Working together to eliminate cyanide poisoning, konzo and tropical ataxic neuropathy (TAN).

CCDN News

Cassava Cyanide Diseases Network

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Contents

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Processing, Cooking and Cyanogen Reduction of Cassava Products in Nigeria

Cassava is an important staple food for 500-1000 million people in the tropics. Nigeria leads the world in cassava production (about 34m tonnes[1]) and is the largest consumer of cassava as food. Nigerian farmers grow sweet cassava with a low level of cyanogens and bitter cassava with a high cyanide content[2] which is preferred for processing of "garri" and "fufu". The main food sources of cassava are the root and leaves which are processed and cooked in diverse ways according to local customs and preferences.

Some of the popular cassava products in Nigeria include garri[2,3] cassava fufu paste,[1] fufu flour,[1] "lafun" (fermented chips),[4] cooked cassava slices or chips (wet or dry)[5] and cassava leaves.[6] Garri is a gritty, starchy, fermented cassava staple consumed throughout Nigeria. It is estimated that about 70% of cassava roots are processed into garri.[7] Garri is processed by peeling the root, washing and grating to form a mash, followed by fermentation for 2-3 days by tying in a hessian bag with occasional pressing to dewater the mash. The cassava cake is sieved to remove fibrous material and heated in a metal dish with stirring over a fire to produce garri. A small amount of palm oil is added during frying if yellow garri is desired.

Garri is a ready-to-eat product used in different ways in the kitchen. One method is to add boiling water with stirring until a sticky smooth garri dough is produced. The dough is cooked and served with soup or stew as the main meal at any time of the day. Garri may also be dispersed in cold water, sweetened with sugar or salted and served as a refreshing drink. Some people chew garri along with roasted peanut, smoked dried fish or palm kernel as a snack.

Fufu paste is a fermented cassava product. It is processed by peeling the root, washing in potable water and fermenting for 4-5 days to soften in a pot or bowl. The ferment liquid is decanted, the roots are crushed by squeezing by hand in another bowl of water and sieved to remove fibrous materials. The sieved material is allowed to settle in the water before decanting, to produce fufu paste. The thick paste is molded into large balls and cooked in boiling water for 15-20 minutes to produces thick fufu balls. The cooked balls are pounded in a mortar with water to yield smooth sticky soft dough. The dough is eaten as small balls with soup or stew for lunch or dinner. The meal is very common among rural cassava consumers rather than in urban areas because of the characteristic odour from fermenting cassava.

Fufu flour is processed by peeling the cassava root, washing in water and fermenting for 2 days in water. It is crushed and ground to form a paste, bagged in woven polythene bags and dewatered by pressing. The recovered cake is spread on a clean surface and sun-dried to

produce flour. Fufu flour is cooked by dispersing the flour in cold water in a pot. It is heated with continuous stirring until a sticky smooth dough is produced. The dough is served along with soup or stew as with fufu paste. It is eaten as the main meal at any time of the day, commonly among urban and rural dwellers.

Cassava chips ("lafun") are processed by peeling the cassava root, cutting into pieces and washing in water. The pieces are soaked in water for 3-5 days and sun dried. It is milled into flour when desired. The flour is dispersed in water and cooked with continuous stirring to produce a sticky dough. The dough is eaten as small fufu balls with soup or stew.

Cooked cassava sliced (wet or dry) is processed by peeling the root, washing in water and cooking for about 20-30 minutes. It is dewatered and cut into thin slices. The slices are soaked over night in water in a pot or bowl. They are washed several times with water to remove slimy material on the slices. They are sun dried on a flat surface and the dry slices are eaten with palm kernel, coconut or roasted peanut depending on locality and preference.

Cassava leaves[6] are consumed in different forms in Nigeria. Fresh immature leaves are washed in water, shredded by hand and squeezed in water to reduce toxic constituents. The vegetable material is filtered out and cooked with condiments. It is eaten in combination with cooked yam (*Dioscorea* sp.) as porridge. In another method fresh cassava leaves are washed in water, shredded gently underwater by hand to remove toxic constituents such as cyanide. It is then used to cook soup or stew for consumption of garri or fufu. In yet another preparation, cassava leaves are cut like other vegetables, blanched and squeezed by hand under water to remove toxic constituents. It is used as a vegetable in cooking soup for consumption of garri or fufu. Finally, young cassava shoots are washed, shredded and placed in boiling water and stirred for a few minutes. The cooking water is decanted and the vegetable recovered for cooking soup for garri consumption.

