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Discovering Poisonous Plants by Tasting: The Case of Children in Mumias Sub-County, Kenya

Wycliffe Wanzala[1], Cornelius C. W. Wanjala[2]

[1]*Department of Biological Sciences, School of Science and Information Sciences, Maasai Mara University, P.O. Box 861 – 20500, Narok, Kenya.*
[2]*Department of Chemistry, School of Pure and Applied Sciences, South Eastern Kenya University, P.O. Box 170 – 90200, Kitui, Kenya.*

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Plants are like a two-edged sword, which cuts on either pointing side. All living organisms exclusively depend on plants for their survival while, on the other hand, the same plants, just like the two-edged sword, are capable of killing any living organisms engaged with it. Identifying the fulcrum point of balancing the engagement level to avoid any harm, is a critical challenge to humanity! *Jatropha curcas* is an example of such a two-edged sword plant. All parts of *J. curcas* have been used in a folk remedy as human and veterinary medicines for a long time without any harm while its products such as oil have been conventionally applied in many industrial processes. Surprisingly, the seeds of *J. curcas* contain highly poisonous jatrophin, toxalbumin curcin and carcinogenic phorbol. Ingesting as few as three untreated seeds can be fatal to humans. The discussion in this case report is based on children who ate raw seeds of *J. curcas*. This is a testimony that children's knowledge about plants is limited and more effort should therefore be dedicated to teaching about poisonous plants. Lessons from this report are, before exploiting any plant for whatever application in the society, it is critical to have an in-depth scientific study of each part of the plant and generate information and henceforth knowledge to advise accordingly. More efforts should be concentrated on the identification and scientific evaluation of the unknown plants in our respective environments and any information generated should be put in the public domain to avoid any future calamity.

Keywords: Euphorbiaceae, *Jatropha curcas*, Jatrophin/Toxalbumin curcin, Mumias, Poisonous, Seeds

Corresponding author: Prof. Dr. Wycliffe Wanzala, PhD; School of Science and Information Sciences, Maasai Mara University, P.O. Box 861 – 20500, Narok, Kenya. E-mail: osundwa1@yahoo.com or wanzala@mmarau.ac.ke

Introduction:

Human discoveries of useful and poisonous plants were made much earlier than the earliest records of medicinal plants by the Chinese in 2800 BC, Ayuverda in 5000 BC, Egyptians in 1500 BC, Greeks in 400 BC and Holy religious books such as the Bible, Koran, Vedas etc. (Maitai 1996). In fact, the identification and use of plants and plant products is as old as human origin and civilization! The ingenious exploitation of plant resources was indeed a manifestation of humans' separation from the rest of animals in the Kingdom Animalia and subsequent quest for independence and the management of food security, housing and health at all costs in life.

Initial discoveries of useful plants (for food, medicines, clothing, energy/fuel, ornamental, timber, ethnically based plants with cultural and traditional values etc.) by tasting, observations of how animals use them and by the doctrine of signatures, was truly accidental and caused many humans a fatality (Ayensu 1978), (Maitai 1996), (Wanzala et al. 2012). Poisonous plants were similarly discovered by a method of trial and error, nevertheless the discovery of arrow poisons remains to date, unexplained mystery in the evolutionary history of humanity. Plants normally cause poisoning by ingestion, contact, absorption or inhalation. Given that the existence of poisonous plants is a fact and research on herbal medicine has so far failed to confirm the usefulness of some herbs, this, however, contributes to making the application of edible plants and traditional medicine very contentious issues in agriculture and pharmaceutical industry, respectively (Maitai 1996), (Kipkore et al. 2014).

Human-based discoveries have been the trend in human evolutionary history until the advent of laboratories where the scientific tests beyond human "guinea pig" can be conducted and results objectively verified through acceptable scientific methodologies. This is in fact, less risky and safe for humans as "guinea pigs" in the laboratory. However, whichever method is applied, it is costly, risky, tedious and not just easy to look at a plant and make judgment as to whether it is poisonous or not.

