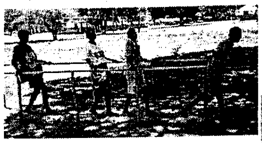
Working together to eliminate cyanide poisoning, konzo and tropical ataxic neuropathy (TAN).



CCDN

Cassava Cyanide Diseases Network

News

Issue Number 5, June 2005

Contents

CCDN Coordinator:
Dr. J. Howard Bradbury
School of Botany and Zoology
Australian National University
Canberra ACT 0200, Australia
Phone: +61-2-6125 0775
E-mail: howard.bradbury@anu.edu.au
Coordinating Group:
Julie Cliff, Paula Cardoso, Arnaldo Cumbana (Mozambique);
Country Contacts:
Cameroon: E.E Agbor, *D.R. Congo:* D.D. Ngudi, *India:* Bala Nambisan and K.T. Shenoy, *Indonesia:*A.Hidayat, *Mozambique* :Anabela Zacarias, *Nigeria.* M.N.Adindu. P.N.Okafor
Website:
www.anu.edu.au/BoZo/CCDN

The Role of Red Palm Oil in Processing Cassava to Gari

Cassava and its products act as energy sources in the diet of many people in Africa. In addition to its high starch content, cassava contains cyanide in the form of cyanogenic glycosides linamarin and a small amount of lotaustralin.[1] When the cells of the tuber are ruptured, the cyanogenic glycoside comes in contact with the enzyme linamarase also present and is broken down into sugar and cyanohydrin which undergoes spontaneous hydrolysis above pH 5 to yield hydrogen cyanide (HCN).[2] This evaporates rapidly in the air and is also readily soluble in water.

High cyanide cassava tubers are processed to reduce the cyanide level. In Cameroon, more than 60% of the cassava is processed traditionally into gari. The cassava tubers are peeled, the fleshy portion or parenchyma washed with clean water and grated into a mash using a hand grater (a perforated tin sheet nailed to a wooden frame) or a mechanical grater made up of a rotating drum covered with a perforated metallic sheet. Normally, the cassava mash is fermented for 1-48 hours in woven polypropylene sacks and dehydrated by compression using stones, logs or a hydraulic press to produce semi-dried cassava cake. The latter is sieved through a cane net sieve into small particles which are roasted and dried in a metal frying pan over a fire. The dried and roasted cassava particles constitute gari.

In some localities, red palm oil is thoroughly mixed with the cassava mash before fermentation while in others, the palm oil is added during roasting. Red palm oil extracted from the husk of fruits of *Elaeis guineensu* Jacq[3] consists mainly of neutral lipids and phospholipids and has a melting point of 29-34°C and a boiling point greater than 200°C.[4,5] Palm oil is added to prevent burning during frying and to give the gari a yellow colour. An attempt was made to investigate the role of red palm oil in gari production.

Gari samples were prepared by the traditional method with and without red palm oil added before fermentation. The temperature and pH of the cassava mashes were measured and the cyanide content of cassava cakes and their corresponding gari samples.[6] The palm oil did not affect the temperature and pH of the cassava mashes during the fermentation period of 3 hours. The cassava cakes with palm oil had lower cyanide content than those without palm oil. The roasting process was easier and faster for mashes (after dehydration) containing palm oil and their corresponding gari samples had lower cyanide content and finer granular texture than the samples without palm oil.

During fermentation, the endogenous linamarase comes into contact with glycoside and converts it into cyanohydrin which spontaneously decomposes into volatile HCN.[7] Palm oil probably acted as a lubricant between the cassava particles in the mash preventing these particles from aggregating, hence increasing the surface area for linamarase action during fermentation. This is probably the reason for the lower cyanide content of cassava mashes made with palm oil. During roasting, cyanohydrin and HCN are volatilised[8] and palm oil (BP>200°C), raised the temperature and facilitated evaporation. This is confirmed by the lower cyanide content of gari samples with palm oil. The palm oil also speeded up the roasting process and acted as a lubricant between the cassava particles. This explains why the gari samples made with palm oil had finer granular texture than those without palm oil.

However, another researcher, argues that palm oil components sequester cyanide ion into a complex which may not be correctly estimated during quantification of cyanide, which would result in apparently low levels of cyanide in palm oil - fried gari.[9] To verify this hypothesis, volunteers were fed the same quantities of gari samples with and without palm oil at different times and their urinary thiocyanate assessed using a standard method.[10] Results showed lower urinary thiocyanate when palm oil processed gari was consumed. Since cyanide is converted in the body into thiocyanate which is excreted in the urine, the lower urinary thiocyanate observed with the consumption of palm oil processed gari, confirmed the fact that these gari samples actually did contain less cyanide.