Starch is another cassava product consumed in the Niger Delta Region. It is cooked to form a thick gel which is eaten with soup or stew. Cassava products are subjected to processes that can reduce total cyanogens. Although, data on cyanogen contents of products are scarce, it was reported that reduction of toxicity varies in degree of effectiveness during processing into different products.[5] Recent studies on cassava products such as garri in some localities revealed that some contained hydrogen cyanide (HCN) levels higher than 10ppm, the safe level for cassava flour[8] and 20ppm for garri.[9] Consumption of improperly detoxified cassava products were reported to cause health disorders such as goitre and cretinism,[10] tropical ataxic neuropathy (TAN) [11]and konzo.[12] TAN occurs in Nigeria, but so far there is no evidence of occurrence of konzo in Nigeria.

Emphasis in research appears to concentrate in the area of production, developing new varieties that are resistant to mosaic disease and are high yielding which is good for food security. It is therefore suggested that research in diseases associated with consumption of cassava products and their elimination through simple and effective processing methods as done in other African countries be extended to Nigeria. This is even more important because Nigeria consumes more cassava products in very diverse forms compared to some other producing countries, and processing and cooking of cassava products is mainly done by rural women using obsolete technologies.[9]

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Total Cyanogen Content of Gari from South-Eastern Nigeria

Gari is a common staple among the Ibo speaking people of South-Eastern Nigeria, especially in Imo State. It is obtained by processing cassava during which about 83% of its inherent cyanogenic glucosides are detoxified.[1] As a result complete detoxification of the cassava is not possible when bitter varieties which contain more than 400 ppm total cyanogens are processed. Sometimes the amount of residual cyanogens in the finished gari may be higher than the FAO/WHO recommended safe level of 10 ppm.[2] This calls for concern because the chronic, continuous ingestion of cyanogens may have serious health implications such as acute intoxication, goiter, konzo and TAN.[3] The disease tropical ataxic neuropathy (TAN) is endemic in some parts of Nigeria.[4,5] Its incidence can be up to 18 to 26 persons per 1000 in villages where the diet is nearly all cassava. By comparison in yam eating villages there is no incidence of TAN.

In this work, 22 gari samples were purchased from markets in Imo State. The total cyanogen content of the samples was determined in triplicate using kit B2 with the colour chart supplied.[6] The mean values for total cyanogen content ranged from 5 to 43 ppm with an average value of 21 ppm (SD 10). 82% of the mean values were above10 ppm, the

FAO/WHO safe level,[2] which indicates that most of the processing was inadequate.

This is quite alarming because some authors have reported cases of cyanide poisoning after consumption of meals that contain cyanogenic glucosides and no free cyanide, eg cooked dewatered lima beans, cassava products etc. It has been suggested that the enzyme required for the hydrolysis of linamarin was supplied by the microbial flora of the intestine.[4] This seems to be the reason for the reported cases of TAN in Nigeria, since TAN occurs as a result of prolonged ingestion of inadequately processed cassava.

It is important to educate processors on the correct methods to use. During processing there must be sufficient time for the linamarase enzyme to contact linamarin and break it down. There is also the need to mount regular checks by governmental agencies to guard against the activities of unscrupulous processors.

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Some Potentially Unsafe Practices in Cassava Retting in Eastern Nigeria

Retting is a simple traditional method for processing cassava tubers, which usually yields products with cyanide levels within the FAO/WHO safe level of 10 mg HCN/kg cassava (ppm).[1] During retting, roots are steeped in water and after they have softened are mashed, washed, sieved and then dewatered into a dough, which may subsequently be processed into various types of products such as "fufu" [2] in Nigeria, and " kivunde" [3] in Tanzania. Fufu is obtained by further pressing out water until the dough becomes firm. Retting takes about three to four days, which cassava processors today consider to be too long.

