ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014

Effect of Drying on Some Anti-Nutritional Factors Present In Bitter Cassava (Manihot Utilisima) and Sweet Cassava (Manihot Palmata)

Amira, P. Olaniyi; Daramola, A. Success and Atolani, S. Temitope
Department of Science Technology
Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria.

***Abstract:** Raw and dried Bitter cassava (Manihot utilisima) and Sweet cassava (Manihot palmata) were analyzed for the effect of drying (a method of cassava processing) on the content of some anti-nutritional factors. The raw bitter cassava was found to contain Saponin: 730mg/kg Oxalate: 49mg/kg, Phytate: 12,320mg/kg, cyanide: 14,300mg/kg while the dried bitter cassava had Saponin: 630mg/kg Oxalate: 32mg/kg, Phytate: 8,770mg/kg and Cyanide: 9140mg/kg. The raw sweet cassava was found to contain Saponin: 21mg/kg, Oxalate: 76mg/kg, Phytate: 7930mg/kg and Cyanide: 77mg/kg while the dried sweet cassava had Saponin: 12mg/kg, Oxalate: 41mg/kg, Phytate: 5220mg/kg and Cyanide: 33mg/kg. Consequently, drying as a method of processing of cassava significantly reduced the level of the various anti-nutrients studied.*

Key words: Manihot utilisima, Manihot palmata, Saponin, Oxalate, Phytate, Cyanide.

I. INTRODUCTION

Cassava, also known as "Manioc or tapioca root" is a dicotyledonous plant, 1-3 meter in height when fully grown. It belongs to the family *Euphorbiaceae* and the genus *Manihot esculenta* represents a whole complex of cultivars of cassava that taxonomy have from time to time tried to separate into distinct species with only little success. Thus *Manihot utilisima* (bitter cassava), Manihot *dulcis*, *Manihot palmate* (Sweet cassava) and other proposed species are generally regarded as synonyms of *Manihot esculenta* (1).

Cassava plant probably originated in Brazil, which is regarded as the leading world producer closely followed by Indonesia (2). The world production of cassava is over 136 million tons and cassava is in sixth place after wheat, maize, rice, potatoes and barley. It is widely spread throughout tropical Africa, Asia and South America being particularly important in Nigeria, Brazil, Zaire, Indonesia and Thailand. It is about 9.6 million tons per hectare which is less than the value for sweet potatoes and yams but greater than for cocoyams (3).

Cassava is propagated from stem cuttings and requires weeding until a canopy is established. Each plant produce elongated irregularly arranged roots, which are usually longer and thicker in the sweet varieties. The root mature in 10-14 months and may be harvested when required after maturation.

The poor storage quality of cassava presents a major problem. As a consequence, in some parts of Nigeria cassava roots are sectioned, dried in the sun and ground into flour and used for paste preparation which is usually eaten with soups or sauces. The flour may also be mixed with flour from cereals or legumes and then used to produce a paste called 'danwake' in Hausa (4). Alcoholic drinks can also be made by fermentation of cassava roots. Cassava root is a source of industrial starch used in laundry and in manufacture of gums and adhesive. It is also used in preparation of pharmaceutical and in production of alcohol (5).

The tubers of some cassava plants especially the bitter varieties are poisonous and must be washed well and boiled for a long time to remove the poison which is hydrogen cyanide and also by the actions of enzymes on linamarin and lotaustralin (cyanogenic glycosides) (6).

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014

The young leaves of bitter cassava are also used as vegetable greens and they are more wholesome than the root since they contain high amounts of protein (7). The leaves are also valuable food for livestock, particularly goats.

A major factor limiting the wider food use of many tropical plants (including bitter cassava) or also making the processing lengthen before fit for eating is the ubiquitous occurrence in them of a diverse range of natural compounds capable of precipitating deleterious effects in man and animals. Manifestation of toxicity range from source reduction in food intake and nutrients utilization to profound neurological effects and death. Compounds which act to reduce nutrient and/or food intake are often referred to as anti-nutritional factors (ANF) (8).

The medical implication of plants have been highly researched and it has been proven to result from active principles such as saponins, glycosides, acid phenols, toxins, amino acids etc. These agents have been implicated to have anti-microbial activities (9, 10).

