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PHARMA & HEALTHCARE (#HEALTHCARE) 1/12/2015 @ 10:44AM | 81,059 views

Did Crocodile Bile Really Kill 75 People In Mozambique?

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Over the weekend, the Associated Press picked up on a tragic story from Mozambique where dozens of people apparently died after drinking a traditional beer that had been laced, allegedly, with “crocodile bile.”

Radio Mozambique (Rádio Moçambique) updated the story Monday morning, confirming that 69 people have died and 196 are hospitalized after attending a funeral on Friday in the village of Chitima in the western part of the country. The mourners had gathered later in the day in a neighborhood to drink Pombe (or Phombe), a fermented mix of sorghum, bran, corn, and sugar. (Note: The Latin name for a yeast, not usually used in brewing, is *Schizosaccharomyces pombe*.)

(Update, Thursday, January 28: The final update from Mozambique health authorities is that 75 people died and another 177 were treated for poisoning. As of this date, the identity of the poison has not been determined.)

The owner of the drink stand, her daughter, nephew, and four members of neighboring families were among the first seven fatalities received at the local hospital morgue on Saturday morning.

Paula Bernardo, district director of [Health](http://www.forbes.com/health/) (<http://www.forbes.com/health/>), Women and Social Action in Cahora Bassa, told Radio Mozambique that as authorities attempted to determine the cause of these deaths, local hospitals

became inundated with people suffering from diarrhea and muscle aches (roughly translated from Portuguese) and more people already dead. The patients came both from Chitima and the nearby village of Songo.



The Nile crocodile, Crocodylus niloticus, in Lake Chamo, Ethiopia. Credit: Bernard Gagnon, C BY-SA 3.0 license

The provincial health director for Tete, Carla Mosse Lazarus, said that samples had already been sent to a national analytical laboratory to determine what poison or poisons had contaminated the 210-liter drum of the brewed beverage.

Oddly, nowhere in today's Mozambique report is there any appearance or speculation that the toxic substance may have been "crocodile bile" or any other local names for such a poison (such as *ndura*). The very short Associated Press [report](#)

(<http://www.nytimes.com/2015/01/12/world/africa/mozambique-contaminated-beer-kills-more-than-50.html>) that appeared yesterday in *The New York Times* cites another official, Alex Albertini, as being the source of this speculation.

If the poison is "crocodile bile," what is it?

Crocodile bile is literally the digestive juice from the gall bladders of the Nile crocodile, *Crocodylus niloticus*. Its use traces back to witchcraft accusations in 1899, according to Professor N.Z. Nyazema, in the Department of Clinical Pharmacology at the University of Zimbabwe, writing in the *Central African Journal of Medicine* in 1984 and 1985. The university, in Harare, is about 300 miles southwest across the Mozambique border from where the poisonings occurred.

Bile contains detergent molecules, called bile salts or bile acids, that animals use to dissolve or emulsify fats. They also bind to hormone receptors that regulate their own production. But more simply, bile salts or bile acids could conceivably be quite toxic in very high concentrations, as would any strong detergent. However, this isn't consistent with the amounts allegedly used in traditional poisoning cases.

Professor Nyazema explains,

“ It is widely believed that the bile from the gall bladder of a crocodile is very poisonous. The bile *nduru* is used as poison which is added to beer or stiff porridge, *sadza*, of an unsuspecting victim. It is not easy to buy this poison neither is it easy for anyone to kill a crocodile solely for the purpose of obtaining the bile. But with a good fee one can obtain some of the poison from a special *n'anga* [a traditional healer of the Zimbabwean Shona tribe]. At times the *n'anga* may undertake to poison the victim thus adding mystery to the ingredients of the poison. It is reported that the poisoning occurs at special occasions like beer drinking: The *nduru* is said to be introduced into the beer by dipping the finger or nail where a small amount is placed: This will suffice for the purpose. The unfortunate victim is supposed to die within 24 hours. The poison is supposed to manifest itself when the patient develops pains mainly in the abdomen.

Professor Nyazema learned these stories from the writings of Professor Michael Gelfand, a South African doctor who led the department in the middle of the 20th century and wrote extensively on colonial medicine in southeastern Africa.

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EALTHCARE (IHEALTHCARE) 1/14/2015 @ 9:27PM | 6,178 views

Crocodile Bile Expert Suspects Toxic Pesticide In Mozambique Tragedy

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The Zimbabwean pharmacologist who proved in the 1980s that crocodile bile is not poisonous says that any speculation on its involvement in [the Mozambique beer tragedy](http://www.forbes.com/sites/davidkroll/2015/01/12/what-is-crocodile-bile-and-is-it-really-poisonous/) (<http://www.forbes.com/sites/davidkroll/2015/01/12/what-is-crocodile-bile-and-is-it-really-poisonous/>) is “nonsense.”

