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The transfer of improved gari production technology

Le transfert de procédés améliorés pour la production de gari

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- Abstract -

Gari is a West African food produced from cassava roots. It is a fermented and granular staple consumed as processed or prepared with hot water and eaten with sauce. Gari production has been well developed in West Africa at the small, medium and industrial levels. There is a need to transfer the process not as Package Technology (PT) but as Total Technology Transfer (TTT) to other parts of Africa where cassava is also grown but not adequately processed. TTT is the transfer of all available knowledge about processing in relation to a particular commodity. With reference to gari production, these include : raw material quality and quantity, equipment, manufacture and maintenance, critical control points and variations in processes, storage of products, by-products, water requirements and environment control (in particular waste water treatment). The overall aim is to transfer a better technology and ensure that the technology is appropriate and sustainable.

- Résumé -

Le gari est un aliment de base d'Afrique de l'Ouest préparé à partir des racines de manioc. Après fermentation et granulation, il est consommé tel quel ou préparé dans de l'eau chaude avec une sauce. La production de gari en Afrique de l'Ouest s'est développée aux différentes échelles : petite, moyenne et industrielle. Au cours des transferts réalisés dans les autres régions d'Afrique où le manioc est produit mais transformé de manière non appropriée, il est important de transférer l'ensemble des procédés utilisables pour les différentes opérations unitaires (TTT) plutôt que de transférer une suite de procédés préalablement sélectionnés (PT). Le transfert TTT est la transmission de l'ensemble du savoir disponible sur une transformation en un produit fini particulier. En ce qui concerne le gari, il prend en compte : la qualité et la quantité de matière première, l'équipement, la fabrication et la maintenance, les points critiques de contrôle et les variations de procédés, le stockage des produits finis, l'utilisation des sous-produits, les besoins en eau et le contrôle de l'environnement, en particulier le contrôle en rapport avec le traitement des effluents. L'objectif final est de transférer une technologie améliorée et de s'assurer que cette technologie est appropriée et peut être utilisée durablement.

Introduction

Gari is the most popular West African staple food produced from cassava. It is consumed as processed or reconstituted with hot water to give a dough-like paste called "Eba", which is consumed with sauce. Gari is a versatile commodity because its organoleptic characteristics can be adjusted to conform to consumer specifications. The main arguments against gari include its bulky starch content which can be augmented during processing or consumption. Gari should be consumed with animal or plant protein accompaniments (Tubman, 1989) or protein enriched with soybeans to boost its protein content (from 1-2 to 9-12%) (Sanni & Sobamiwa, 1993). It is, therefore, the most developed, convenient and storable commodity from cassava.

Gari may be produced at a small, medium or large scale (Sanni, 1990) but in Nigeria many women carry out processing on a smallscale for economic reasons. At this level, there has been a change from "Processing with little or no mechanization at subsistence level" to "Commercial small-scale processing using essential equipments", (Sanni, 1991). These essential equipments are available in various parts of West Africa (Amadi, 1973).

1. A benefic technology transfer

Cassava has a wide geographic spread covering western, central and eastern regions of Nigeria (Hahn, 1989). Cassava roots are bulky, perishable and most varieties are unsuitable for direct consumption because of the presence of cyanogenic glucosides. Processing renders cassava palatable, decreases toxicity and prolongs shelf-life (Sanni, 1991). Cassava processing in Central and East Africa depends on manual implements and weather uncertainty. The gari production technology has been developed at different levels, so as to make it possible to choose the appropriate level. Gari production includes root grating, then the mash is fermented and pressed for dewatering. The resulted mash is roasted to dryness over heat. All these gari production stages may involve mechanical equipments.

There is an urgent need to transfer gari production technology to other parts of Africa where cassava is grown but not adequately processed. Insufficiently processed cassava has been implicated in a variety of pathological cases such as acute cassava poisoning, iodine deficiency disorders, tropical ataxic neuropathy and the irreversible and debilitating Konzo (Essers *et al.* 1991; Banea *et al.*, 1992 ; Banea, 1993). All of these conditions give serious health troubles and some may be lethal.

2. Package technology or total technology transfer ?

Package Technology (PT) is whereby all equipment needed for the processing of a certain commodity is made available "in a pack". However, this concept may collapse for a variety of reasons. The "recipient actors" may not be able to maintain the equipment or it may have such a large capacity that it is impossible to obtain a regular supply of raw materials to fully utilize it. Africa cannot afford grandiose technology transfer which is doomed to collapse.