In modern era, choosing to eat fruits of a plant with no prior knowledge was a bold decision by children to innocently revert to old tactics of discovering poisonous plants as "guinea pigs" in the laboratory, the current case being reported from Mumias Sub-County in Kenya. Nevertheless, worldwide, plants are known to be one of the top 10 most frequent causes of poisoning in young children under the age of 6 (Dolan and Welch-Keesey 2016). Plants are ubiquitous in our environments and everyday life is wholly dependent on plants and plant resources in a variety of

ways for our survival. Unfortunately, it is sad to note that in the entire Kingdom Plantae, there are potentially harmful plant species to humans, children becoming the most vulnerable group in the human population in spite of precautionary efforts being advanced worldwide (Fančovičová and Prokop 2011). This may be due to poor identification skills of poisonous plants by children, thus posing a very high risk of poisoning effect amongst them. This case report is a manifestation of how plants, albeit the fact that they support life in entirety (Agbogidi et al. 2013), can, on the other hand, create a huge risk on human livelihoods if care is not taken.

2. Making distinction between poisonous and non-poisonous plants

This is challenging and it is not easy to make the distinction between poisonous and non-poisonous plants in the world of unregulated "alternative medicine'', no research on edible/non-edible plants in the wild, rocketing food insecurity and in the light of looming poverty in every sector of life. For instance, hunger may make anything look like food, particularly when the nasty wild plants look appetizing; being caught in the wild environments without food, becomes an even more dangerous scenario (MacWelch 2015). The poisoning effect may range from mild irritation to severe illness or death (Dolan and Welch-Keesey 2016), partly depending on the chemical composition of the plant. For instance, one plant usually has so many phytochemicals found in unique proportions in different parts (flowers, buds, fruits, seeds roots, stems, leaves etc.) and at a certain specific time during the growth and development of the plant (Duke 1983), (Prasad et al. 2012). Choosing therefore, which part(s) of such a plant has an appropriate proportion of the phytochemicals considered safe for human consumption, is a trial and error mechanism, which positions humans as "guinea pigs" in a laboratory. Further, determination of such proportions are indeed very perplexing, time consuming and just costly by any means. This may help explain why the whole of medicinal or edible plants are rarely used; instead only specific parts of a given plant are considered (Wanzala et al. 2012).

Case report:

Background

On Sunday, February 1st, 2015 at Mwikunda 'B' village in Mumias Sub-County, about 18 children admired ripe fruits of *Jatropha curcas* while passing by (Figure 3). The appetizing fruits coupled with their hunger, left the 18 children, aged between 5 and 12 years, with no option

other than sampling the sweet fruits competitively. After consumption of fruits, particularly the seeds the children started complaining of stomachache before their condition worsened and became complicated with severe vomiting, diarrhea and acute abdominal pains. The children were taken to Matungu Sub-County Hospital where they were given first aid and thereafter referred to St. Mary's Hospital Mumias for specialized treatment while in critical conditions (Figure 1).