Norman Z. Nyazema, Ph.D., now a professor of pharmacology at the University of Limpopo in South Africa, told Forbes.com that he more likely suspects a common agricultural pesticide as the agent that has now killed 73 people in the villages of Chitima and Songo, Mozambique.

Residents had gathered on Friday evening following a funeral, drinking a brewed sorghum and corn beer called pombe or phombe. Dozens died by Saturday morning, including Olivia Olocane, the woman who brewed and sold the beer, as well as her daughter and nephew.

Original accounts, repeated by American press outlets over the weekend and Monday, speculated that a traditional witchcraft poison termed “crocodile bile” was behind the deaths.

Speaking from his office in Limpopo, Professor Nyazema said, “Yes, I saw this on the news last night that people had been drinking some beer that was laced with what is supposedly crocodile bile – which is, really, a lot of nonsense.”

“Crocodile bile is not poisonous whatsoever,” said Nyazema.



Norman Z. Nyazema, Ph.D., is a clinical pharmacologist and pharmacy professor at the University of Limpopo in South Africa. While at the University of Zimbabwe in the 1980s, Professor Nyazema conducted the original experiments demonstrating that crocodile bile was not the lethal poison as depicted in traditional medicine and witchcraft. Photo credit: N.Z. Nyazema

Limpopo is the northeasternmost province of South Africa and borders Zimbabwe, Mozambique, and Botswana.

Professor Nyazema has been studying the science behind traditional beliefs and medicines in south and southeastern Africa for more than three decades. He said that the mystical properties of crocodile bile and other tissues, such as the brain, have been passed around Bantu-speaking people for years.

“The crocodile is a powerful creature – the crocodile can devour a human being who is crossing a river. You have to possess these certain powers to be able to kill it and get its bile.”

From myth to science, then back to myth

Nyazema says that he originally began his work on the substance in the early 1980s at the University of Zimbabwe to identify the signs and symptoms of crocodile bile poisoning.

“At first, I believed in it and was looking for an antidote,” said Nyazema. “I wanted to find out the signs and symptoms of the poisoning by the crocodile bile.”

His first clue that the lethality of crocodile bile was a myth came when he approached a regional crocodile farm for gall bladders to conduct his studies in mice.

“I went out to the crocodile farms to collect some of the stuff and – lo and behold, you won’t believe it – these guys in the crocodile farms were drying this stuff to send it to China because the Chinese think it is an aphrodisiac,” said Nyazema. “Honestly – and while we here are saying it is a poison!”

Nyazema also knew that modern medicine extracts the bile from cattle to produce ursodeoxycholic acid to dissolve some types of gallstones and treat

primary biliary cirrhosis. (UDCA is still available from generic drug manufacturers for these indications.) Perhaps bile from the crocodile had some component unlike that of other creatures that might provide the basis for its purported attributes.

A Norwegian colleague arranged for Nyazema to send samples to a laboratory at Sweden's Karolinska Institute for analysis. "I thought I would find something different," said Nyazema.

Instead, crocodiles have about 18 of the same bile constituents among the 24 to 32 shared by humans and other mammals.

Nyazema concluded that traditional beliefs somehow conflated with the use of several arrow poisons that native peoples extracted from plants of the area.

"I went into the anthropology and found accounts of where someone is called to a beer party – and people want to get rid of so-and-so – and when beer is being drunk, it's done in such a way that he drinks from this particular place where someone has placed the poison," said Nyazema. "We're talking about some really potent stuff," referring to a dozen or so plant chemicals called cardiac glycosides that can slow or stop the heart. "But it certainly isn't crocodile bile."

While his science was solid and published in two papers in the Central African Journal of Medicine in 1984 and 1985, Nyazema's work was not well received by those outside of biology and pharmacology.

"One political science colleague at the university said, 'Why are you trying to denigrate our traditional beliefs?'," recalled Nyazema. He suspects that some social scientists were offended or threatened by his scientific examination of traditional remedies and poisons.

Nyazema wrote in 1985, "Maybe Zimbabwean social scientists trained in the tradition of cultural relativism and objective analysis have been most anxious to promote the legitimacy of peasant institutions."

He concluded a related discussion in another paper, writing, "Hardest myths can take root in the shallowest soil."

Identity of the poison still awaits laboratory analysis

Sadly, the people of Chitima, Mozambique, would have fared better if crocodile bile had indeed been used instead of the deadly adulteration of the drink last Friday.