Total Technology Transfer is the provision of all available knowledge relating to the processing of a particular commodity. It is the result of a sincere desire on the part of the "owners" of the technology to impact information and assist the "recipient actors". TTT is only "Total" in relation to current knowledge and has to be updated as more information is acquired.

The main aspects of TTT with reference to gari production include: Raw material supply in quantity and quality, equipment, fabrication and maintenance, Critical Control Points (CCP) and variations in processing, storage, by-products, water supply, effluent treatment and infrastructure.

2.1. Raw material quantity and quality supply

Cassava is a hardy crop and the only raw material for gari production. The cultivars to be planted must be carefully selected to ensure a continuous and adequate supply for a sustained production of gari. For example, in Ibadan, small-scale gari processors produce an average of 45kg gari per day (Sanni, 1991) from approximately 150kg of cassava. If each woman processor works for 25 days per month, then she would process 45 tonnes of cassava into gari per year. 100 women will need 4,500 tonnes of cassava annually. There will be a need to produce more cassava, all round the year to ensure adequate raw material supply.

There are improved cultivars, e.g. TMS 30572, 4(2)1425,which reach maturity by 12 to 18 months whereas local cultivars such as *Odongbo*, *Ege dudu*, etc. mature in 2-3 years. The cassava variety is an important determinant in the quality of gari. Adequate processing of cassava will result into gari with low cyanogen content.

2.2. Equipment Fabrication and Maintenance

Equipments for rapid processing of cassava have been used in Nigeria for over 20 years (Amadi, 1973). The stages in the processing of cassava include: peeling, washing, grating, dewatering, granulating or sieving, roasting, cooling and packaging (Adeniji, 1976, Oyewole *et al.*, 1986; Sanni, 1990).

Peeling is done manually because cassava is bulky and irregular in shape with various peel thickness. Mechanical peeling result in heavy losses. Washing is also manual for convenience and to reduce cost. There are many models of grater using electricity, diesel or petrol motor. The grating surfaces are made from iron sheet, galvanised iron or stainless steel; the first two being rust-prone. Low cost and low energy graters are available in the market and women processors use them.

Sieving or granulating is manual and is done on raffia or metal sieves. There are metal sieves which can be used while standing or shaken mechanically. The rotating drum sieve is less effective (Tubman, 1989). Rapid removal of water from fermented pulp lasts from 30 mn to 2 h and is achieved by using hydraulic jack or screw press. The screw press designed by RAIDS Nigeria was recently improved to enhance efficiency. Roasting over heat is preferably carried out in a cast-iron pan or an assortment of trays. Rotating-drum roasters do not produce gari of good quality because such devices do not mix and roast well (Tubman, 1989). The cooling of gari after roasting takes place on suitable trays and the product may be packaged in thick polythene bags. RAIDS Nigeria has designed a simple bag-sealing machine.

Model equipment have to be purchased and the "recipient actors" trained to manufacture the equipment. There is often a lot of improvisation to keep equipment in a good working condition. The proper usage and maintenance of these equipments must be learnt not only from the research institutes who design but also from the local artisans who manufacture and maintain the equipment. An effort should be made to produce quality equipment and at the same time to keep a low cost within the reach of the users. This may necessitate government assistance.

2.3. Critical Control Points and Variations in Processing

Gari production must be learnt. The critical control points include raw material control, treatment time, process control, equipment and personnel sanitation control (Sanni, 1990). Fermentation time varies from 1 to 2 days to obtain a bland product or 3 to 5 days to give a sour product (Sanni, 1991). The aim should always be to produce a safe gari product which is acceptable to the consumers.

Palm oil may be added to grated mash before a 1 - 2 day fermentation period or the pan smeared with palm oil prior to the roasting of the granulated mash. This imparts a yellow colour to gari.

Hahn (1989) suggested that the protein enrichment of cassava flour or gari with soyflour is feasible, but wondered whether such a product would be economic and acceptable to consumers. Recent investigations (Sanni & Sobamiwa, 1993) have shown that soybean enriched gari is acceptable to habitual gari consumers. Full-fat soybean flour was added to grated mash or soybean residue mixed with the dewatered mash and granulated. No economic assessment of the process has been studied.

2.4. Storage

Gari is a storage cupboard food which should be dehydrated to a water activity (a_w) of less than 0.7 (Sanni, 1991). This corresponds to a moisture content of 12%. It should have a microbial load of less than 104 cfu/g. Stored gari has been reported to be stable for up to 1 year (Tubman, 1989).

