KonzoCare

MEMBERS

- Rakshan Raviraj (Biology, Chemistry, Maths) - Introduction, The Product and Illustrations
- Joshua Barker (Biology, Chemistry, Maths) - Existing Methods, Strengths and Limitations
- Nityan Amin (Biology, Chemistry, Maths) - Importance of the problem and Affordability
- Chiji Nwankwo (Biology, History, English) - Application of the product, Ethical and Cultural Considerations and Illustrations
- Sohayb Bennia (Biology, Chemistry, Maths) - Sustainability and Clinical Trials.

INTRODUCTION

Konzo, meaning “tied legs” in the Yaka language, is a severe and irreversible form of paralysis that mainly affects children and women in rural parts of Central and East Africa. First documented in the 1930s in the Democratic Republic of Congo (DRC), Konzo is caused by frequent consumption of bitter cassava that hasn’t been properly processed to remove its natural cyanide toxins.

Normally, cassava needs water and time to be made safe. But as climate change leads to longer and more severe droughts, safe processing becomes difficult or impossible. When water is scarce and hunger is urgent, families often resort to eating cassava that still contains harmful cyanide—triggering outbreaks of Konzo.

This is not just a health issue—it’s a crisis of inequality made worse by climate change. Poor communities are forced to choose between eating unsafe food or facing starvation.

We present KonzoCare: a low-cost, practical kit that combines:

- Early detection of dangerous cyanide levels in cassava
- Sulfur-based nutritional supplements to support natural detoxification
- Low-water processing techniques using solar drying

This integrated approach is designed for drought-prone regions, helping prevent new cases of Konzo and reducing the long-term health and social impacts of climate-driven food insecurity.

IMPORTANCE OF THE PROBLEM

Konzo causes irreversible paralysis in the legs by damaging motor neurons in the spinal cord, often leaving people using crutches or crawling for life. It mainly affects children and women, reducing mobility, halting education and limiting work. The disease traps entire cassava-dependent communities in a cycle of poverty, worsened by drought and lack of healthcare access.

Official records up to 2009 documented 6,788 cases of Konzo across five African countries, with the highest incidence in the Democratic Republic of Congo (DRC).

However, experts estimate the actual number of cases is significantly higher, with at least 100,000 cases in the DRC alone by 2002.

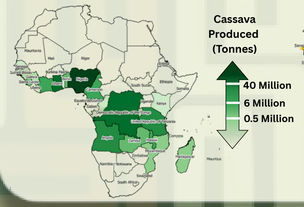
Konzo is made severely worse by droughts, which are on the rise due to climate change. e.g. during a severe drought in Mozambique in 1981, an outbreak of more than 1,100 cases of Konzo occurred, and was associated with an almost exclusively cassava-based diet.

In years with average rainfall, cassava flour contained approximately 40 ppm (parts per million) of total cyanide.

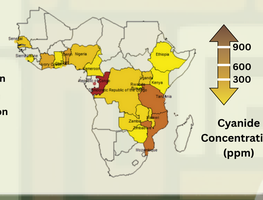
However, during the 1981 drought, the cyanide concentration in cassava flour rose to about 120 ppm.

The World Health Organization recommends a maximum of 10 ppm of cyanide in cassava flour.

Production of cassava in sub-Saharan African (SSA) countries for the year 2020



Reported maximum cyanide content in cassava roots from Sub-Saharan Africa



EXISTING METHODS

Wetting method

This method involves mixing cassava flour with water, spreading it in a thin layer, and leaving it under the sun for a couple of hours. Enzymes in the cassava break down toxic cyanide compounds, releasing hydrogen cyanide gas into the air.

Pros:

- Highly effective: Can reduce cyanide content by over 90%
- Low-cost : Requires only water, sunlight, and basic tools.

Cons:

- Water dependent – Needs clean water, often unavailable during droughts when Konzo risk is highest.
- Weather sensitive – Relies on strong sun; doesn’t work in cloudy or rainy conditions.
- Difficult to apply correctly – Cassava must be spread and dried precisely; mistakes leave toxins.
- Not emergency-friendly – Steps are often skipped during food shortages, raising health risks.
- No safety check – There's no way to confirm if the cassava is truly safe to eat.

Boiling method

Boiling cassava roots or flour in water helps reduce cyanogenic compounds by leaching them into the water and breaking them down with heat. This method is often used in combination with other techniques like soaking or grating.

