Transformation Alimentaire du Manioc.
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Traditional cassava processing in Uganda

Procédé traditionnel de transformation du manioc en Ouganda

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- Abstract -

Cassava is a very important food to the low income group of people in Uganda. A study was therefore carried out in four districts of Uganda to study how cassava-based foods are traditionally prepared. The report includes the production level of cassava and the population that depends on it.

The traditional methods of processing cassava were found to be boiling, baking, frying, sundrying, and either hand grinding or milling. Cassava was also found to be prepared mixed with broad beans, peas and sometimes with meat. Composite flour was also found to be produced; this usually consisted of cassava flour mixed with either millet, sorghum or maize (corn).

Cyanide and nutrient values of the cassava products were determined. Cyanide ranged from 20.1 to 94.5 mg/kg, crude protein from 1.04 to 4.38 g/100 g, and soluble carbohydrates from 0.4 to 2.68 g/100 g. The main method of processing cassava is boiling. However, composite flour consumption is also significant and is the major method of cassava preservation.

- Résumé -

Le manioc est un aliment très important pour les groupes de population ayant un bas revenu en Ouganda. Une étude a donc été réalisée dans 4 districts de l'Ouganda pour décrire les méthodes traditionnelles de préparation des aliments à base de manioc. Cet article indique également le niveau de production du manioc et le nombre de personnes qui en dépend.

Les méthodes de transformation traditionnelles utilisées sont différents types de cuisson (dans l'eau bouillante, au four, dans l'huile), le séchage au soleil et la mouture par écrasement à la main ou dans un moulin. Des modes de préparation consistant à mélanger du manioc avec des haricots communs, des pois et quelquefois de la viande ont également été observés. Des farines composées sont également préparées : il s'agit de mélange de farine de manioc et de farines de mil, de sorgho ou de maïs.

Les teneurs en composés cyanés et en nutriments des produits dérivés du manioc ont été déterminées. Les teneurs en composées cyanés varient entre 20,1 et 94,5 mg/kg, celles en protéines entre 1,04 et 4,38 g/100 g et celles en sucres solubles entre 0,4 et 2,68 g/100 g.

La principale méthode de préparation du manioc consiste à faire bouillir les racines dans de l'eau, toutefois la consommation de farines composées est aussi importante et leur préparation constitue la méthode la plus employée pour conserver le manioc.

Introduction

Cassava (*Manihot esculenta* Crantz) goes under different names in Uganda. It is called *muwogo* around Lake Victoria, and *mogo*, *gwana* and *gbanda* in Lira, Gulu and Moyo Districts, respectively. Cassava became a staple food in Uganda in the 1950's and a lot of people now rely on it to stave off famine.

As reported elsewhere (Langlands, 1966), cassava was introduced into Uganda by Arab traders in the 1860's, around Lake Victoria. It spread to Lira and Apach districts in the 1920's as an anti famine anti-locust measure; and in some places planting of a legal minimum of land under cassava was enforced. Cassava reached Iganga, Jinja and Kamuli around 1900, and at that time banana cultivation was still prominent. Table 1 shows the major cassava producing areas of Uganda and their tonnage and acreage between 1981 and 1984. Also shown is the population at the 1980 census.

Although a lot of cassava is produced and eaten in Uganda, a dependable method of fresh cassava storage has never been developed. The storage and preparation methods have always remained traditional. Table 2 shows the area and production of the main food crops between 1983 and 1985 in Uganda.

Cassava production is only second to plantain in tonnage and third in acreage. It, therefore, became necessary to carry out a study in the four districts so as to determine the chemical composition of cassava. Secondly, the aim was to study how cassava-based meals are prepared by the local inhabitants. As a third step, some local products were collected and taken to the laboratory at Makerere University, in order to assess the effects of cassava processing techniques on their chemical composition.

Materials and Methods

Fresh cassava roots, as well as different cassava products commonly prepared and eaten in Lira, Apach, Iganga and Kampala, were obtained from local inhabitants and analyzed for HCN and other nutrients. The traditional preservation, storage and preparation of cassava products was studied in the four districts through house-to-house surveys and interviews. A total of 300 samples were analysed and the HCN and nutrient content of each sample in this study is the mean value obtained from three or four replicate assays of the sample.

