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

CCDN Cassava Cyanide Diseases Network News

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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, Mario Ernesto (Mozambique); Rezaul Haque (Australia)
Country Contacts:
D.R. Congo: D.D. Ngudi, *India:* Bala Nambisan and K.T. Shenoy, *Indonesia:*A.Hidayat,*Mozambique* :Anabela Zacarias, *Nigeria.* M.N.Adindu.
Website:
www..anu.edu.au/BoZo/CCDN

Cassava Leaves, a Non-negligible Source of Dietary Exposure to Cyanogens

Cassava leaves are the main daily source of protein in a diet consisting of processed cassava roots as the major staple food in the Democratic Republic of Congo. In many parts of this country, cassava leaves are prepared as follows:

The hard petioles are removed, the tender leaves and the shoots are selected and may be blanched in warm/boiled water for a few minutes or partially dried in a pan or a pot over a fire and then squeezed to remove liquid before pounding. The spinach–like mass obtained after pounding with a traditional wooden mortar and pestle is then cooked with some water added for at least 30 minutes of boiling. Usually palm oil and salt are added and sometimes also traditional spices and onion.

Raw leaves have high protein content but limiting in sulfur amino acids and also in lysine and leucine. Cooking was found to lower the protein content from 28.6 % to 12 % dry weight on average, but it is still a relatively high protein content compared to other vegetables. Quantitatively, cassava leaves can almost fulfill the recommended daily protein intake but this protein is of poor quality.

Cassava leaves contain very high levels of cyanogenic glycosides compared to the edible parts of roots. Insufficient processing of these roots is suggested to be associated with the occurrence of the neurological crippling disorder konzo. Detoxification of cassava leaves can be achieved by a combination of simple processing methods like pounding and boiling (cooking), the most common ways of preparing cassava leaves for human consumption. In our recent studies, we observed a significant reduction in total cyanogens when the raw pounded cassava leaves were cooked. The residual cyanogens were below the FAO/WHO recommended safe limit set at 10 mg HCN equivalent kg^{-1} dry weight. Since cooking of cassava leaves required a lot of boiling time (at least 30 minutes) and, since in konzo affected areas firewood is the only fuel available, cooking is done generally in the evening when mothers are back from the field after a tiresome day of hard work and long walking. In those regions, cassava leaves with inadequate preparation and cooking can be a non-negligible source of dietary exposure to cyanogens apart from the cassava roots that are suggested to be involved in the etiology of konzo. In addition, the cassava root diet is low in essential sulfur amino acids and the addition of cassava leaves, as a protein rich vegetable does not compensate for this deficiency.

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Delphin Diasolua Ngudi, Yu-Haey Kuo and Fernand Lambein

Rehabilitation of Konzo Patients in Mozambique

Nampula Province in Mozambique has suffered two large epidemics of konzo, the first in 1981 associated with drought, and the second in 1992-3 associated with war. Sporadic cases of konzo continue to appear in the province, particularly in Mogincual District. During the two large epidemics, rehabilitation centres using local material were mounted in the worst-affected areas.

We recently started a new rehabilitation project, conscious that the needs of konzo patients were still great.
During the two large epidemics, many patients weren't reached – in the first because it affected a huge geographical area and in the second because of the difficult post-war conditions. Those who had been reached had new needs, e.g. children who were now young adults needed new walking aids. The new konzo sufferers also needed rehabilitation and existing services were too far from their homes.

The project was a collaborative effort between the Provincial Directorate of Health and the Mozambican Red Cross and received financial support from AusAID.

To locate konzo cases, we worked through community leaders. Red Cross volunteers were trained to teach basic therapeutic exercises and how to prevent contractures. They also learnt how to construct basic exercise training aids, such as parallel bars and walking ramps.

A total of 52 communities in four districts were visited. We found 381 patients with paralysis, of whom 363 were konzo sufferers. More patients (138) were identified in Mogincual District which had suffered the most recent epidemic and where cases continued to appear. Foci of konzo which had not been identified in previous epidemics were discovered in Erati District.