Pros:

- Reduces cyanide content: Especially effective when cassava is peeled, grated, and boiled thoroughly.
- Simple and accessible: Requires only water and heat—tools most households already have.

Cons:

- Not fully effective alone: Boiling may not remove all cyanide unless combined with other methods (e.g., soaking or grating).
- Loss of nutrients: Some vitamins and minerals may leach into the water and be discarded.
- Fuel and water intensive: Requires sustained boiling, which can be a burden in resource-limited settings.

Fermentation method

Traditional soaking (retting) of peeled cassava roots in water for 3–4 days allows fermentation, which helps reduce cyanide levels.

Pros:

- Reduces cyanide significantly: Especially when soaking is done for the full recommended duration.
- Utilizes traditional knowledge: Familiar to many communities.

Cons:

- Incomplete detoxification: Shortened soaking times (1–2 days) are common and ineffective.
- Water access needed: Not feasible in drought-prone areas.
- Labour-intensive : Requires constant monitoring and handling of large volumes.

THE PRODUCT

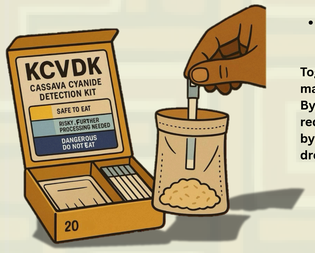
Our KonzoCare Kit combines three key tools: cyanide vapour detection strips, a sulfur-based nutritional supplement, and a solar-powered cassava dryer. Designed for use in drought-prone and resource-limited areas, this integrated kit tackles the root causes of Konzo through early detection, safe processing, and nutritional protection—even during food shortages and climate emergencies.

The Konzo Cyanide Vapour Detection Kit

A simple, pocket-sized test kit that allows users to check if their cassava roots or flour are safe to eat—without needing water, electricity, or lab access.

The kit uses a pyridine-barbituric acid test strip to detect hydrogen cyanide gas released from cassava. Within 2–3 minutes, the strip changes colour based on cyanide levels.

This is powered by the König reaction, which is highly specific to cyanide and can detect levels as low as 0.1 ppm—well below the WHO safety threshold for cassava (10 ppm), offering reliable early detection even in remote, drought-affected areas.



DetoxiPlus – Sulfur-Based Nutritional Support

DetoxiPlus is a nutritional supplement designed to help the body naturally remove cyanide—especially in people who eat cassava regularly.

It works by supporting the rhodanese pathway, the body’s built-in system for detoxifying cyanide. This process relies on sulfur-based nutrients to convert toxic cyanide (CN^-) into thiocyanate (SCN^-) a much less harmful compound that is safely passed out in urine.

Key Ingredients:

- Methionine – An amino acid that helps produce cysteine, which fuels the detox pathway
- Cysteine – Provides sulfur (-SH groups) essential for the enzyme that clears cyanide
- Vitamin B12 – Binds to free cyanide, turning it into a safe compound called cyanocobalamin
- Selenium – Supports antioxidant enzymes that protect the body from cyanide-related damage

Together, these ingredients help people who are malnourished or at high risk from cassava-based diets. By boosting the body’s natural defences, DetoxiPlus reduces the risk of nerve damage and paralysis caused by chronic cyanide exposure—especially during droughts and food shortages.

Solar Cassava Dryer

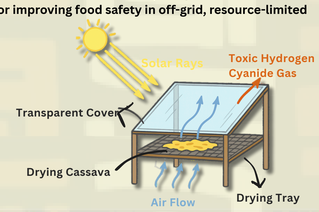
The Solar Cassava Dryer is a passive thermal drying system designed to accelerate the removal of moisture and volatile cyanide compounds from cassava using solar energy and natural airflow. It is especially useful during droughts, since it requires no water to operate.

It operates by harnessing the greenhouse effect to trap heat within an enclosed drying chamber and uses thermal convection to maintain continuous airflow, which removes water vapour and volatile gases released from grated or ground cassava.

