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HEALTH IMPLICATIONS OF CASSAVA PRODUCTION AND CONSUMPTION

AKINPELU, A.O. * L. E.F. AMAMGBO*, A.O. OLOJEDE,* A.S. OYEKALE**
***National Root Crops Research Institute, Umudike,**
Private Mail Bag 7006, Umuahia, Abia State
**** Department of Agricultural Economics, University of Ibadan, Ibadan, Oyo State**
Corresponding author's Email: *oladipo.akinpelu@nrcri.gov.ng*; *immadipo@yahoo.com*

ABSTRACT
The paper examined health issues on production and consumption of cassava. It was revealed that production of cassava is dominated by the use of cassava varieties that contain hydrogen cyanide (HCN) which if consumed without adequate fermentation may be toxic to human. Efforts should be intensified by research institutes to develop more cassava varieties that are low in hydrogen cyanide (HCN) especially in areas where cassava and its products were newly introduced. The use of agrochemicals on cassava farms should be approached with caution. Protective clothing and equipments such as gloves, overall, nose and eyes guards should be provided before applying agrochemicals. Farmers and stakeholders in cassava enterprise should be educated on the need to keep their environment and sources of water free from pathogen and disease causing organisms.

Key words: cassava, health, hydrogen cyanide, agrochemicals

INTRODUCTION

Agriculture produces the necessary food for the world's populations under both rainfed and irrigated conditions (Appelgren and Klohn, 2001). Agriculture is the activity most essential for human survival. It feeds people, produces basic commodities for society and provides gainful employment for the majority (Ojemade, 2007). Nigeria, like any other typical African country, is an agrarian economy in which agriculture and agro-allied enterprises are the most popular income-generating activities providing employment for up to 90% of the rural dwellers (World Bank, 1993).

Cassava (*Manihot esculenta* Crantz) has its origin in Latin America where it has been grown by the indigenous Indian population for at least 4000 years. After the discovery by the Americas, European traders took the crop to Africa as a potentially useful food crop; later it was also taken to Asia to be grown as a food security crop and for the extraction of starch. Okogbenin *et al* (2006) reported that cassava is native to tropical America and was introduced to Africa by the Portuguese in the sixteen century. It can compete with other, more valuable crops such as maize, soybean and vegetables mainly in areas of acid and low-fertility soils, and those with low or unpredictable rainfall. Cassava is found over a wide range of edaphic and climatic conditions between 30 ^{0}N and 30 ^{0}S latitude, growing in regions from sea level to 2300m altitude, mostly in areas considered marginal for other crops: low-fertility soils, annual rainfall from < 600mm in the semiarid tropics to >1500mm in the subhumid and humid tropics. It is a major source of carbohydrate and it is the third largest source of carbohydrate in the world with Africa being the largest centre of production (Alves,2002).

Nigeria is the largest producer of cassava in the world (FAO,2008) with about 45 million metric tonnes and its cassava transformation is the most advanced in Africa (Egesi *et al.*, 2006).Cassava is grown throughout the tropic and could be regarded as the most important root crop, in terms of area cultivated and total production (Ano,2003).It is a major food crop in Nigeria (Ogbe *et al.,* 2007).It is strategically valued for its role in food security, poverty alleviation and as a source of raw materials for agro-allied industries in Nigeria with huge potential for the export market (Egesi *et al.,* 2007). In urban areas, cassava consumption of poor households is double that of non-poor households. In rural areas, poor households consumption of cassava is triple that of non-poor households. When dried, cassava is both conservable and transportable over long distances.

Cassava (*Manihot esculenta Crantz*) can be a powerful poverty fighter in Africa. The cash income from cassava proves more egalitarian than the other major staples because of cassava's low cash input cost (Nweke, 2004). According to Egesi *et al* (2006), cassava has in recent years transformed from famine reserve commodity and rural staple to a cash crop in Africa. It is a very important crop in Nigeria deriving from the extensive use of the various products and by-products as staples to most Nigerians. The consumption of cassava cuts across all parts of the country. Its adaptability to climatic and soil conditions even in marginal soils has endeared cassava to most people that have to do continuous cultivation on limited available land. The general acceptance of cassava and its products to all classes of Nigerians on its own draws close attention to the producers of cassava (Olanrewaju *et al.,* 2009).