Most patients were young adults, aged between 20 and 29. There were more males in the age group 10-29 years of age and more women over 30. 47% were mild cases, able to walk without support. 41.4% were moderate, needing support to walk, while 11.1% were severe (unable to walk).

162 patients were identified who needed a variety of aids, which were supplied through the project. Three rehabilitation centres were opened, which treated a total of 62 patients. All but one patient improved in the centres.

Although the project was successful, we did not manage to reach all affected communities and cases, particularly in the more remote areas. Requests are still coming in from these communities. Rehabilitation of konzo patients is an ongoing need.

Domingos Nicala

Broadening the Diet Prevents Konzo

At a Workshop in Nampula, Mozambique in 2000[1] the first of four strategies proposed to eliminate konzo was to broaden the diet of the people by introduction of other staples, vegetables, pulses and fruits. This would have the effect of reducing daily consumption of cassava and hence the daily intake of the cyanide compound (linamarin).

One way to estimate the daily intake of cassava is by a dietary survey in which people are asked whether they ate cassava on the previous day. A second method has just been developed[2]. It is based on the measurement using the picrate kit method[3] of the total cyanide content of cassava flour in a village and urinary thiocyanate contents of children at the same time and place.

The daily amount of cyanide taken into the body depends on the weight of cassava flour (or gari) consumed and its total cyanide content. Some of the linamarin is absorbed by the body[4] and the cyanide (CN) is converted to thiocyanate (SCN) which is removed in the urine. By measurement of the thiocyanate content of the urine and an estimate of the daily urine volume, it is possible to calculate the daily maximum weight of cassava flour consumed.

Both methods to measure the daily intake of cassava were used in four study areas in Mozambique. In the first two areas there has been recent cases of konzo and in the other two control areas no recent cases of konzo. It was found that in the first two areas 87% of all children ate cassava the previous day and their maximum daily cassava intake was very high, whereas in the control areas only about 50% ate cassava the previous day and their daily cassava intake was much lower (about 100 g/day).

These results shows that konzo can be prevented by broadening the diet of the people through reducing their intake of cyanide containing cassava. This action is also very desirable in order to improve both the nutrition and the quality of life of the people.

In trying to prevent the occurrrence of konzo in known konzo-prone areas we need to ask whether more effort should be expended by agriculturalists and extension workers towards the introduction of other staples, vegetables, pulses and fruits?

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J Howard Bradbury

Konzo Count

Since the introduction of this feature in CCDN News 1, there are unconfirmed reports of 15000 cases of konzo in Democratic Republic of Congo. About 2200 cases of konzo have been confirmed since 1981 in Northern Mozambique (see report P.2). In Mtara Region of southern Tanzania there are reported to be 214 cases and on Pemba Island WHO has reported a second outbreak.

We thank readers who have responded to the request made in CCDN News 1, to inform us of outbreaks and further details including the approximate number of cases.

Drought Increases Cyanide Content of Cassava and Incidence of Konzo

Cassava grown under low rainfall conditions has an increased total cyanide content due to water stress of the plant.[1] In the 1997-8 season in Mogincual District of Northern Mozambique the rainfall was 880 mm compared with an average rainfall of 1100 mm.[2] This produced cassava harvested in 1998 and July 1999 that when processed to flour had much increased total cyanide levels. However the following season 1998-9 had normal rainfall and produced cassava with normal cyanide content, which on processing gave flour with a cyanide distribution curve similar to that observed in 1996.[3]

Comparison of the three distribution curves shows that the cyanide content of cassava flour has increased from Fig. 1c (normal) to Figs 1a and 1b. The mean values of each of these graphs is 41, 100 and 148 ppm respectively. Thus cassava grown during the period of low rainfall has produced flour with a total cyanide content increased by 2.4-3.6 times.

Another comparison is to consider the percentage of samples in the high cyanide range (>100 ppm) in Fig. 1. This increased from 6% in Fig. 1c to 43% in Fig. 1a to 65% in Fig. 1b.