The key components include:

- Transparent Cover – Allows shortwave solar radiation to enter the chamber while trapping longwave infrared radiation, raising internal temperatures to 50–70°C to promote efficient drying.
- Drying Trays – Made from mesh or woven material, these trays hold the cassava in thin layers, allowing maximum exposure to heat and air.
- Ventilation Pathways – Enable hot, moist air to rise and escape, creating a convection current that draws in cooler, drier air from below, maintaining a low-humidity environment essential for evaporation.
- Elevated Heat and Airflow – Increase the vapour pressure differential between the cassava and surrounding air, enhancing moisture removal and facilitating the release of hydrogen cyanide gas through natural volatilization.

Together, these elements form a closed-loop, energy-efficient system that significantly reduces drying time and lowers residual cyanide content in cassava. The process ensures more uniform drying, reduces contamination risks, and provides a reliable method for improving food safety in off-grid, resource-limited settings.



VIDEO OF HOW CASSAVA IS PROCESSED – CREATED BY US

PRODUCT APPLICATION

How to use the KCVDK

1. Crush a small sample of cassava root.
2. Place a small sample of crushed root in the breathable pouch. Insert the test strip in the holder, suspending it above the cassava.
3. Close the pouch and wait 2–3 minutes.
4. Open the pouch and check the colour of the strip. Follow the colour chart to decide if the cassava is safe, needs more processing, or must be discarded.

How to use the DetoxiPlus

Who Takes It:

- Children over 5 years, women of childbearing age, and any individuals identified at high risk of Konzo.
- Particularly during drought, famine seasons, or after known exposure to high-cyanide cassava.

Dosage:

- 1 sachet or tablet once per day during high-risk periods
- Can be taken with or without food.

Form:

- Fast-dissolving powder (to be mixed with any available liquid, including small amounts of porridge or water).
- Alternatively, a chewable tablet with a mild flavor.

How to Use a Solar Cassava Dryer

1. Prepare Cassava: Peel, wash, and slice or grate into thin pieces.
2. Arrange on Trays: Spread evenly on wire mesh trays; avoid stacking.
3. Load into Dryer: Insert trays with space between layers; close cover securely.
4. Position in Sunlight: Place dryer in direct sun, angled for maximum exposure.
5. Dry Cassava: Leave for 6–8 hours in strong sun or 1–2 days in mild conditions.
6. Check Dryness: Cassava should be crisp and brittle; drying time varies.
7. Store Safely: Remove and store in airtight containers to prevent moisture.

CLINICAL TRIALS

KCVDK

Purpose: To validate the accuracy and usability of the detection strip in real-world settings.

Diagnostic Trial (Pre-Clinical)

- Compare KCVDK strip readings against gas chromatography lab results.
- Participants: Cassava samples (no humans)
- Goal: Validate detection sensitivity to 0.01 ppm

Phase I – Usability Study

- Who: 30 local farmers and women processing cassava
- What: Observe usage technique, timing, ease of interpretation
- Where: Village-level pilot

Phase II – Field Accuracy

- Who: 100 households in Konzo-endemic areas
- Compare: KCVDK results vs lab-tested cassava samples
- Goal: 90%+ accuracy and correct interpretation rate

Phase III – Community Rollout

- Train community health workers to monitor strip usage
- Measure reduction in consumption of unsafe cassava

DetoxiPlus

Purpose: Test safety, efficacy in reducing cyanide toxicity, and acceptability in malnourished or at-risk individuals.

Phase I – Safety Trial

- Who: 20–30 healthy adult volunteers
- Goal: Ensure no side effects or nutrient overdose
- Monitor: Urine thiocyanate, liver enzymes, side effects

Phase II – Pilot Efficacy

- Who: 100 participants consuming cassava daily
- Compare: Thiocyanate levels (with vs. without supplement)
- Duration: 1 month

Phase III – Nutritional Intervention

- Who: 300 villagers including children (under nutritionist oversight)
- Goal: Reduce symptoms of sub-acute cyanide toxicity
- Track: Long-term improvements in health markers

Phase IV – Community Adoption

- Acceptability study (taste, form, packaging, cultural alignment)