The districts chosen are of differing geographical location and, therefore, the respective environmental conditions were different. As reported elsewhere (Langlands, 1966), cassava was introduced into Uganda by Arab traders in the

Table 1

Population and production statistics for the major cassava producing areas in Uganda (Sources: Ministry of Agriculture Entebbe, Uganda 1988 and Ministry of Planning Kampala, Uganda 1988)

District	Population in 1980 (thousands)	1981		1982		1983		1984	
		Ha ('000)	Ton ('000)	Ha ('000)	Ton ('000)	Ha ('000)	Ton ('000)	Ha ('000)	Ton ('000)
Apach	313	174	170	20	191	22	187	25	120
Arua	472	20	193	21	200	22	196	25	111
Gulu	391	21	204	24	226	25	221	18	86
Iganga	644	8	73	10	91	10	87	20	89
Lira	470	20	192	21	198	22	194	23	110
Nebbi	233	18	175	16	115	18	153	14	72
Soroti	586	19	185	17	164	19	163	25	107
Kampala	459	6	61	1	64	8	71	7	34
Total Uganda	12636	310	3000	331	3127	372	2329	401	1881*

*The yield of cassava was poor in 1984 because of a prolonged drought.

Table 2

Area and production of main food crops in Uganda (Source: Ministry of Agriculture Entebbe, Uganda 1988)

Crop	1983		1984		1985	
	Ha ('000)	Ton ('000)	Ha ('000)	Ton ('000)	Ha ('000)	Ton ('000)
Cassava	372	3239	401	1881	450	4100
Finger millet	341	545	332	223	415	715
Groundnuts	124	99	172	118	160	145
Mixed Beans	398	314	385	265	450	518
Plantain	1209	6647	1209	6461	1260	7812
Sweet potato	457	1843	387	1791	470	2400
Sorghum	207	407	206	164	320	650