Radio Mozambique continues to quote health authorities this morning as saying that samples of the beer and objects found at the bottom of the 210-liter drum are being tested by a national analytical laboratory.



This still image from a SkyNews video shows investigators retrieving objects from the bottom of the drum containing what is thought to be the toxic brew that has killed 73 people and hospitalized over 100. Credit: SkyNews via the Washington Post

“What the government asks is that one should avoid speculation or misinformation to avoid panic. Let us wait calmly for the results of the analyzes, because enough samples were taken,” said national Deputy Minister of Health, Nazira Abdul.

[Original statement in Portuguese: “O que o Governo pede é que se deve evitar especulação ou desinformação para evitar o pânico. Aguardemos com calma pelos resultados das análises, porque foram colhidas amostras suficientes.”]

In addition to sending two health experts to the village, Abdul said that the government was also providing psychological services to bereaved families, especially for children orphaned by the death of both parents. The Mozambican government has declared three days of national mourning and the provincial government is reportedly assisting in the costs and process of burial, particularly to avoid contact by others with an unknown poison.

Despite the official admonition to resist speculation, Carlos Bernardo at *Jornal Notícias*, the daily newspaper of the capital city of Maputo, has been investigating local suspicions as to the nature of the poison and the motive for what appears to be an intentional act.

Bernardo reported today

(<http://www.jornalnoticias.co.mz/index.php/primeiro-plano/29971-chitima-tragedia-que-chegou-na-subtileza-do-pombe>) on village rumors that Ms. Olocane produced a high-quality pombe brew in large quantities, up to 1,000 liters per week, and still often being sold out. Suspicions are that a competitor may have hired an intermediary to poisoned the brew while it was unattended as Olocane and others attended the neighbor’s funeral, intending only for her customers to experience diarrhea and muscle pain.

Among the “suspicious items” taken from the remaining drum of pombe was an unlabelled and empty 200 milliliter bottle tie with a heavy piece of wood to an empty 500 milliliter bottle of mineral water. Bernardo also reports that the poison may have been purchased from poachers just over the border with Zimbabwe who allegedly use poison to kill elephants for the ivory trade. An

elephant travel corridor to run near Chitima. Elephants are often seen traveling over the border to drink in Cahora Bassa, about 25 miles from Chitima.

Nyamena speculates on agricultural pesticides

At first, Professor Nyazema proposed that perhaps the beer was made in drums that had not been cleaned properly from whatever industrial use had preceded their adoption for brewing.

But after these rumors and the symptoms of those poisoned were presented to him (diarrhea and gastrointestinal distress), he immediately suspected an organophosphate pesticide as the most likely culprit.

“The organophosphates are used in farming regions areas in this region as pesticides – things like malathion and parathion, ” said Nyazema.

Organophosphate pesticides are a class of chemicals called irreversible cholinesterase inhibitors, meaning that they permanently block the enzyme that degrades the neurotransmitter, acetylcholine. First made in the 1950s as tamed versions of World War II nerve gases, malathion and parathion are long off-patent and are relatively inexpensive to purchase in bulk.

Still sold in big-box U.S. home improvement stores, the organophosphate inhibitors are selective for the cholinesterases of insect pests but can inhibit human cholinesterases when consumed in high doses. [The Merck Veterinary Manual](http://www.merckmanuals.com/vet/toxicology/insecticide_and_acaricide_organic_toxicity/organophosphates_toxi) (http://www.merckmanuals.com/vet/toxicology/insecticide_and_acaricide_organic_toxicity/organophosphates_toxi) calls malathion, “one of the safest organophosphates because of its selective toxicity.”

Many later generation organophosphates are available and manufactured within Mozambique, so Nyazema couldn’t make a prediction beyond suspecting this class of chemicals.

Failure of the body to degrade acetylcholine due to organophosphate poisoning can cause suppression of breathing and bronchospasms, lowered heart rate and blood pressure that can give rise to cardiac arrhythmias, muscle fasculations (rapid tremors) and seizures, and gastrointestinal pain, diarrhea and fecal incontinence.

Poisoned patients [require](http://emedicine.medscape.com/article/167726-clinical) (<http://emedicine.medscape.com/article/167726-clinical>) respiratory support and cardiac monitoring and can be treated with the anticholinergic drug, atropine, a plant-derived drug that blocks acetylcholine action.

Until a full report emerges on the detailed clinical treatment and the contents of the bottles reportedly found in the brew, the cause of the Chitima tragedy will remain a mystery. But in addition to taking samples of the tainted brew, one hopes that blood samples were taken from victims – clinical diagnostic kits can detect if a patient’s cholinesterase has been inactivated by an organophosphate.

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