Bedarf sowohl in ländlichen Regionen als auch in Städten ständig zunimmt. Gari kann mit Beilagen wie Fleisch, Fisch, Ei, Bohnen usw. zu zahlreichen Speisen verarbeitet werden, die sich großer Beliebtheit erfreuen.

Entsprechend der großen Bedeutung von Gari hat es zahlreiche Bemühungen gegeben, die bis in die 50er Jahre zurückreichen, die Herstellung von Gari mit Hilfe von Maschinen und Geräten zu rationalisieren und zu mechanisieren. Diese Bemühungen waren keineswegs immer von Erfolg begleitet, weil örtliche Gegebenheiten und Möglichkeiten nicht beachtet wurden. Die vorliegende Arbeit schildert diese Versuche in historischer Reihenfolge mit ihren Ergebnissen und schließt ab mit der Darstellung eines vollmechanisierten Verfahrens der Firma Hubrich in Hamburg.

Acknowledgement

This piece is a review of experiences and a synthesis of preliminary information on the processing of cassava into gari in Nigeria, being one of the technology cases currently studied by a team of researchers from the International Service for National Agricultural Research (ISNAR) in the Hague, Netherlands. The author is a member of the research team.

I am particularly indebted to Prof. Dr. Hans Walter of the Faculty of International Agriculture, GhK-University of Kassel, Witzenhausen in W-Germany for his interest in the topic and for suggesting the inclusion of a mechanized gari processing technology for comparison. I also thank Mrs. Schmutzler of the same faculty for the stenographic work.

For the ISNAR side, I am grateful to the members of the research team to Profs. Johnson Ekpere and Ajibola Taylor, and Dr. David Kaimowitz for comments on the research.

Opinions expressed in this publication are the author's and do not necessarily reflect those of the above institutions or individuals.

References

1. ADETOBA, J. O., 1979: The Story of TEXACO-Agro-Industrial Nigeria Ltd., Opeji, Abeokuta

2. EKPERE, J. A., et al., 1986: The Place of Cassava in Nigeria's Food Security, Rural Nutrition and Farm Income Generation: A Situation Analysis for Oyo State – Nigeria, IITA, Ibadan

3. GRACE, M. R., 1977: Cassava Processing. FAO Plant Production and Protection Series **3**, FAO, Rome

4. HAHN, S. K., 1984: Tropical Root Crops: Their Improvement and Utilization. Conference Paper 2 IITA, Ibadan

5. HUBRICH, A. – Maschinenbau (1985): What can I produce from Cassava Roots? Flow sheet **57n**, Hamburg

6. IDOWU, I. A., 1980: „Verarbeitung von Kassava (Maniok) zu Gari unter besonderer Berücksichtigung der Verhältnisse in Nigeria" (Diplomarbeit). GhK – Universität Kassel, Witzenhausen

7. IITA-Research Highlights, 1981–1984: Farming Systems Program, IITA, Ibadan

8. JONES W. and A. AKINRELE, 1976: Improvements of Cassava. Processing and Marketing. Recommendations and Reports for IITA, Ibadan

9. KWATIA, J. T., 1986: Cassava: Storage, Processing and Utilization. IITA-UNICEF Consultation on Promotion of Household. Food Production and Nutrition, IITA, Ibadan

10. NGODDY, P. O., 1974: Gari Mechanization in Nigeria: The Competition between Intermediate and Modern Technology

11. NGODDY, P. O. and R. KAPLINSKY, 1974: Operational Instruments in Agro-Industrial Planning: Choice of Technology in Gari Manufacturing in Nigeria

12. NRCRI – Umudike (undated): Briefs on Cassava, L.S.O. Ene (edt.), Umudike

13. RAIDS, 1987: Village Gari Production. RAIDS, Ibadan

14. RAIDS, 1988: Rural Agro-Industrial Development Scheme: Aims and Activities. RAIDS, Ibadan