The incidence of konzo in Mogincual District increased over the period 1997-1999 with 27 new cases being observed.[2] This is very much less than the 786 konzo cases found in Memba District in 1981-2, due to a severe drought.[4]

A link has been established between low rainfall, which causes production of high cyanide cassava and hence high cyanide cassava flour and increased incidence of konzo. Since periods of low rainfall/drought are a recurring feature of the weather in Africa and cause elevated cyanide levels in cassava, it is important to reduce the cyanide content of flour *sufficiently* by processing to allow for this recurrent event.

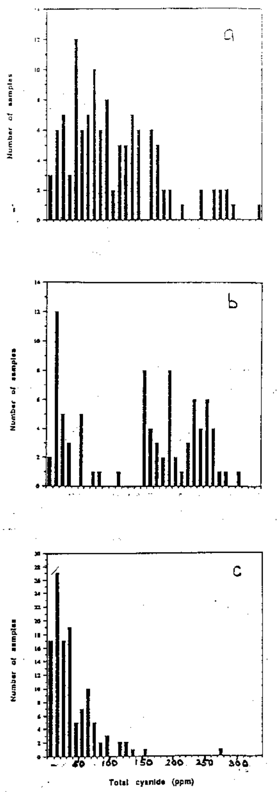

Figure 1. The distribution curves of total cyanide contents (0-10, 11-20, 21-30 ....331-340 ppm) of cassava flour samples collected from Mujocojo,Terrene-A, Acordos de Lusaka & Cava: (a) 119 samples in November 1998, (b) 84 samples in July 1999 & (c) 119 samples in October 1999

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J.Howard Bradbury

TAN

What is TAN (Tropical Ataxic Neuropathy)?

TAN is a neurological syndrome characterized by a gradual onset of ataxia (falling over while walking), loss of sensation in the feet and hands, atrophy of the optic nerve in the eye, and deafness. The presence of any two of these features is considered enough to establish a diagnosis.

When and where was TAN first described?

The term TAN was first used by Osuntokun in Nigeria in 1969. The syndrome had first been reported in the mid-1950s among communities in south-western Nigeria who were dependent on cassava as their staple food.

Where else has TAN occurred?

A similar disease was described in Tanzania in the 1960s and 1970s.

Where does TAN occur now?

No further cases were reported in the medical literature until recently and it was thought that TAN had disappeared from Nigeria with the economic boom of the 1970s. In 1999, investigators revisited Ososa, a semi-urban community that had been endemic for TAN in 1969. They found that 6% of the population suffered from TAN, a higher percentage than in 1969.

Who is affected byTAN?

TAN affects mostly adults and the prevalence increases with age. In the 1999 survey, the prevalence was higher in females (7.7%) than males (3.9%). The highest prevalence (24%) was in women in the 60-69 year age group.

What causes TAN?

TAN has been ascribed to eating poorly processed bitter cassava. If so, the increase with age suggests that it is due to a long-term exposure.

Bitter cassava contains high concentrations of cyanogenic glucosides (mostly linamarin), which are broken down to release cyanide. In TAN-affected communities, elevated concentrations of thiocyanate (the main product of cyanide metabolism in the body) have been found in urine. But the concentrations are much lower than those found in konzo-affected communities.

To make it safe for eating, bitter cassava needs processing to lower the cyanide levels. Many processing methods exist, which give a variety of products. In Nigeria, *gari* is the major source of dietary cyanide. Gari is made by grinding up peeled cassava roots and the ground product is stored in a bag for 3 days, which promotes the enzyme-catalysed breakdown of linamarin. Excess water containing cyanide is squeezed out and the drying is completed by roasting in a metal bowl over a wood fire with stirring to dry and remove HCN.

The underlying cause of TAN is poverty. Its re-emergence in the last decade in Nigeria probably reflects increasing poverty.

What is the treatment for TAN?

There is no specific treatment for TAN. The disease does not respond to vitamin supplements or improved diet.

How can TAN be eliminated?

As for konzo, the key to TAN elimination lies in development. TAN-affected communites should be targets for development assistance. Specifically, they need support to vary their diet and the crops they grow. Improved cassava processing may also help to eliminate TAN.

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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.

 Please send all correspondence to the CCDN Coordinator, Dr J Howard Bradbury, see p. 1 for address.