In Nigeria, practices, which include the addition of chemicals not permitted in foods during retting, have been adopted by local processors to shorten retting time[4]. These chemicals are used in the mistaken belief that they will accelerate retting. Microorganisms are known to have roles in the chemical processes occurring during retting including the detoxification of cyanogenic glycosides[2,4]. An alteration of chemical conditions during retting may affect the growth of these microbes thereby compromising the detoxification process. In addition, a carry over of added chemicals into the finished product may constitute a health hazard on consumption of such retted cassava foods. This report investigates these risks in fufu, a popular cassava meal in eastern Nigeria.

Bitter cassava roots (2 years old) containing about 300 ppm cyanide, were steeped in water for 4 days and then processed into fufu as described above. Kerosene (a thin oil distilled from petroleum), sodium bicarbonate (Trona, Solvay Chemicals Inc.) and common iron nails were added to steep water along with the cassava roots, at the rate of 0.5 mL kerosene/L, 1 g trona/L and 10 g nails/L in separate trials. Total cyanides were determined on dried (50^0C) samples of fufu using a picrate paper kit B2[5]. Residues of added chemicals in fufu were determined by comparison between quantities in the test samples and control samples[6]. Trona was estimated by determining bicarbonates (method No. 33.076). To determine iron, 10g of dried samples were dry ashed and iron measured using a spectrophotometer (Spectronic 21 UVD), see method No. 14.013.

Samples of cassava retted with kerosene and nails contained 9 and 8 ppm of cyanide respectively. However, samples retted with trona, contained 20 ppm cyanide, which exceeded the FAO/WHO 10 ppm safe level for total cyanides. Since kerosene is not miscible with water it would have been eliminated during washing of the dough. On the other hand, the amounts in the control and treated samples of trona (bicarbonate) were 3660 and 4880 ppm and of iron were zero and 87 ppm respectively. The high level of bicarbonate in the control sample is due to the hardness of local water supplies.

The results show that addition of these chemicals to water for retting cassava may render fufu unsafe for consumption. Trona, ($NaHCO_3$) is an alkaline salt that greatly reduces the activity of linamarase, an enzyme with maximum activity at pH 5.5 – 6,[7] which therefore resulted in fufu with unacceptably high levels of cyanide. Disease consequences associated with consumption of food containing cyanogenic compounds are well known. Residues of trona (bicarbonate) and iron resulted from insoluble compounds that these chemicals formed during retting, that were trapped within the mash. Ingestion of trona may cause gastrointestinal disorders. It is also a suspected carcinogen because it contains 0.4% silica.[8] The presence of iron in the fufu is also a potential danger. Iron overload due to excessive dietary intake among African Bantu resulted in high hepatic iron stores in a substantial part of the population and a high prevalence of liver cirrhosis[9].

Therefore the use of these chemicals during retting, should be strongly discouraged.

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Wetting method to remove cyanide from cassava flour (English)

Cassava flour is placed in a container and its height marked on the side of the container. Water is added slowly with thorough mixing until the wet flour volume comes up to the mark on the container.

The wet flour is spread out on a basket in a layer no thicker than 1 cm thick and left in the shade for about 5 hours. This time is needed for breakdown of the cyanide compound by the enzyme present to give hydrogen cyanide gas that escapes. The wet flour is used for cooking the same day to prevent spoilage which may occur if it is left overnight. Less water is needed to produce the traditional porridge ("ugali", "luku") from wet flour than from dry flour, but otherwise the cooking is the same.

Methode de mouillage pour eliminer le cyanure de la farine du manioc (Francais)

De la farine de manioc est placee dans un recipient et sa taille marquee du cote du recipient. L'eau est ajoutee lentement en melangeant completement jusqu'a ce que le volume humide de farine atteigne la marque sur le recipient.

La farine humide est étalée sur un panier ou un plateau sur une couche pas plus profond que 1 cm d'épaisseur et laissée à l'ombre pendant environ 5 heures. Le temps ne devrait pas être moins de 5 heures. Ce temps est nécessaire pour la dégradation du composé de cyanure (linamarin) par l'enzyme (linamarase) pour produire le gaz de cyanure d'hydrogène qui s'échappe à l'air. La farine humide doit être employée pour faire cuire le même jour afin d'empêcher la détérioration qui peut se produire si elle est laissée durant la nuit. Moins d'eau est nécessaire pour produire le gruau traditionnel ("ugali", "luku") à partir de la farine humide que de la farine sèche, mais autrement la préparation est identique.