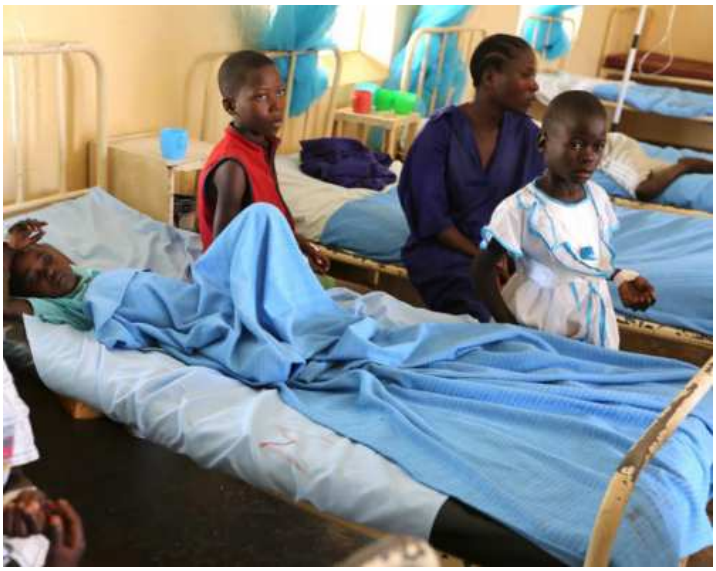

Figure 1. A section of the 18 children from one family recuperates at St. Mary's Hospital Mumias morning of Monday, February 2, 2015. They were admitted after eating wild fruits of *Jatropha curcas*. Adopted from Wakhisi and Sakwa (2015). http://www.standardmedia.co.ke/article/2000150269/panic-as-18-children-in-a-mumias-hospital-after-eating-poisonous-fruits, as retrieved on Tuesday, February 3rd, 2015 at 10:00 GMT +3.

Cultural beliefs beyond *Jatropha curcas* Linn. poisoning – Is this ritual medicine?

When it became apparent that the sickness of the 18 children was due to the fruits they ate, it caused panic among residents who claimed the tree had grown on a community grave since 1993. The children's sickness therefore was a punishment from the disturbed evil spirit of the dead. While some residents claimed that the tree had grown naturally but unfortunately on the grave of their relative wife. Culturally, it was believed that the children had disturbed the peace of the evil spirit, which became annoyed and caused the sickness in children and they may therefore die. Community old men and women were therefore assembled at the site so that the specific tree of *Jatropha curcas* Linn. to be ceremoniously uprooted while the evil spirits were appeased by shading blood of an animal and roasting meat at the site as a sign of reconciliation,

recognition, asking for forgiveness from the disturbed evil spirit. This was therefore believed to restore the lost relationship between the living and the dead. The residents claimed that the tree on which the fruits grew had been there for many years (more than 20 years), but they had never known that the plant was poisonous! They could not therefore understand why the tree became poisonous all of sudden when their children ate its fruits. The residents wondered because most plants causing acute and sub-acute poisoning are well known to the local community where they grow, as the cause-effect relationship is easy to establish (Maitai and Mungai 2005). However, some people claimed that certain trees were usually planted by the family members of the deceased as one way of ensnaring the person who killed their beloved one, so this could be the case. In the framework of these complaints and counter accusations, what did not come out clearly was, whether the fruits of these trees of *Jatropha curcas* Linn. had been eaten in the past or not? As no one appeared to be associated with the fruits of this tree any more, answers this question was not forthcoming and residents remained elusive on this particular issue but determined to conduct the suggested ceremony.

According to the traditions of the *AbaWanga* people, if the tree was to be uprooted from the grave, then a sheep, a goat or cattle, depending on circumstances, has to be slaughtered to appease the dead and prevent the dead from causing any calamity. An animal of a certain color, usually brown, black or white, was to be provided by the relatives of the dead and/or the parents of the affected children and had to be slaughtered in a specific special way closer to the tree to be uprooted.

The panic of the sickness of the children and clamor to conduct this ceremony intensified until it attracted the attention of local Governor of Kakamega County, Kenya News Agencies (KNA)/media houses and plant scientists in Kenya. The Governor, however, ordered the tree to be uprooted and warned residents to avoid planting unknown trees in their homes to avoid such incidents in future and as one of the remedies of preventing plant poisoning in human environments.

Whether or not the alleged ceremony was to provide some healing powers to the sick children, it remained a mystery up to date! However, ideologically, this way of thinking to save life is a reflection of the value of traditional and cultural lifestyle of the *AbaWanga* people in Mumias, the former Wanga Kingdom. This is a testimony of ritual medicine inherent in the

ethnoknowledge of the *AbaWanga* people. This community still retains their traditional Kingship (*Obunabongo*) up to date and henceforth, their cultural values, taboos and norms.

