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

CCDN News

Cassava Cyanide Diseases Network

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Cyanide and Thiocyanate Kits

The total cyanide content of cassava roots and flour may be determined using a simple picrate kit developed by Dr Bradbury and coworkers at the Australian National University in 1996. The kit contains all that is needed to analyse 100 samples of root or flour. A stepwise procedure (protocol) must be followed, which is available in English, French, Portuguese and Bahasa Indonesia.

In the human body much of the ingested cyanide is converted to thiocyanate which is removed in the urine. The urinary thiocyanate content gives a measure of the recent cyanide intake. In 1998 a simple picrate kit method with 100 analyses was developed for urinary thiocyanate.

These kits are available from Dr Bradbury free of charge to health and agricultural workers in developing countries. The kits are funded by the Australian Centre for International Agricultural Research (ACIAR) and may also be purchased by workers in developed countries. Nearly 250 kits have been supplied to workers in 35 countries.

Kit A (cassava roots), Kit B2 (cassava products-flour,gari etc), Kit D1 (urinary thiocyanate) and Kit E (cyanogenic leaves) are available.

The kits have been used to screen cassava collections and remove those of high cyanide content, to show the effect of drought on cyanide levels and to give warning of outbreaks of konzo, to check out cassava leaves and roots for animal use and to measure urinary thiocyanate levels in children exposed to cyanide from cassava flour.

Konzo Count

There are published reports of konzo occurring in Mozambique, Tanzania, the D.R.Congo, Cameroon, Central African Republic and anecdotal reports of konzo from Angola and Uganda. Currently, there are reports of 620 cases of konzo in Bandundu region of D.R.Congo, about 300 in Northern Mozambique and of its occurrrence in three locations in Tanzania.

We appeal to our readers to let us know whether konzo occurs at all in your region. If it is present could you, if possible, inform us of the approximate number of cases.

Cyanide Poisoning

Consumption of cassava roots or cassava products (such as cassava flour, gari and fufu) that contain large amounts of cyanide compounds may cause acute intoxication within 1-4 hour. Symptoms include vomiting, nausea, dizziness, palpitation, weakness, stomach pains, headache and diarrhoea, which all cleared within 24 hourst[1,2]. In some cases cyanide poisoning causing death has occurred after consumption of cassava roots or products such as gari[1].

Cyanide inactivates the enzyme cytochrome oxidase which catalyses one of the reactions involved in respiration (oxidation of food). Respiration is therefore stopped, key energy conversion processes are halted and heart failure occurs rapidly. Sodium thiosulphate or nitrites are effective antidotes for cyanide poisoning.

In correspondence with many workers in cassava–growing countries, I have received 14 reports of cases of acute intoxication and sometimes deaths. These reports are very widespread from Zambia, Ghana, Nigeria, D.R.Congo, Cameroon, Tanzania, Benin, Malaysia, Cote D'Ivoire and Ethiopia.

Since this problem results from the cyanide toxicity of both cassava roots and processed cassava it will not be solved, by improvements in processing methods. It can be eliminated altogether, as in the South Pacific (PNG, Fiji etc), by using sweet, low cyanide cassava varieties. Broadening the diet of the people would also be beneficial.

References

[1]Akintonwa, Tunwashe & Onifade, Acta Hort. **375**, 285-288, (1994).

[2] Mlingi, Poulter & Rosling, Nutr. Res. **12**, 677-687, (1992).

J. Howard Bradbury.

Strategy to Eliminate Konzo

At a Workshop in Nampula, in November 2000 a strategy was developed for the elimination of konzo in Mozambique. This strategy should be applicable in all countries in which konzo occurs. The four points which make up the strategy are given below. For a more detailed account see Roots[1].

1. Introduce other staples, vegetables, pulses and fruits to decrease the daily cyanide intake and broaden the diet of the people.
2. Improve processing of cassava roots to produce flour that has less residual cyanide. For example, in Mozambique the heap fermentation method produces flour with about one half the cyanide content of flour processed by sun drying.
3. Introduction of low cyanide, high yielding, well-adapted, disease-resistant varieties of cassava, facilitated by IITA. and other Centres.
4. Improve early warning systems. Warning of a possible konzo epidemic may be obtained by using picrate kits to monitor cyanide levels in cassava roots and cassava products and amounts of urinary thiocyanate in the population.

Reference

[1] Ernesto, Cardoso, Nicala, Mirione, Massaza, Cliff, Haque & Bradbury, Roots (Newsletter of SARRNET and EARRNET), **8**, No 1, Dec. 2002, 8-11.

Impact of Environmental Factors on Cyanide Content in Cassava

Cassava varieties show a large variation in the cyanoglucoside (linamarin) content of the edible tuber, ranging from 15 to 450μg cyanide equivalent/g fresh tissue. The concentration of cyanogen in the tuber is genetically controlled, but environmental and cultural conditions also influence its level. Shade conditions increase the cyanogens content in the tuber, because of the metabolic changes induced by low rates of photosynthesis. Drought conditions also increase the tuber cyanogen content, presumably due to increased translocation of linamarin/metabolites to the tuber, as a result of leaf senescence. Irrigation, on the other hand, facilitates starch accumulation in the tuber, prevents leaf senescence and decreases the cyanogen content in the tuber; a 40% decrease in cyanogens content is observed, as compared to non-irrigated. Application of nitrogen causes marginal increase in linamarin content, due to higher free amino acid levels while application of potassium increases tuber starch and lowers the cyanogen content. A significant decrease in tuber cyanogen is achieved by pruning or girdling the stem one or two months before the tubers are harvested.Both these techniques arrest the translocation of linamarin from leaves to tubers and also induce increased degradation of linamarin in tubers. The cyanogen in tubers is reduced by 40–50 % by these processes. However, the tubers also show decreased dry matter/starch, (ca 5% decrease) which makes them unacceptable for cooking, but suitable for preparation of drychips/ flour, which is the raw material for a number of food products.