ETHICAL AND CULTURAL CONSIDERATIONS

- The KonzoCare Kit was designed with equity, dignity, and cultural sensitivity at its core. It supports safe food preparation in ways that are accessible, familiar, and empowering for the communities most affected by Konzo.
- The solar dryer is based on traditional cassava drying practices, but improved with scientific design. This respects cultural norms while improving safety, helping build trust and uptake—especially among older community members.
- Young children and elderly caregivers, who are often involved in food preparation, can use the dryer and detection kit safely. The design ensures inclusivity and autonomy regardless of age, gender, or literacy level.
- The KCVDK test strips provide clear, colour-based results that can be interpreted even by those with limited reading ability or visual impairments—supporting health literacy and independent decision-making.
- The DetoxiPlus supplement offers non-invasive support that aligns with local dietary habits and avoids unfamiliar or medicalised interventions, which can raise concerns or stigma.
- Ethically, the kit promotes preventive care—addressing Konzo before it causes harm. This reflects the principle of beneficence, prioritising community health while avoiding unnecessary harm or dependency.
- By combining scientific innovation with local wisdom, ease of use, and respect for cultural values, the KonzoCare Kit aims to deliver health solutions that are not only effective—but also ethically sound and socially acceptable.

STRENGTHS

- ✓ Detects cyanide quickly and easily
- ✓ Highly specific and sensitive test
- ✓ Supports natural detoxification in the body
- ✓ Contains essential sulfur amino acids
- ✓ Improves food safety in off-grid areas
- ✓ Reduces moisture and cyanide effectively
- ✓ Utilises traditional knowledge for familiar use

LIMITATIONS AND HOW TO OVERCOME THEM

- Incomplete detoxification if not followed properly
  ~Provide a clear video tutorial
- Supplement requires consistent use
  ~Offer the supplement in pre-measured daily doses
- Passive dryer relies on suitable weather
  ~provide modular drying kits with weather-resistant covers.
- Limited to cassava cyanide detection only
  ~Invest in research and development to expand detection capabilities to other cyanogenic foods

SUSTAINABILITY

The KonzoCare Kit is built for long-term impact with a low environmental footprint, tailored to the realities of drought-prone, off-grid communities.

Low Resource Use

- The solar dryer requires no electricity, fuel, or water, yet achieves a 4× reduction in cassava cyanide content.
- This makes it ideal for regions facing climate-induced resource scarcity, while reducing dependence on finite energy sources.
- No disposable parts are used in the dryer or detection kit—components are durable and reusable, with minimal waste generation.

Renewable Materials & Local Sourcing

- The dryer frame is made from bamboo, one of the world’s fastest-growing and self-renewing materials.
- Bamboo can grow up to 30cm per day, and when harvested correctly (cut above the root), it regenerates without replanting—reducing deforestation pressure and carbon emissions.
- Bamboo is also abundant in the Congo River Basin, allowing for local production, minimising transport emissions, and promoting regional economies.

Community Ownership & Knowledge Transfer

- Sustainability is not just environmental—it’s social. We prioritise community-led training to ensure the product is used correctly and consistently.
- Training women—who traditionally manage cassava preparation—creates local experts who share knowledge organically within the village.
- This model has succeeded in countries like Tanzania, where training 200 women led to widespread community adoption through peer learning.
- By combining renewable materials, climate-smart design, and community leadership, the KonzoCare Kit is built for a sustainable future—economically, socially, and environmentally.

AFFORDABILITY

Price Breakdown:

Solar Dryer

Solar Dryer - £6.00

- Transparent Cover - £1.50
- Wooden Frame + Mesh - £3.00
- Labour (Assembly) - £1.50

Detection Kit

Detection Kit - £1.00

- Test Strips (20x) - £0.60
- Plastic Holder + Pouch - £0.30
- Instruction Card - £0.10

DetoxiPlus Supplement

DetoxiPlus - £1.10

- Amino Acids - £0.60
- B12 + Selenium - £0.30
- Packaging - £0.20

Total Cost: £8.10

- Cost can be reduced per person, as each kit can serve multiple families:
- Kit consists of: One dryer + 20 test strips + supplement sachets, for shared household use.

How costs are minimised:

- All parts avoid expensive technology, electricity, or import reliance
- Designed to be mass-producible and shippable in lightweight packaging.
- Local NGOs and health centres can distribute and maintain kits, reducing supply chain costs
- Government / NGO grants can provide essential financial support

Price of the kit can be justified because:

- Treating Konzo is less cost effecient than preventing it (lifelong paralysis, caregiving, lost income).
- One kit could prevent multiple cases, making it cheaper than hospital care or disability support.
- Kit is usable even during droughts—eliminates water dependence, avoiding costs linked to water scarcity.

REFERENCES

The NCS