2.5. By-products

All byproducts of gari processing are useful. The peel may be added to livestock feed (Hahn, 1989). Others are Cassareep which is useful as nematicide and manure (Da Ponte, 1993). "Koko" may be milled to give "Lebu" which is consumed like gari. "Koko" and "Lebu" are fractions of roasted meal with average particle size of 2.48 mm and 0.39 mm, respectively. Gari itself may be further milled to give gari-fufu with the average particle size of 0.24 mm. Starch can be recovered from the effluent of the hydraulic press.

2.6. Water Supply and Environment control

Potable water is essential in gari production; washing of cassava roots, equipment and maintaining a sanitary environment. There should be adequate drainage of the waste water from cassava press since it contains mainly hydrocyanic acid (cassareep). It has a short shelf-life of about 3 days (Da Ponte, 1993) and the effluent should be treated before being released into streams or the environment in order to reduce pollution which is common in the vicinity of cassava processing units.

2.7. Infrastructure

There is a need for a reliable transport system of cassava roots from farms to processing units. These units should be properly structured to contain sheds for holding cassava roots, peeling, washing, roasting and rooms for cooling and packaging. Roasting areas, in particular, should be ventilated, with well-designed stoves and chimneys which minimise the exposure of the "garifyers" to heat and smoke. Many available fuels such as firewood, sawdust, charcoal or gas may be used.

Conclusion

There is a need to transfer gari production technology from West Africa to other parts of Africa where cassava is grown, but not adequately processed. The transfer must be properly planned to prevent a sporadic emergence of processing units. TTT will reduce what might have taken 20 - 30 years into a 2 - 3 phase period of 2 years. A possible 3 phase approach of about six months duration in each phase follows :

Phase 1

a - Equipment, manufacture, maintenance and purchase.

b - Cassava cropping promotion (quantity and quality).

Phase 2

a - Gari production workshops, (CCP, additives, storage, by-products, infrastructure, etc.)

b - Evaluation of consumer organoleptic preferences.

Phase 3

- Organisation of process locations, encouragement of local entrepreneurs.

Another advantage is that such infrastructures can be modified for multiple use in making other cassava products, such as starch, fufu paste, etc. If the problems identified in West Africa are eliminated and the current scientific knowledge incorporated, there is the possibility of faster transfer of a better technology.

References

ADENIJI (M.O.), 1976 - Fungi associated with the deterioration of gari. *Nigerian Journal of Plant Protection* 2 : 74 - 77.

AMADI (B.C.), 1983 - The impact of the invention of a mechanical gari processing machine on the cultural aspects of gari consumption and cassava farming in Nigeria. *Oxford Agrarian Studies*, 12 : 94-99.

BANEA (M.), 1993 - *Cassava processing, dietary cyanide exposure and Konzo in Zaire* - Thesis for the degree of Master of Medical Sciences, Uppsala University, Sweden, 65 pg.

BANEA (M.), POULTER (N.H.), ROSLING (H.), 1992 - Shortcuts in cassava processing and risk of dietary cyanide exposure in Zaire. *Food and Nutrition Bulletin* 14 : 137-143.

DA PONTE (J.J.), 1993 - Cassareep, should we throw it away ? *Cassava Newsletter*, 17 : 8.

ESSERS (A.J.A.) ALSEN (P.), ROSLING (H.), 1991 - Insufficient processing of cassava induced acute intoxications and the paralytic disease KONZO in a rural area of Mozambique. *Ecology of Food and Nutrition*, 27 : 17-27.

HAHN (S.K.), 1989 - An overview of African traditional cassava processing and utilization. *Outlook on Agriculture*, 18 : 110-118.

OYEWOLE (T.B.), FAPOHUNDA (T.), GEBREMESKEL, HAHN (S.K.), 1986 - *Cassava processing in the Ibadan area: Technique and processes.* International Institute of Tropical Agriculture.

SANNI (M.O.), 1990 - Hazard Analysis of critical control points in the commercial production of high quality gari. *Nigerian Journal of Science*, 26: (in press).

SANNI (M.O.), 1991 - Gari processing in Ibadan metropolis : Factors controlling quality at the small-scale level. *9th Symposium of the ISTRC, Ghana, Oct. 20-26.*

SANNI (M.O.), SOBAMIWA (A.O.), 1993 - Processing and characteristics of soybean fortified gari. *World Journal of Microbiology and Biotechnology*, 10: 268-270.

TUBMAN (A.F.), 1989 - Development of cassava processing and preservation facilities in Liberia. *In* Akoroda (M.O.), Arene (O.B.), eds.: *Proceedings of the 4th Triennial Symposium of the International Society for Tropical Root Crops(Africa Branch).* Kinshasa, Zaire, 5-8 Dec.: 229-234.