Thus high cyanogen potential tubers can be converted into lower cyanogen potential tubers by manipulation of cultural conditions. The contribution of field cultural practices in modulating tuber cyanogens level needs to be addressed.

References

Ramanujam & Indira, Ind.J.Plant Physiol. **27**, 355-360, (1985).

Nambisan, (1996) Does transport of linamarin occur in cassava? In: Tropical tuber crops - Problems, prospects and future strategies (Kurup et al. Eds) p 21-26.

Bala Nambisan.

Konzo

What is konzo?

Konzo is a disease characterized by the sudden onset of paralysis of both legs. The paralysis is called spastic because the affected legs are rigid, not floppy (as in a flaccid paralysis), and the reflexes are increased. Konzo patients walk with a typical spastic gait.

The paralysis is of varying degrees of severity – in the most severe cases, the patient cannot walk at all. In moderate cases, the patient needs support (one or two sticks or crutches). In mild cases, the patient can walk without support, but still has the typical walk.

Konzo patients may also have weakness of the arms, difficulty in talking, seeing and hearing.

The damage to the nervous system caused by konzo is permanent. It neither gets better nor worse, although patients may have further attacks, which worsen their condition. They may also get functional improvement with physiotherapy, or as they adapt to their condition. Also, if patients are not treated with physiotherapy, they may develop permanent contractures – shrinkage and shortening of the muscles.

How is konzo different from other diseases that cause spastic paralysis?

Most other causes of spastic paralysis do not begin suddenly and then stay stationary, as konzo does.

The main distinguishing feature of konzo is that it has always been reported in association with a monotonous diet of bitter cassava.

When and where did konzo first occur?

The first described cases of konzo occurred in 1928, in the then Belgian Congo (now D.R. Congo).

Where does konzo occur now?

Konzo has been described in the Central African Republic, D.R. Congo,Cameroon, Mozambique, and Tanzania. There are also anecdotal reports of konzo from Angola and Uganda.

Who is affected by konzo?

Konzo affects mostly children of both sexes above the age of two years and women of child-bearing age. Adult men are also affected, but not as often.

When does konzo occur?

Konzo occurs at times of extreme agricultural crisis, for example during drought and war. It usually shows a seasonal distribution, coinciding with the dry season. In Mozambique, this is also the time of the cassava harvest. In times of crisis, it often appears in epidemics, with large numbers of cases. However, konzo also occurs in less extreme circumstances in the poorest rural cassava-dependent communities of Africa, when cases may be sporadic.

What causes konzo?

Bitter cassava contains high concentrations of cyanogenic glucosides (mostly linamarin), which are broken down to release cyanide. Around the time of onset, konzo patients always have cyanide poisoning. High concentrations of thiocyanate (the main product of cyanide metabolism in the body) are found in blood and urine.

To make it safe for eating, bitter cassava needs processing to lower the cyanide levels. Konzo is often associated with short-cuts in processing. For example, in areas where processing is by sun-drying, people cannot wait to complete the process if they are hungry.

We do not know for certain what directly causes konzo – cyanide, one of its metabolic products, linamarin, or maybe even another compound.

Konzo patients also have a diet that is very low in sulphur containing amino acids and sulphur amino acid deficiency may be necessary for konzo to occur.

The underlying cause of konzo is poverty, which forces people to subsist on a diet of insufficiently-processed bitter cassava. The emergence of konzo in the past thirty years in many countries of Africa reflects the increasing rural poverty of the continent.

What is the treatment for konzo?

There is no specific treatment. Konzo patients respond well to physiotherapy. Even patients who cannot walk may be able to walk with physiotherapy and walking aids. Patients and carers should also be taught how to prevent contractures.

How can konzo be eliminated?

The key to konzo elimination lies in rural development. The poorest rural cassava-dependent communities should be targets for development assistance. Specifically, they need support to vary their diet and the crops they grow. Breeding and distribution of improved sweet cassava varieties is an option when farmers desire them. This is not the easy solution it might appear, as farmers may have chosen bitter cassava because of its drought- and theft-resistant properties. Improved cassava processing is another option. Once again, it may not be an easy solution, as improved methods may be more labour-intensive and time-consuming. Building on local knowledge may help, for example in Mozambique we have found that women use the more efficient heap fermentation process in preference to sun-drying at times of greater risk of konzo. Finally, we need improved early warning systems in konzo areas, so that epidemics are detected and prevented well in advance.

Julie Cliff

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 (1-2 pages A 4 double spaced) written in English concerned with the following subjects:
1. Cyanide poisoning, konzo, TAN, goitre and cretinism facilitated by cyanide intake from cassava and any other cyanide diseases due to cassava.
2. Reduction of cyanide intake from cassava through agricultural and nutritional means such as by broadening the diet of cassava consumers through introduction of new crops, pulses, vegetables and fruits, and by reducing the cyanide content of cassava varieties through selection and breeding. The effect of environmental factors such as drought on cyanide levels in cassava.
3. Processing methods for conversion of cassava roots to stable food products of low cyanide content.
4. Chemical analysis to determine the total cyanide content in cassava roots and products and thiocyanate in urine.
5. Other relevant matters of interest.
Because CCDN News is a newsletter, full-size original papers or reviews cannot be considered for publication.

Material published in CCDN News may be freely reproduced, but please always indicate that it comes from CCDN News. We wish to thank Miss Belinda Purdey for designing and setting up the front page. Please send all correspondence to the CCDN Coordinator, Dr J Howard Bradbury, see p. 1 for address.