We conclude that palm oil plays a beneficial role during the processing of cassava into gari. It reduces the cyanide content by intervening during both fermentation and roasting. Palm oil during fermentation of the cassava mash, prevents aggregation of particles and hence increases the surface area for linamarase action. During roasting it facilitates the volatilisation of cyanohydrin and HCN and makes easier and quicker the drying process. It also gives the gari a finer granular texture and yellow colour with improved organoleptic properties.

References

[1]Tewe, O. O. and Lyayi, E.A .(1989). Cyanogenic glycosides. In Toxicants of plant origin, Vol II. Glycosides Ed. Checke. P.R. CRS Press, p 43-60.

[2]Cooke, R. D. and Maduagwu, E.N. (1985). J. Food Technology 13 : 299-306.

[3]Hahn, S.K. (1995), IITA Research Guide 41.

[4]Chow, M.C. and Ho.C.C. (2002) J. Oil Palm Research. 14 (1) : 25- 34

[5]MSDC Data (2004). Red palm oil. Online Data.

[6]Bradbury, M.G., Egan,S.V. & Bradbury, J. H. (1999). J. Sci. Food Agric. 79: 593-601.

[7] Westby. A. and Twiddy, D.R.. (1992). World J. Microbiol. Biotech. 8, 78-80.

[8]Vasconcelos, A.T., Twiddy. D.R., Westby A. and Reilly, P.J.A. (1990). Int.J.Food Sci.Technol.25,198– 203.

[9] Uvere, P.O. (1999). Plant Foods for Human Nutr. 53(3) : 249 – 253.

[10] Haque, M.R. and Bradbury, J. H. (1999). Clin. Chem.45: 1459 – 1464

Esther E.Agbor
University of Dschang
BP 353, Dschang, Cameroon
agboresther@yahoo.co.uk

Heap Fermentation of Cassava in Nampula Province, Mozambique

Cassava is an essential part of the diet of the people of Nampula Province in Northern Mozambique. The province, of about 3 million people, is the largest producer of cassava in Mozambique, averaging 2.22 million tons per year with an average yield of 5.5 tons per hectare.[1] Cassava chips flour is the most widely consumed cassava product in Nampula Province. The large chips may be heap fermented before sun drying or sun dried directly before pounding into flour. Bitter varieties of cassava are normally fermented before sun drying and pounding.

Biochemical and microbial changes occurring during heap fermentation of cassava were studied and the predominant microorganisms were isolated and identified.[2] The method of heap fermentation observed in Nampula differs from the one used in Uganda[3] because in Nampula, sun drying is not done before heaping and covering. High ambient temperatures force the local people to carry out heap fermentation in a shady place during the day for lower temperatures for fungal growth. The heap environment is also improved by covering the roots to avoid moisture loss. In Nampula, heap fermentation is usually carried out during the dry season. At midday, the temperature inside the heaps during fermentation was lower (28.2 ± 0.8 °C) than the temperature outside (33 ± 0.5 °C). Evaporation of the moisture lowered the temperature inside the heap. In an earlier study in Uganda it was found that the temperature of the incubated roots was 2 to 12 °C higher than the ambient temperature near the heaps, which was 23-29 °C in the mornings.[3]

The slight decrease in the pH of cassava from 6.1 to 5.6 as fermentation progressed was probably caused by production of lactic acid by bacteria. The pH range between 5 and 6 allows breakdown of cyanogenic glucoside.[4]

Lactic acid bacteria [LAB], *Leuconostoc,* which were isolated in this study, have also been isolated in cassava fermentation for gari and fufu preparation in West Africa.[5] The LAB play a role in determining the overall flavour of fermented cassava products. The moulds, *Rhizopus stolonifer* and *Neurosopora sitophila*, isolated in this study, have been also isolated and identified from cassava heap fermentation.[3] Results suggest that moulds are the main microorganisms involved in heap fermentation. The fermentation plays an important role in reducing the total cyanogens in cassava chips. The average total cyanogenic level in unfermented cassava flour was 158 mg HCN/kg, while in fermented cassava flour, 17 mg HCN/kg was recorded. The average cyanogenic potential of fresh cassava roots was 259 $\pm$ 9 mg HCN/kg. However, the cyanide levels in all the cassava samples were above 10 mg HCN/kg, the WHO safe level,[6] probably because all the varieties used were high cyanide bitter varieties. A similar result was obtained in Uganda.[3]

Acknowledgments
We thank the Swedish International Development Agency (SIDA/SAREC) for funding the work and World Vision, Nampula, Mozambique for providing transport for field work.