Fuglie (2002) reported that cassava is a competitive crop, especially for the production of starch and animal feed. The use of cassava from 1993-2020 is predicted to increase by around 1.74 per cent per annum in Africa region. This implies that there is room to expand production. Moreover, improvements in quality, processing, and product marketing could increase the value of cassava products by about 20 per cent (Harshey *et al*., 2000).

Cassava is increasingly popular with farmers particularly in countries of tropical Africa simply because of its agricultural advantages and potential to feed rapidly increasing populations. Also households under stress from HIV/AIDS are switching from high-input to low-input farming systems that involve cassava (FAO, 2008). Cassava roots are rich in energy, containing mainly starch and soluble carbohydrates, but are poor in protein. It is estimated that people eat more than 60% of all cassava produced in Africa, with about a third of the harvest being fed to animals and the rest transformed into secondary products. Although raw cassava is occasionally consumed in the Congo region, Tanzania and West Africa, this is relatively rare (Scott *et al*, 2000).

According to Kenyon *et al* (2006), a wide range of products can be processed from cassava as demonstrated by data from the Collaborative Study of Cassava in Africa (COSCA). The fresh peeled tubers are eaten as a vegetable after boiling or roasting. Boiled and pounded into a paste, the tubers are often added to soups and stews ("Fufu" in Nigeria). Because the fresh tubers deteriorate rapidly once they are harvested (post-harvest physiological deterioration; PPD), they are often preserved as sundried chips ("Kokonte" in West Africa) and consumed after cooking or being ground into a flour.

Apart from the processing of cassava into foods, the crop can also be processed into chips for animal feed and into starch for many food and non-food uses. Cassava flour is used in the preparation of bread, biscuits, confectionary, pasta and couscous-like products and in the production of adhesives. Cassava starch is used in the foodstuff, textile and paper industries, and in the manufacture of plywood and veneer adhesives and glucose and dextrin syrups. Through fermentation, it can also be used for alcohol production, and as a waste material it can be processed to biogas (Kenyon *et al*., 2006). The overall objective of the study was to identify the various health issues associated with the production, consumption and utilization of cassava and its products.

Health and cassava production

The process of agricultural production and the output it generates can contribute to both good and poor health among the producers as well as the entire society. Being an agricultural producer is a determinant of health relative to income and labour (Corinna and Ruel, 2006). Labour equally predisposes producers to a range of occupational hazards including accidents, strains, diseases and poisoning. Studies (Schultz, 1999;Strauss and Thomas, 1998) showed that there is a positive relationship between health and productivity of skilled and unskilled labour. Good health as related to labour output or better production organization can enhance farmer's/ household income and economic growth. Stakeholders in farming with good health generally have better intellectual capacities

The importance of health as a form of human capital cannot be under estimated. Good health and productive agriculture are important in the economy of any nation especially in the fight against poverty. Health enhances work effectiveness and the productivity of an individual through increase in physical and mental capacities. Health affects agricultural system by affecting the health of the producers. Poor health will result in loss of work days or decrease worker capacity, decrease innovation ability and ability to explore diverse farming practices and by such makes farmers to capitalize on farm specific knowledge (Ajani and Ugwu, 2008). They concluded that health has a greater share in the inefficiency of the farmers and calls for attention of policy makers in Nigeria.

Although the practice of agriculture is essential for human health, careless and inappropriate agricultural practices can degrade and contaminate natural resources and in so doing, harm human health (Nugent and Drescher 2006). Health, wellness and economic growth are important in the overall development of a people. A state of health is said to exist when there is perfect harmony between humans and their environment (Mafimisebi and Oguntade, 2010). Amidst the alarming report of effects of diseases on farmers, Nigerian subsistent farmers spend as much as 13 per cent of total household expenditure on treatment of malaria alone. This gives enough evidence that the cost of combating diseases and health problems by the farmers are quite enormous, considering the frequency and prevalence of diseases among the Nigerian farmers (Ajani and Ugwu, 2008).

