

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



CCCDN News

Cassava Cyanide Diseases Network

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Wetting Method Improves Nutritive Value of Cassava for Broilers in Nigeria

Nigeria is the world's largest producer of cassava with an estimated 2004 production of about 38.2 million metric tons.¹ With the current Federal Government emphasis on cassava production, it is expected that its production in Nigeria could double within the next few years. Most of the cassava produced is locally consumed as it is the staple food. Attempts to use it as a source of energy in poultry production as an alternative to maize have not yielded encouraging results because of its content of cyanogenic glucosides.^{2,3} Maize on the other hand has been playing a key role as a source of energy in poultry diets in the country. However, because maize is a major human food and also used for various industrial raw materials in the country, demand outstrips supply, leading to more than a 2000% increase in price within the last 20 years. This has contributed to the high cost of poultry feed with concomitant increase in the price of poultry products.

One method of processing cassava tubers for human consumption is sun-drying. Unfortunately, the traditional sun-drying method leaves a large amount of the cyanogenic glucoside, linamarin, remaining in the cassava flour, amounting to 25 – 33% retention of the cyanide.⁴ Recent studies in Australia have shown that wetting cassava flour for 5 hours at the ratio of 5 parts of water to 4 parts of flour reduces its cyanide content to about 1/3 of its previous level and therefore makes it safe for

human consumption.⁴ Although the objective of the work in Australia was to make cassava flour safe for human consumption, we felt that it could also be applied to processing of cassava tubers in Nigeria for inclusion in poultry diets to serve as an alternative to maize.

Trials were conducted to test the efficacy of the wetting method in broiler production. Bitter cassava tubers (var TMS 30572) were peeled, cut into slices and spread in the sun to dry until brittle and then milled to produce sun-dried cassava meal (flour). Part of the meal was then soaked in water using the ratio stated above and thinly spread on the floor at room temperature to allow hydrogen cyanide gas to escape. After 5 hours, it was thinly spread by the side of a tarred road to dry, milled and sieved to produce wetted sun-dried cassava meal. Samples of fresh cassava meal, sun-dried cassava meal and wetted sun-dried cassava meal were tested for cyanide content using cyanide kit B2 which Dr. J. H. Bradbury graciously sent to us.⁵

To compare maize, sun-dried cassava meal and wetted sun-dried cassava meal as sources of energy in broiler diets, 5 fairly iso-caloric and iso-nitrogenous broiler starter diets were made. Diet 1 (control) contained maize as the source of energy; in diets 2 and 3, 75% of the maize in the control diet was replaced with sun-dried cassava meal and wetted sun-dried cassava meal, respectively. In diets 4 and 5, 100% of the maize was replaced with sun-dried cassava meal and wetted sun-dried cassava meal, respectively. Each diet was fed to a group of 30 young broiler

CCCDN 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, Ian Denton, Humberto
Muquingue, Arnaldo Cumbana, Dulce
Nhassico

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 and P.N.Okafor

Website:

www.anu.edu.au/BoZo/CCDN

chicks for 5 weeks. Thereafter, the diets were adjusted to finisher form and fed for the next 4 weeks.

Fresh raw cassava meal recorded 800 ppm cyanide; sun-dried cassava meal gave 50 ppm cyanide while the wetted sun-dried cassava meal gave 10 ppm cyanide. The reduction observed in this study was to 1/5 of the previous level, compared with 1/3 recorded by Bradbury.⁴

At 100% replacement level of the dietary maize with sun-dried cassava meal, weight gain of the broilers dropped by 10% relative to the control group. At seventy-five percent replacement level, the growth performance of the birds dropped by 5%. Wetted sun-dried cassava meal produced the same effect as the control diet both at 75% and 100% replacement levels. It appeared therefore that a cyanide content of 50 ppm in the cassava meal could still generate nutritional problems for broilers if it is incorporated at levels of 50% of the diet or more. Both sun-dried cassava meal and wetted sun-dried cassava meal did not affect the feed intake of the broilers. At 50% dietary level, sun-dried cassava meal containing 50 ppm introduced 25 ppm cyanide into the diet, but with wetted sun-dried cassava meal containing 10 ppm, the diet would contain only 5ppm cyanide. The WHO safe standard for cyanide is 10 ppm. The wetting method therefore appears to be very effective as a method of processing cassava tubers for human consumption as well as a source of energy in poultry diets.