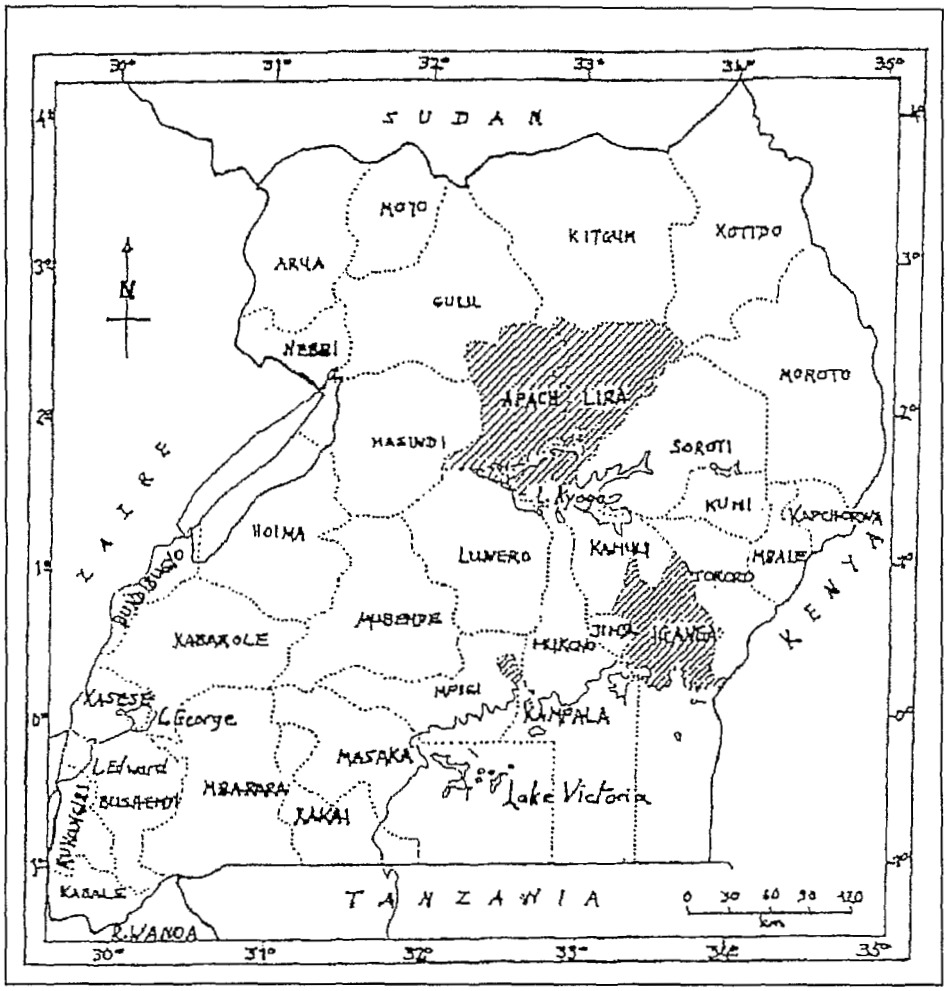

Figure 1
Geographical location of four regions investigated in Uganda.

1860's, around Lake Victoria. It spread to Lira and Apach districts in the 1920's as an anti famine anti-locust measure; and in some places planting of a legal minimum of land under cassava was enforced. Cassava reached Iganga, Jinja and Kamuli around 1900, and at that time banana cultivation was still prominent.

Kampala City and District is located in Mpigi District. The climate is moist, tropical in character, with moderate temperatures ranging from 20°C to 25°C. The annual rainfall ranges from 955 mm to 1709mm and there are two rainy seasons in the year, following the solar equinoxes. The long rains are from March to June,

whilst the short rains are between September and November. December to February and July to August are dry seasons, with occasional rain storms. The vegetation consists of a mixture of forests and invading savanna trees and grass, the dominant species being elephant grass (*Pennisetum purperum*). Figure 1 shows the geographical location of the areas of the study and Kampala was chosen in this study because it is the capital city and is cosmopolitan. Moreover it was around Kampala that cassava was initially introduced into Uganda and then spread to other areas.

Iganga District is found to some 170km to the East of Kampala. It lies between latitudes 1°S and 1°N and longitude 33° to 34°E. It also has bimodal type of rainfall, with mean annual amounts ranging from 1140mm to 1500 mm. The first rains begin in March and end in June, whilst the second rains begin in August and end in November. The maximum temperature is 30°C and the minimum is 17°C. Iganga is characterized by tropical grasslands. Langsdale (1964) reported that the vegetation is mainly composed of medium altitude deciduous forests, savanna, wooded savanna particularly *Combretium spp*; savanna associated *Hyperrhenia spp.*, scattered shrubs and grass layer. Most of the district is covered by general flat land with a few rocky hills, with gentle slopes and is less than 1120 mm above sea level. Iganga was chosen for the study because cassava is beginning to be reintroduced there and is becoming important as a staple food.

The geographic locations of Lira and Apach are to the North of Kampala by about 300 km. These two neighbouring districts were chosen because cassava plays an important role in the diet of the inhabitants. Lira has a cassava processing plant which produces cassava chips, starch and flour for both home consumption and the European market. These two districts are largely flat at an altitude between 900 m and 1200 m, with some rolling hills. A large proportion of the districts are represented by Lake Kyoga, with a considerable area of papyrus swamp associated with, and, independent of the lake itself. The rainfall averages about 1270 mm, falling on 140 to 170 days of the year. The wet season extends from April to October with peaks in April, May and August and a dry spell in June and July. The rainfall is bimodal (McLallum, 1962) and the temperature range is between 20°C and 30°C. The vegetation is woody savanna, comprising of shrubs, through scattered trees to open canopy of trees with under-lying, well developed grass. The dominant tree species are *Acacia spp.*, *Combretium spp.* and *Hyperrhenia spp.*

Chemical analysis

The methods described by Grace (1971) and Adas (1981) were used in the sample assays:

1. Moisture content by drying in the oven at 100°C for 5 hours (Grace, 1971)
2. Crude protein by the Kjeldahl method
3. Soluble carbohydrates using the anthrone reagent
4. Cyanide by picric acid test and titration