Humedecimento da farinha de mandioca com agua para remover cianeto (Portugues)

Introduz-se a farinha de mandioca num recipiente e marca-se na parede deste o nível do volume que ocupa. Adiciona-se água (vagarosamente) e mistura-se profundamente até que o nível do volume da "pasta" que se obtém alcance a marca no recipiente. Estende-se a "pasta" assim obtida numa peneira ou bandeja, numa espessura não superior a 1 cm e deixa-se na sombra por cerca de 5 horas. O tempo não deve ser inferior a 5 horas. Este é o tempo necessário para a degradação do composto que contém cianeto (linamarina) pelo enzima linamarase para produzir cianeto de hidrogénio (gás) que escapa para o ar. A farinha tratada por este método deve ser cozida e consumida no mesmo dia para evitar a putrefacção que pode ocorrer quando deixada para o dia seguinte. Esta "pasta" necessita de pouca água para preparar a massa tradicional ("ugali", "luku") comparada com a farinha seca, mas o procedimento (cozedura) é o mesmo.

Metodo humedo para remover el cianuro de la harina de yuca (Español)

Colocar la harina de yuca en un recipiente y marcar la altura sobre un lado del recipiente. Agregar agua lentamente, mezclando totalmente, hasta que el volumen de la harina húmeda llegue a la marca realizada sobre el recipiente.

Esparcir la harina húmeda en un cesto o en una bandeja con una capa no más gruesa que 1 cm de espesor y luego almacenar en la oscuridad por cerca de 5 horas. El tiempo de almacenamiento no debe ser menor de 5 horas. Este tiempo es necesario para la degradación de los compuestos cianogenicos (linamarina) por la enzima presente (linamarasa) para producir el acido cianhídrico (gas) el cual se libera al aire.

La harina húmeda debe ser cocinada el mismo día, para evitar la pudrición que puede ocurrir si esta se almacena durante toda la noche.

Es necesaria una menor cantidad de agua para producir la tradicional papilla ("ugali", "luku") a partir de harina humeda que si se utiliza harina seca, pero de una u otra manera la coccion es la misma.

Njia ya kuldwanisha ili kuondoa sumu ya "sianaidi" katika unga wa muhogo (Swahili)

Unga wa muhogo unawekwa kwenye chombo cha uwazi na kimo chake kiwekewe alama nje ya chombo. Maji yamiminwe taratibu kwa kuchanganya na unga mpaka ujazo wa unga ulio lowa ufikie kimo cha chombo.

Unga uliolowa utolewe nje na kuwekwa kwenye trei (tray) au kikapu wazi na unene wa msambazo wa unga usizidi unene wa sentimita moja (1). Kwa unene uachwe kwenye kivuli (shade) kwa kacibi masaa 5 (matano). Muda usipunque masaa 5 (matano). Huu muda unahitajiwa kwa kuuua dutu kwa kutumia mmengenyo uliomo ili kuzalisha gesi ya hydrojeni sianide ambayo hupotea hewani. Unga uliolowa lazima utumike kupikia sila hiyo ili kuzuia mehacho (spoilage) ambao ungetokea kama unga ungelala bila kupikwa. Maji kidogo yanahitaji wa kwa kutengeneza ugali wa kienyeji (luku) kwa unga uliolowa kuliko unga uliomkavu, bila hivyo mapishi ni yaleyale.

The editor thanks those kind people who translated this text into the various languages.

PestNet

PestNet is a forum to discuss issues concerning plant protection and quarantine. Although set up for the Pacific and Asia, it welcomes members from anywhere in the world.

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CCDN News is the Newsletter of the Cassava Cyanide Diseases Network (CCDN). The CCDN is a free, worldwide network commenced in June 2001, which is working towards the elimination of konzo, TAN and other cassava cyanide diseases.

CCDN News will consider for publication short articles and letters (1-3 pages A 4 double spaced) written in English. Because CCDN News is a newsletter, full-size original papers or reviews cannot be considered for publication.

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