Identity of the plant species

Following the news by KNA about the poisonous fruits of a wild plant in Mumias Sub-County, we visited the site (Mwikunda 'B' village) and sampled the candidate plant species. The plant specimens were harvested, prepared, packaged and stored according to the Herbarium rules and regulations until transported to the Herbarium of the University of Nairobi, School of Biological Sciences for authentic botanical identification using voucher specimens. The plant taxonomy also used the Hutchinson system of plant taxonomy based on the plants' probable phylogeny. The plant was confirmed to be *Jatropha curcas* Linn. While in the Herbarium, further non-experimental validation studies were conducted and a voucher specimen prepared and deposited.

Non-experimental validation studies:

Secondary data evaluation and analysis

This involved the collection of comparative and contrasting secondary data on ethnopractices and various conventional studies conducted on *Jatropha curcas* Linn. in time and space. An extensive literature search was conducted on the taxonomy of the plant specimen collected and their ethnobotanical and conventional applications from the internet, research institutions, non-governmental organizations (NGOs), East Africa and the University of Nairobi herbaria libraries and laboratories.

The *Jatropha curcas* Linn.

Jatropha curcas Linn. is a flowering semi-evergreen shrub or small tree of Euphorbiaceae family (Figure 2). It reaches a height of 6 m. The plant is native to the American tropics (Mexico and Central America) but is cultivated in tropical and subtropical regions around the world, becoming naturalized in some areas. It is resistant to a high degree of aridity, allowing it to be grown in deserts. Contrary to this observation, the plant requires more water for its growth and development than it was thought before (Achten et al. 2007), (Achten et al. 2008) (Mogaka et al. 2014). The specific epithet, *"curcas"*, was first used by a Portuguese Doctor, Garcia de Orta

more than 400 years ago and is of uncertain origin. Common names include: Barbados nut, purging nut, physic nut, or JCL (an abbreviation of *Jatropha curcas* Linnaeus).

Figure 2. The aerial parts of *Jatropha curcas* Linn. with its mature fruits.

The medicinal and industrial values of *Jatropha curcas* Linn.

Traditionally, *Jatropha curcas* Linn. has shown several potentials in medical and industrial applications (Duke 1983) (Gübitz et al. 1999) (Openshaw 2000) (Prasad et al. 2012). The plant has a long curative history in many parts of the world as well as among several African countries like Gabon, Nigeria, Kenya, South Sudan and Ghana (Thomas et al. 2008) (Orwa et al. 2009) (Prasad et al. 2012) (Mogaka et al. 2014). Most parts of this plant are used for the treatment of a wide range of human and veterinary ailments. For instance, industrially, it is used for making soap, candles, a synthetic detergent, lubricants, softeners and dyeing assistants while, on the other hand, the plant is medically used as a contraceptive and for the treatment of a wide range of diseases like cancer, piles, snakebite, paralysis, dropsy, etc. (Duke 1983). Additionally, the boiled and roasted seeds are used as food, as this kind of treatment has been known to reduce the effect of plant poisoning (Maitai and Mungai 2005). However, this method is not exhaustive in removing poisonous compounds from target plants and should not be relied on to declare some plants safe for human consumption after treatment. Nevertheless, Bones (2012), the Biology Professor at Norwegian University of Science and Technology think otherwise and has

demonstrated that plants can be genetically programed to reduce the toxic substances they produce thus making them more palatable than ever before in a sustainable manner. Nonetheless, this option may not work well with countries, which have banned genetically modified organisms within their boundaries like France and Norway in Europe.

The eminence and value of *J. curcas* Linn. was strongly highlighted in 2004/2005, when the plant began to be viewed globally as a possible source of biofuel (Tomomatsu and Swallow 2007), (Fairless 2007), (Slingerland and Tjeuw 2014). The seeds contain 27-40% oil that can be processed to produce a high-quality biodiesel fuel, usable in a standard diesel engine.