Results

The process of conservation began with the harvesting of the roots when required for food. This was done by pulling the plant with roots, out of the ground, or by carefully digging with a hand hoe to remove mature roots, guarding them against injury; the quantity at harvest depends on the size of the family. The roots were carried in baskets with care not to wound them; there is a belief that harvested roots should not be wounded else they test bitter. Even jumping over harvested cassava was found to be forbidden in the studied areas. These beliefs may have stemmed from the fact that injury caused to roots exposes the wound to air, which then causes hydrolysis of linamarin to cyanide by enzyme linamarase (Iwatsuki *et al.*, 1984). Fresh cassava was found to be stored by reburying or placing in water for a few days. This is done by getting water in a large container like a pot, an old oil drum or in some cases the roots were packed in a sack and then placed in a stream or pond of water. During the study, only local cultivars were found to be grown and a list of some of these are shown in Table 3. The most popular cultivars were found to be Bukalasa 8, Bukalasa 11, Ebwanatereka and Bao.

1. Preparation of cassava products

The tradition of food items containing cassava varied in the four districts. The different cassava products commonly eaten by the inhabitants of the four areas are shown in Table 4 and were prepared by four general methods. In addition, raw cassava toots were eaten occasionally between meals and fresh cassava was found to be roasted in hot charcoal.

1.1. Boiled cassava ('mogo' 'otedo' 'muwogo')

Fresh cassava roots were peeled, washed and boiled in water for 20-40 minutes until cooked. This method was found to be practised in all the areas of the study and was the most popular method of preparing fresh cassava. Spices may be added and this was seen to be common in the urban areas, whereas the village inhabitants added salt to the cooking cassava. Some other foods, like groundnuts stew, simsim paste, broad beans, peas and, at times, meat were added to the cooking cassava and the mixture was called *Aputta* in Lira and Apach, whilst in Iganga it was called *katogo.*

Table 3
Cassava cultivars grown in the areas investigated

Cassava cultivars
'Bao'
'Bukalasa 8'
'Bintiminsi'
'Serere'
'Sukan'
'Kiwoko'
'Bukalasa 11'
'Empologoma'
'Kulanabwana'

Table 4
Local names of cassava products

Cassava product	Processing method	Areas		
		Lira/Apach	Iganga	Kampala
Boiled	Cooking	mogo otedo	muwogo	muwogo
Roasted	Oven hot charcoal	mogo obulo	muwogo mwokye	muwogo mwokye
Fried cassava	Deep fry	mogo ocelo	umwogo musike	umwogo musike
Cassava paste	Sundrying, grinding and cooking	kwon mogo	chawda	buwunga
Cassava and millet (fermented)	Sundrying, grinding and cooking	kwon kal	obuita	buwanga
Cassava and sorghum (fermented)	Sundrying, grinding and cooking	kwon bel	mutama	buwunga
Cassava and broad beans, peas, and meats	Cooking	Aputta	katogo	katogo

1.2. Cassava paste ('kwonmogo' 'chawda')

This was found to be a major constituent of diet in Iganga. The roots were peeled, sliced and then dried in the sun on a mat, flat rocks, or specially prepared ground smeared with cow dung to reduce dust and dirt. The drying takes about 3 to 4 days, and the dried chips are then stored in old tins, baskets or granaries. When the paste is required, the chips are pounded then ground into flour, and added to boiling water with mixing until a consistent paste is obtained. The paste was found to be popular in all the areas studied.

1.3. Cassava flour mixed with millet and sorghum ('kwon kal' 'kwonbel' 'obuita' 'mutama')

Cassava flour was mixed with either millet or sorghum and then a paste was prepared as in pure cassava paste. In Iganga, however, there was a preference for more cassava in the mixtures than in the other areas. One part of sorghum was added to two parts of cassava and ground into flour, the resulting paste was called *mutama.* Millet was mixed with cassava and ground into flour, the resulting paste was called *obuita.* However, in Apach and Lira, where this particular method of preparation is very important and popular, one part of cassava is mixed with four parts of millet and the resulting is called kwon *kwon kal.* If one part of sorghum is added to two parts of cassava, the resulting paste is called *kwon bel.* In the Lira and Apach districts fermented cassava (obtained by slicing fresh cassava into chips and leaving them covered in a cool place for a day or two until the chips are slightly mouldy) was also used. When this was the case, the amount of cassava was reduced, and some people preferred the fermented cassava because of the flavor it imparted to the resultant paste.