It is therefore concluded that dietary maize could be completely replaced with wetted sun-dried cassava meal as a source of energy in broiler diets provided that the diet is balanced for crude protein, because of the disparity in crude protein content between maize and cassava meal.

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A. B. I. Udedibie
Dept. Animal Science & Technology
Federal University of Technology
PMB 1526, Owerri, Imo State,
Nigeria

e-mail: abiu-futo@yahoo.com

Modification of Nutritional Quality of Cassava Through Plant Nutrition

Cassava contains the cyanogenic glucosides linamarin and a small amount of lotaustralin, which are hydrolyzed to hydrogen cyanide (HCN) catalysed by the enzyme linamarase, when the tissue is damaged. The cyanogenic potential of known cassava varieties ranges from less than 10 mg HCN equivalents/kg fresh weight (ppm) to more than 500 ppm.¹ Consumption of cassava and its products causes cyanide poisoning with symptoms of vomiting, nausea, dizziness, stomach pains, weakness, headache and diarrhoea and occasionally death.² Moreover, high dietary cyanogen exposure from poorly processed cassava roots may be associated with the occurrence of a neurological disorder konzo, an irreversible paralysis of the legs.³

It is therefore crucial to characterise cassava varieties based on their cyanogenic potential and assess other factors like growing conditions and plant nutrients that affect the level of HCN in cassava, so that varieties for household consumption and industrial use can be identified and better strategies devised to reduce HCN content.

One strategy to reduce the cyanide content of processed cassava is to improve processing methods used for conversion of roots to storable cassava products. The major methods of flour making in Africa involve sun drying of peeled roots followed by crushing in a pestle and mortar and sieving. This method retains 25–33% of the original linamarin present.⁴ Heap fermentation removes twice as much linamarin as does sun drying. In order to produce cassava flour with 10 ppm cyanide, the World Health Organisation safe level, one would need to use sweet cassava roots containing not greater than 32ppm linamarin.⁴ Thus attempts made to reduce the cyanide content of

cassava products to safe levels by using these traditional processing techniques alone are not successful, but use of a new wetting method will reduce the cyanide content of flour by 3-6 fold.⁵ Manipulation of the growing conditions such as moisture and mineral nutrients is also important in reducing cyanide content of cassava roots.

A field experiment was conducted at Jimma Agricultural Research Centre where a factorial combination of three cassava varieties (NR – 44/72, NW – 45/72 and OY – 44/72) and six potassium rates (0, 50, 100, 150, 200, and 250 kg K₂O /ha) were investigated in a randomised complete block design with three replications. The experimental site was uniform and previously under cassava cultivation without any fertilisation. Total cyanide content of cassava roots was analysed at harvest using the picrate paper kit A.⁶

Root cyanide in all cultivars decreased with increasing application of potassium from 78 ppm with no added potassium to 58 ppm at the highest potassium rates.⁷ Hence potassium application reduced the average root cyanide content by about 25%. It is important to select appropriate varieties that respond well to fertilisation.⁸ Similarly, results of a long term fertiliser experiment in India revealed that cassava plants supplied with ash and crop residues, which are known to have a high content of potassium, had low root cyanide content.⁹ Potassium application also enhanced the starch content and reduced the cyanide content in tubers of cassava plants.¹⁰ A significant reduction of root HCN content with potassium application coupled with various post harvest processing techniques that could further reduce the remaining cyanide levels, may help to ensure safety in cassava consumption.

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Solomon Endris
Ethiopian Institute of Agricultural
Research,
Jimma Centre, PO Box 192,
Jimma,
Ethiopia

e-mail: solomon.endris@gmail.com

Prevention of Konzo due to Cyanide from Cassava

Konzo is an irreversible paralysis of the legs due to excessive intake of the cyanide compound (linamarin) from cassava and cassava products such as cassava flour. It occurs mainly amongst children (see picture of boy with konzo, supported by his father) and women of child bearing age in Democratic Republic of Congo (DRC), where there are reported to be 100,000 cases, Tanzania, Mozambique, Central African Republic, Cameroon and probably other countries. It is particularly prevalent during war (as has occurred recently in DRC) and during drought,¹ when cassava produces much more linamarin than normal.²

We now have a new wetting method to reduce the cyanide content of cassava flour by 3-6 fold.³⁻⁴ The method is described in detail in several languages below. The method was checked out by rural women in northern Mozambique who accepted it without reservation and found that the taste of stiff porridge made from

treated flour was preferred to that from untreated flour.⁵

In some districts of Nampula Province where konzo is persistent the wetting method is now being shown to rural women so that they can remove the cyanide poison from the cassava flour that they make. It is hoped that this new wetting method of getting rid of the poison will soon spread to those other countries where konzo occurs



and help to eliminate it altogether.