(a) (b)

Figure 3. Fruits (a) and seeds (b) of *Jatropha curcas* Linn. Each inflorescence yields a bunch of approximately 10 or more ovoid fruits. A three, bi-valved cocci is formed after the seeds mature and the fleshy exocarp dries. The seeds become mature when the capsule changes from green to yellow, after 2 to 4 months (b). As retrieved from http://www.biodieselmagazine.com/articles/9008/sgb-confirms-genetic-diversity-of-jatropha-is-comparable-to-corn and http://www.reuk.co.uk/Jatropha-for-Biodiesel-Figures.htm, respectively on Saturday, May 14, 2016 at 6:58 PM East Africa Time.

Toxicity property of *Jatropha curcas* Linn.

Much like other members of the family Euphorbiaceae, members of the genus *Jatropha* contain several toxic compounds (Prasad et al. 2012). The seeds of *Jatropha curcas* contain highly poisonous toxalbumin curcin, a lectin dimer and carcinogenic phorbol (Anonymous 2008). Despite this, the seeds are occasionally eaten after roasting, which reduces some of the toxicity. Its sap is a skin irritant, and ingesting as few as three untreated seeds can be fatal to humans as they are the source of the highly poisonous toxalbumin curcin or jatrophin. In 2005, Western Australia banned *Jatropha gossypiifolia* as invasive and highly toxic to people and animals

(MacIntyre 2007). While, on the other hand, *Jatropha* oil is not suitable for human consumption, as it induces strong vomiting and diarrhea.

Comparative analysis and conclusion

Jatropha curcas is a unique plant, compared to a two-edged sharp sword, cutting in either direction! The toxicity property and the industrial/medical value of this plant is well documented in literature. Various parts of the plant have different phytochemical composition and some of which are highly poisonous like toxalbumin curcin and jatrophin found in seeds, which were consumed by the 18 children being reported in this case. The same seeds contain a lot of oil, which induces strong vomiting and diarrhea, the critical conditions in which the 18 children were admitted at St. Mary's Hospital Mumias for specialized treatment. Since previously, *J. curcas* had been praised for its several potentials in industrial application and medicinal values (Prasad et al., 2012), (Agbogidi et al. 2013), it follows with logical necessity that before exploiting any plant for any application, it is crucial to have an in-depth scientific evaluation of each part of the plant and advice accordingly (Prasad et al. 2012). If such knowledge could have existed amongst the people of Mumias, probably the 18 children would not have eaten the seeds of *J. Curcas* as early warning strategies would have been put in place.

Although cooking and roasting of poisonous plants to make them less poisonous and henceforth edible is a practice (Maitai and Mungai 2013), may not be a sustainable solution as such for not all active ingredients causing poisoning effect may become affected by heat. Probably genetic engineering may offer an everlasting solution to the problems of poisonous plants in the society when it is used to develop once inedible plants to become fit for human consumption and help solve world hunger problem (Bones 2012).

Reducing the risk of plant poisoning in your environment

As an effort towards reducing the risk of poisoning from plants in one's environment, the following steps are recommended as adopted from Dolan and Welch-Keesey (2016). These recommendations need to be observed all the time because there are about 250,000 plant species known in the world, but only 5,000 to 10,000 plant species are considered edible, the rest are considered as either poisonous or just inedible for humans (Bones 2012). From this database therefore, it follows with logical necessity that the unknown plant species, which are still in the

wild, pose the greatest risk in the society, particularly to children who, more often than not encounter them ignorantly in their respective environments while playing (Fančovičová and Prokop, 2011).

1. Keep all plants up off the floor and out of reach of children and pets.
2. Think about using fake instead of real flowers and plants if young children or pets live in or visit your home.
3. Store bulbs and seeds locked away, out of sight and reach of children.
4. Never eat any part of an unknown plant.
5. Teach children not to eat anything straight from a plant or bush.
6. Teach children to show all plants and berries to an adult before eating.
7. Never chew on jewelry, etc., made from plant material or allow children to do so.
8. Don't rely on cooking and/or roasting to destroy poisonous compounds in plants.
9. Remember that plants can also be a choking danger for children and pets.
10. Fence off or remove known poisonous or dangerous plants in your environment.
11. Keep the Poison Information Center phone number in your country near your phone or in the contact list of your mobile phone.

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