References
[1]Sistema Nacional de Aviso Prévio, 2003. Informação e mercados agrícola 2002-2003. Ministry of Agriculture and Rural Development Mozambique, Maputo, Mozambique.
[2]Tivana, L.D.,Bvochora, J.,Owens, J.D. and Mutukumira, A.N. (2003) Proc. Thirteenth ISTRC Symp., Nov 2003, Arusha, Tanzania, in press.
[3]Essers, A.A., Ebong, C., van der Grift, R., Nout, M.R., Otim-Nape, W. and Rosling, H. (1995). *Int J Food Sci Nutr* 46: 125-136.
[4]White, W., McMahon, J. and Sayre, R. (1994). *Acta Horticulture* 375: 69-77.
[5]Westby A and Twiddy DR. 1992. *World J Microbiol & Biotechnol* 8: 175-182.
[6]FAO/WHO (1991). Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission XII, supp. 4. Rome,

L.D.Tivana,J. Bvochora &J.D.Owens
Faculty of Engineering
Eduardo Mondlane University
Maputo, Mozambique
ltivana@yahoo.com.br

Differential Diagnosis of Spastic Paraparesis Relative to Konzo

Konzo is a pure upper motor neuron disease. Its clinical diagnosis is straightforward: a visible symmetric and non progressive spastic paraparesis, a history of onset less than 1 week, exaggerated knee or ankle jerks and the absence of signs evoking a spinal disease.[1] The context is also clear: consumption of cyanide-rich cassava and poor nutritional status.

It should be easy to distinguish konzo from other etiologies of spastic paraparesis (SPP) in tropical regions, but this is not always the case. The clinical pattern may not be as complete as theoretically described. In addition, it is difficult to perform accurate and specific tests to decide precisely the diagnosis, as health institutions are unequipped and populations are poor. Possible coexistence of konzo with other etiologies of SPP does not allow reducing all SPP to konzo, once the toxicity of consumed cassava is established. Finally, konzo, highly and definitively disabling, should be distinguished as clearly as possible from other causes of SPP, which might have different outcomes and management. The precision and correctness of the diagnosis of SPP will determine the adequacy and the efficiency of treatments provided to patients.

We briefly review other possible etiologies of SPP in tropical regions where clinical data are the most important tool for health workers to perform the differential diagnosis, and this is the reason why we did not include biological or other tests. We selected a limited number of pathologies according to the similarities in their clinical picture with konzo and their probability to be present in the same region as konzo.

The closest etiology of SPP to distinguish from konzo is neurolathyrism.[2] Despite the clinical similarities, the two are easy to distinguish. The neurotoxin that causes neurolathyrism is present in the drought tolerant grass pea and the onset is rather subacute or insidious. With konzo there is a higher susceptibility of women of reproductive age and of children of both sexes and of young men for neurolathyrism. In cases where the source of SPP has not been identified, some confusion might arise, especially if the age distribution is in favor of non-adults, males are predominant (like in some konzo studies[3]) and the rapid and slow onset cannot be clearly distinguished. However, no geographical overlap exists between the two diseases as cassava and grass pea are not consumed in the same region.

Human T-Lymphotropic Virus Type I (HTLV-I)-associated SPP, referred to as tropical SPP or HAM (HTLV-I-Associated Myelopathy) [4,5] is much discussed in konzo-affected regions. But HAM has a progressive evolution and exhibits, in addition to SPP, clear signs of spinal cord diseases (incontinence of bladder and bowel, sensory disturbances) and eventually encephalopathy. Problems to distinguish HAM from konzo occur in situations where the clinical pattern of HAM is restricted to SPP.

Deficiency in vitamin B-12 can also cause SPP[6] but appears in very particular circumstances: impairment of intestinal absorption (intestinal diseases and surgery) or in groups deprived from animal food (strict vegetarians or very poor populations). Concomitant presence of anaemia is very evocative. Neurological signs include, in addition to spasticity, sensory perception impairments, ataxia, personality and behavioral changes (depression) and, in late stages, muscular atrophy. Hyperreflexia is rare. Confusion with konzo might occur in cases where neurological signs are retricted to spasticity, when hyperreflexia is present and in the absence of anaemia. Coexistence of the two pathologies is likely to happen (as they both affect extremely poor and malnourished populations), which seriously complicates the etiological diagnosis of SPP.