1.4. Roasted cassava ('mogo obulo' 'muwogo mwokye')

Cassava was found to be roasted in all the three areas studied. The roots were or were not peeled and were then placed in hot ashes or charcoal for 20-30 minutes. Roasted cassava was found to be popular among school pupils who used it as a snack in school.

1.5. Fried cassava ('mogo ocelo' 'muwogo musike')

Fried or grilled cassava was a typical food stuff around trading centers, urban areas. It was obtained from fresh roots that were peeled, washed, cut into small pieces and then deep fried in oil.

2. Chemical composition of cassava products

The fresh cassava, used in this study, was not selected, but bought from Wandegeya market in Kampala, the variety was unknown. There was a wide range of results which precluded calculating means, and the values were classified into three categories based on HCN content as proposed by Bolhius (1954), De Bruijn (1971) and Coursey (1979) as follows:

1. innocuous, less than 50 mg HCN/kg fresh peeled roots;
2. moderately toxic, 50-100 mg/kg;
3. extremely toxic, over 100 mg HCN/kg.

According to this classification, the cassava bought in the Kampala market was moderately toxic when either raw or steamed, whilst when boiled it was innocuous. The mixture of fresh, cooked cassava and pulses or meats were not assayed because of inadequate and unreliable equipment. Most of the processed products were obtained in flour form and these were then analyzed for HCN and other constituents. The HCN in 'Ebwanatereka', grown in Iganga and Lira, gave the same value of HCN. The sample from Lira had millet added to it but millet also contains a cyanogenic glucoside-durrin (Conn, 1969). The other cultivars, like 'Bukalasa 8' grown in Lira, and 'kulanabwana' and 'serere' grown in Iganga, showed low values of HCN after sundrying and grinding into flour, as shown in Table 5. The sundrying removed most of the water 80-88%. The crude protein varied and appeared to be cultivar dependent.

Discussion and conclusion

From this investigation, it can be concluded that the traditional methods used in Lira, Apach, Iganga and Kampala for preparing cassava based foods, appear to bring about contact between cyanogenic glucosides and linamarase by cell rupture; boiling and sundrying then removed between 80 to 88% of the HCN (El Tinay *et al.*, 1984). There was, however, a variation in the HCN content of the flour produced from different cassava cultivars. In some samples, the level of residual HCN was relatively high. This may provide cause for concern as to the likely effects of cassava flour consumption.

The study also shows that the most common method for preparing cassava for immediate consumption is by boiling, where peeled roots are served in a variety of ways. Preparation of paste from flour is common in Iganga and urban areas, whilst the paste obtained from the mixture of cassava and millet are important in Lira and Apach. Deep frying and roasting were also used as methods of preparation, but were not main methods.

Table 5.
HCN and nutrient contents of cassava products in the area of study.

Cassava product	H_2O (%)	Crude proteins (Nx6.25) (%)	No. of samples	Origin of sample	HCN total mg/kg	Soluble carbo-hydrates (%)
Fresh						
Raw	60.0	2.06	6	Kampala	94.5 ± 2.4	2.00
Boiled	56.0	1.13	8	Kampala	27.0 ± 1.4	1.20
Steamed	54.0	1.02	12	Kampala	67.5 ± 1.3	1.34
Flour						
Serere	11.0	4.38	7	Iganga	40.5 ± 1.8	1.40
Ebwanatereka	11.5	1.84	11	Iganga	81.0 ± 1.1	2.40
Kulanabwana	10.0	2.58	20	Iganga	33.6 ± 1.2	0.40
Bukalasa 8	7.0	1.04	8	Lira	20.7 ± 1.3	2.68

Cassava appears to be an important source of carbohydrate in Uganda, as shown by Table 2, as well as in other countries of Africa (Oyenuga, 1955). The calories derived from cassava consumption cannot be determined in the absence of a detailed nutrition study; but if production figures are taken as a guide, and if acreage is related to consumption, the cassava rank third as a source of carbohydrates.

In conclusion more studies are needed into the processing of cassava into new products. Detoxification studies need to be carried out including the effects of cassava on local nutrition and the possible incidence and importance of cassava related diseases, such as goiter and spastic paraparesis.

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