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J Howard Bradbury

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 or a tray in a layer no thicker than 1 cm thick and left in the shade for about 5 hours. Time should not be less than 5 hours. This time is needed for breakdown of the cyanide compound by the enzyme present to produce hydrogen cyanide gas that escapes to the air. The wet flour must be used for cooking the

same day in order 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 (Français)

De 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 cianogénicos (linamarina) por la enzima presente (linamarasa) para producir el ácido 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 húmeda que si se utiliza harina seca, pero de una u otra manera la cocción 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 kuua dutu kwa kutumia mmengenyu uliomo ili kuzalisha gesi ya hidrojeni sianide ambayo hupotea hewani. Unga uliolowa lazima utumike kupikia sila hiyo ili kuzuia mehacho (spoilage) ambao ungetokea kama unga ungelala bila kupikwa. Maji kidogo yanahitajiwa kwa kutengeneza ugali wa kienyeji (luku) kwa unga uliolowa kuliko unga uliomkavu, bila hivyo mapishi ni yaleyale.

Cyanide Intake from Cassava Causes Stunting of Children

When cassava containing the cyanide containing compound linamarin is eaten, part of the linamarin is absorbed into the body as cyanide.¹ The poisonous cyanide (CN) is detoxified as a priority by a series of chemical reactions² to produce thiocyanate (SCN), which is removed in the urine. Thus in animals and humans, measurement of the thiocyanate content of the urine indicates the amount of cyanide taken into the body over previous days. The sulphur needed for the conversion of CN to SCN

comes from the sulphur-containing (S-containing) amino acids methionine and cysteine/cystine. These are essential amino acids; the word "essential" means that they cannot be synthesized in the human body and therefore must be obtained from the food that we eat. If the diet is mainly cassava, with little intake of animal or vegetable protein, then the supply of these S-containing amino acids is likely to be severely restricted.

In children it has been calculated that up to 23% of the S-containing amino acids obtained from their daily consumption of cassava flour is used up in detoxification of the cyanide present in the flour.³ Another estimate, based on urinary thiocyanate and sulphate analyses, shows that 10-20% of S-containing amino acids are used up to detoxify ingested cyanide from cassava.⁴ The question is whether this reduction in availability for protein synthesis of S-containing amino acids, limits the amount of protein available for growth in children.

To answer this question, two groups of children aged up to 3 years in the northern and southern zones of Bandundu Province in the Democratic Republic of Congo (DRC) were studied using dietary interviews, urine analysis and anthropometry, in which the height and weight of children was measured and their age recorded. Both groups of children had cassava as their staple diet. The group living in the northern zone used well processed cassava, but those in the southern zone had poorly processed cassava.⁴ The high cyanide intake of the latter was shown by an average urinary thiocyanate concentration of 757 μ mole SCN/L, which is very high and associated with outbreaks of konzo. By comparison children in the north had a much lower average value of 50 μ mole SCN/L. It was found that the children in the south aged above one year had a statistically lower height for age compared with those in the north, which means that they were stunted.⁴

It is concluded that the priority requirement of the body to detoxify poisonous cyanide and produce relatively non-toxic thiocyanate can cause stunting in children. This is because S-containing amino acids are used up

to detoxify cyanide and hence are not available for protein synthesis and growth. This probably explains why chickens do not grow as well on high cyanide cassava flour, as they do if the cyanide is largely removed from that flour⁵ using the wetting method.⁶

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J Howard Bradbury and Ian C Denton

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.

PestNet allows members to exchange messages on quarantine, biological control, pest management, pest outbreaks, and to send images of pests for identification. It has 675 members in 60 countries and during the 6 years it has been in existence PestNet has exchanged more than 4000 messages. Join by sending a blank e-mail to pestnet-subscribe@yahoo.com.

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 concerned with the following subjects:

1. Cyanide poisoning, konzo, TAN, goitre and cretinism facilitated by cyanide intake from cassava and any other cyanide diseases.
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. Other relevant matters of interest.

Because CCDN News is a newsletter, full-size original papers or reviews cannot be considered for publication.

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