Human Immunodeficiency Virus (HIV) is mostly affecting developing countries of which many are within the tropical region, and chronic myelopathy is not rare in HIV-infected patients.[5,7] The most prominent feature is the so-called HIV-associated vacuolar myelopathy of which the pathogenesis remains elusive. It occurs in the advanced immunosuppression stage and presents the clinical pattern of any myelopathy, including SPP, gait impairment, incontinence of bowel and bladder, paresthesia, etc. The evolution is progressive and the symmetry of signs is not constantly found. Opportunist infections can also lead to myelopathies.[5] The history of the disease and clinical signs give already strong arguments for HIV infection. But for undiagnosed cases with a poor neurological picture and advanced malnutrition in konzo-affected areas, the differential diagnosis is difficult.

In conclusion, several pathologies can cause SPP in tropical regions apart from konzo. The sudden onset, the symmetry of signs, the lack of spinal cord signs and the presence of cyanide-rich cassava improperly processed in the diet are important arguments in favour of konzo. However, the context and other clinical signs evoking different etiologies alone or in association with konzo should be looked for: consumption of drought-resistant grass-pea for neurolathyrism, signs of myelopathies and other specific patterns associated respectively with HTLV-I, HIV infection, deficiency in vitamin B12, etc. In this way, it may be possible to have the most appropriate therapeutic and/or preventive strategies available to overcome SPP in the tropics.

References

[1]Anonymous, Weekly Epidemiol. Record (WHO) 1996;71:225-228.
[2]Getahun H, Lambein F, Vanhoorne M. and Van der Stuyft P. Trop. Med. and Intern. Health 2002;7:118-124.
[3]Tylleskär T, Banea M, Bikangi N, Fresco L, Persson L.A & Rosling H. Bull. World Health Organ. 1991;69:581-589.
[4]Segurado, A., Biasutti, C, Zeigler R., Rodrigues, C., Damas, C.D., Jorge, L.& Marchiori,P.E. Mem. Inst. Oswaldo Cruz (Rio de Janeiro) 2002;97:329-333.
[5]Berger J, R.and Sabet A. Sem. in Neurol., 2002;22:133-141.
[6]Healton,E.B., Savage, D.G, Garret, T.J. and Lindenbaum, J. Medicine (Baltimore) 1991;70:229-245.
[7]Tan, S.V.and Guiloff, R.J., J.Neurol. Neurosurg. Psych. 1998;65,23-28

.Joelle Nsimire Chabwine
Department of Medicine, Catholic University of Bukavu, D.R.Congo
jo_nsimy@yahoo.fr

Cassava Toxicity in Philippines

This summer, Filipinos suddenly became aware of cassava (called "kamoteng kahoy") cyanide poisoning. Several incidents occurred during this period. In March, 28 children died and about 80 people in Mabini in Bohol Province in the central Visayas region were hospitalised after eating "maruya", a sweetened cassava cake delicacy. Initial findings pointed to cyanide, but further investigations showed that a pesticide, "carbamate", accidentally present in the cooking oil was the cause of the deaths. In May, 22 youngsters at a church camp in Cauayan, Negros Occidental Province, were hospitalised after poisoning by "alupi", another cassava-based delicacy. Fortunately, all 22 were discharged from the hospital later on. Three members of the Manobo indigenous tribe from North Cotabato Province in Mindanao died after eating "kayos" (wild yam). Like cassava, kayos contains cyanogenic glycosides. At least 93 more tribespeople, have been also poisoned.

People living in regions of the Philippines where cassava and cassava-based delicacies are consumed, are aware of the possibility of poisoning. They are confident that their methods of processing these crops are sufficient. However, what is most striking, is that poisoning happens, especially among the indigenous people of Mindanao, due to hunger, made worse by severe drought. At a time when the country and its people are struggling financially, incidences such as these will occur more often, sadly, not because people made bad decisions, but because they have no decision to make, as they are forced because of hunger to eat these dangerous foods.

There is a need for government intervention to make safer foods available, and also for better information for the people about these root crops, their preparation, and avoidance of poisoning.

Emmanuel V. Garcia
Chemistry Department, DeLaSalle University, Manila, Philippines
mel_garcia_chem.@yahoo.com

Correction

In CCDN News 4, P.3 it was incorrectly stated that hydroxynitrile lyase could be stored at 40^0 C, but it is actually -4° C. The editor apologises to Dr Bala Nambisan and readers.

CCDN News is the Newsletter of the Cassava Cyanide Diseases Network (CCDN). The CCDN is a free, worldwide network commenced in June 2001, working to eliminate konzo, TAN and other cassava cyanide diseases. All correspondence to be sent to the CCDN Coordinator Dr J Howard Bradbury.