Ugwu (2006) reported estimated economic cost- both direct and opportunity cost – of a farmer becoming sick once to be ₦22,225.53. Adewale *et al* (1997) valued the opportunity cost of guinea worm infection on a farmer at ₦9,566.00 .This is potential cocoa output lost due to ineffective supervision of farms occasioned by ill health. A farmer loses on the average 22 working days when incapacitated by one sickness or the other per time (Ugwu, 2006; Ashagidigbi, 2004). This finding was corroborated by Rwaheru (2011) who reported that the most common ailment affecting the farmers in Uganda is malaria which has been reported as leading to drastic reduction in agricultural productivity. The study found out that malaria incidence and number of days lost to malaria illness at household level had a negative and significant effect on agricultural crop production.

The study revealed that agricultural production of the households that were negatively affected by malaria illness had 23.7 percent less agricultural output than those who did not report any malaria incidence. The study further indicated that loss in household agricultural crop production as a result of malaria illness was 71.62 kilograms and 110.94 kilograms when number of days lost to malaria illness was considered. The effect of malaria on agricultural production has generally been attributed to malaria's effect on labor availability through number of days lost due to malaria attacks (Rwaheru, 2011).

The health impacts of agricultural chemicals (pre and post emergence herbicides, insecticides, pesticides, etc) used in cassava production are a function of their degree of accumulation in environmental sinks—soil, air, water, plants—and the degree to and form in which humans are exposed to them. It has been estimated, for example, that only 0.1 percent of pesticides actually reaches pests, while the remainder stays in the environment or on food. Overuse of pesticides is also related to declining biodiversity, such as of pollinating bees. Though difficult to measure, both processes have health implications. Much more measurable are the acute effects on agricultural workers using pesticides: millions suffer ill-health effects of pesticides every year, especially in developing countries. Direct and indirect exposure to agricultural chemicals has been linked to intestinal, respiratory, gastrointestinal, neurological, reproductive, and endocrine disorders, as well as cancers and poisoning (Nugent and Drescher, 2006).

Health and cassava consumption

All cassava organs, except seeds, contain Cyanogenic Glucosides (CG). Cultivars with < 100 mg kg $^{-}$1 fresh weight (FW) are called 'sweet' while cultivars with 100-500 mg kg^{-}1 are 'bitter' cassava (Wheatley *et al.*, 1993). Total Cyanogenic Glucosides concentration depends on cultivar, environmental condition, cultural practices and plant age (McMahon *et al.*, 1995). Cassava roots contain the glycoside linamarin which is converted into hydrogen cyanide (HCN) by the enzyme linamarinase. HCN is toxic to man and hence much of the processing of cassava tubers is to promote release and removal of the HCN prior to consumption. Fermentation is an effective means of removing HCN and in West Africa the principal form in which cassava is eaten is as a fermented meal known as "Gari" (Kenyon *et al*., 2006).

Naturally occurring acyanogenic cassava has never been observed (Bradbury and Holloway, 1988). Since linamarin is bitter (King and Bradbury, 1995), high-cyanide cassava roots containing >100ppm cyanide are normally bitter and are called bitter cassava. One such variety in Nigeria is called 'chop and die'. It is difficult to understand how cassava can be promoted without giving proper consideration to the fact that it contains a cyanogen (linamarin) that liberates poisonous cyanide in the body (Madamombe, 2006). When linamarin is hydrolysed, it releases hydro cyanide, a volatile poison (Cooke and Coursey, 1981); but some cyanide can be detoxified by the human body (Oke, 1983).

In some varieties of cassava the interior of the roots (parenchyma) contains only a small amount of cyanide. This is called sweet cassava, which may be boiled and eaten, as is normal in the South Pacific (Bradbury and Holloway, 1988). However, Cardoso *et al*, 2005 reported that in Amazonia (the original source of cassava) and in Africa different varieties have a range of total cyanide contents in the parenchyma from very low to very high (1–1550 ppm). Cardoso *et al.*, 2005 and Siritunga *et al* 2004 in separate studies reported that linamarin is present in large amounts in the leaves and the peel of cassava roots (900–2000mg HCN kg^{-1} fresh weight) and the leaves also contain a second enzyme called hydroxynitrile lyase, which catalyses the hydrolysis of acetone cyanohydrin to produce HCN and acetone.

Cyanogenesis is initiated in cassava when the plant tissue is damaged. Rupture of the vacuole releases linamarin, which is hydrolyzed by linamarase, a cell wall-associated -glycosidase (McMahon *et al*., 1995). The linamarin content of cassava flour was reported to be more than double during drought (Cardoso *et al.*, 2005; Ernesto *et al.*, 2002),which leads to outbreaks of konzo; most recently there were more than 100 cases in Nampula and Zambezia Provinces due to drought in 2005 (Muquingue *et al.*, 2005). Consumption of cassava and cassava products containing large amounts of cyanide can cause acute intoxication, with symptoms of dizziness, headache, nausea, vomiting, stomach pains, diarrhoea and sometimes death (Mlingi *et al.*, 1992). Since the lethal dose of cyanide is proportional to body weight, children tend to be more susceptible to outright poisoning than adults. In regions where there is iodine deficiency, which causes goitre and cretinism, cyanide intake from cassava exacerbates these conditions (Delange *et al.*, 1994).

Ihedioha and Chineme 2003 in their work suggested that shortening the fermentation period of cassava mash to about 24 hours constitutes a health hazard to consumers of gari. Various health disorders are associated with the consumption of cassava, which contains residual cyanogens. These disorders include hyperthyroidism, tropical ataxic neuropathy, and konzo (Osuntokun, 1981). When cassava is eaten, most of the ingested cyanide is converted into thiocyanate, a reaction catalysed by the enzyme Rhodanese, which uses up part of the pool of S-containing essential amino acids methionine and cysteine/cystine (Osuntokun, 1981; Westly, 1988; Cardoso *et al.*, 2004). These amino acids are essential in the diet because they can only be obtained from the food consumed. A shortfall of these S-containing amino acids would limit protein synthesis and could cause stunting of growing children, as was found in a study of children in DRC (Cardoso *et al.*, 2004).

A study made in Nampula Province in Mozambique showed that an estimated maximum cassava flour intake of children in an area prone to konzo was 700–900 g fresh flour per child per day and in a non-konzo area was 20–140 g fresh flour per child per day (Cardoso *et al.*, 2004). It is important that the introduction of cassava into new regions is accompanied by efforts to educate the people in correct methods of processing of cassava to remove cyanogens, rather than simply ignoring the dangerous aspects of this crop (Madamombe, 2006). It is likely that the high rate of population increase in these tropical African countries is a major cause of increased cassava production, which highlights the need for proper health safeguards against cyanide diseases.

CONCLUSION AND RECOMMENDATIONS

The paper examined health issues on production, and consumption of cassava. It was revealed that production of cassava is dominated by the use of cassava varieties that contain hydrogen cyanide which if consumed without adequate fermentation may be toxic to human. Efforts should be intensified by research institutes to develop more cassava varieties that are low in hydrogen cyanide (HCN).

The use of agrochemicals on cassava farms should be approached with caution. Agricultural workers using agrochemicals should be well educated and guided on dangers inherent in abuse of such chemicals. Protective clothing and equipments such as gloves, overall, nose and eyes guards should be provided before applying agrochemicals. These equipments should be kept properly after each chemical application.

Awareness should be created on the need for farmers and other stakeholders in cassava production to ensure proper fermentation of harvested cassava before utilization especially in areas where cassava and its products were newly introduced. Farmers and stakeholders in cassava enterprise should be educated on the need to keep their environment and sources of water free from pathogen and disease causing organisms.

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