Although toxic compounds are widely distributed in the plant kingdom, it is generally considered that tropical legumes contain a more complex array of these substances followed by cassava than other crops species. The presences of these anti-nutritional factors constitute a major setback, limiting the nutritional and food qualities of plant because they are known to exert a deleterious effect when ingested by man or animal without adequate processing (11). The level of deleterious substance in tropical cassava vary with the species of plants, cultivar, and post-harvest treatment such as crushing/grounding, soaking processing in which is lost large quantity of moisture content with reduction in anti-nutrients and drying (8).

Saponins are steroid or terpenoid glycoside often referred to as 'natural detergents'. These are a group that are now classified as subgroup of the glucosides and are characterized by their bitter and astringent taste, foaming properties and their hemolytic effect on the red blood cells. They are widely distributed in the plant kingdom being found in over five hundred genera (12). Saponin have been shown to possess both beneficial (cholesterol lowering, inhibition of cancer cells, energy booster, antibiotics) and deleterious properties (13). And among plants grown for food, the presence of saponin in cassava is important.

Oxalate, a C_2 dicarboxylic acid anion is produced and accumulated in many crop plants and pasture weeds. Oxalate may be present in plants as the soluble salts of potassium, sodium or ammonium oxalic acid or as insoluble calcium oxalate. They possess inhibitory effect on digestion. Oxalate affect calcium and magnesium metabolism (14) and react with proteins to form complexes, thus presenting an inhibitory action on peptic digestion (15).

Phytic acid, a hexaphosphate derivative of inositol is an important storage form of phosphorous in plants. It is insoluble and cannot be absorbed in the human intestine. Phytic acid has 12 replaceable hydrogen atoms with which it could form soluble salts with metals such as calcium, iron, zinc and magnesium. Phytate can also inhibit digestibility by chelating with calcium binding with substrate or proteolytic enzyme (8).

Glycosides are a group of compound sometimes referred to as glucoside when the basic organic component is glucose. Glycosides vary considerably in their chemical composition but have in common the production of a sugar and other substrate known as genin or a glycone or enzyme on acid hydrolysis. Some glycosides following enzyme hydrolysis, produce hydrocyanic acid and are known as cyanogenic glycosides. Cyanogenic glycosides are a group of O-glycosides formed from decarboxylated amino acids (the group arises from α-carbon atom and the amino group). The high content of cyanides in bitter cassava want to lower its usefulness, but apparently prior mechanical elimination of liquid content coupled with a heat or hot water treatment during processing is adequate for detoxifying cassava beverage products (8).

In this study, results are presented to show that drying of bitter cassava (*Manihot utilisima)* and sweet cassava (*Manihot palmata)* can significantly reduce the amounts of some anti-nutritional factors.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014

II. MATERIALS AND METHODS

Tubers of bitter cassava *(Manihot utilisima)* and sweet cassava *(Manihot palmata)* were uprooted from a farm at Erinfun, Ado Ekiti, Ekiti State, Nigeria and the identity authenticated at the soil and crops unit of the Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria.

Saponin content of both the raw and dried forms of bitter cassava were determined using filtration and crystallization methods (16) Determination of oxalate content was accomplished using both filtration and titration methods while the phytate contents of both the raw and dried cassava were determined using filtration and titration methods (17). Total cyanide was determined by distillation, condensation and titration methods (18).

III. RESULTS

Table 1 shows the concentrations of saponin, oxalate, phytate and cyanide as determined for the raw and dried bitter and sweet cassava.

Table 1: Concentrations of Saponin, Oxalate, Phytate and Cyanide of Raw and Dried Bitter and Sweet Cassava.

SAMPLE	SAPONIN (mg/kg)	OXALATE (mg/kg)	PHYTATE (mg/kg)	CYANIDE (mg/kg)
Raw Bitter Cassava	730.00	49.00	12,320.00	14,300.00
Dried Bitter Cassava	630.00	32.00	8,770.00	9,140.00
Raw Sweet Cassava	21.00	76.00	7930.00	77.00
Dried Sweet Cassava	12.00	41.00	5220.00	33.00

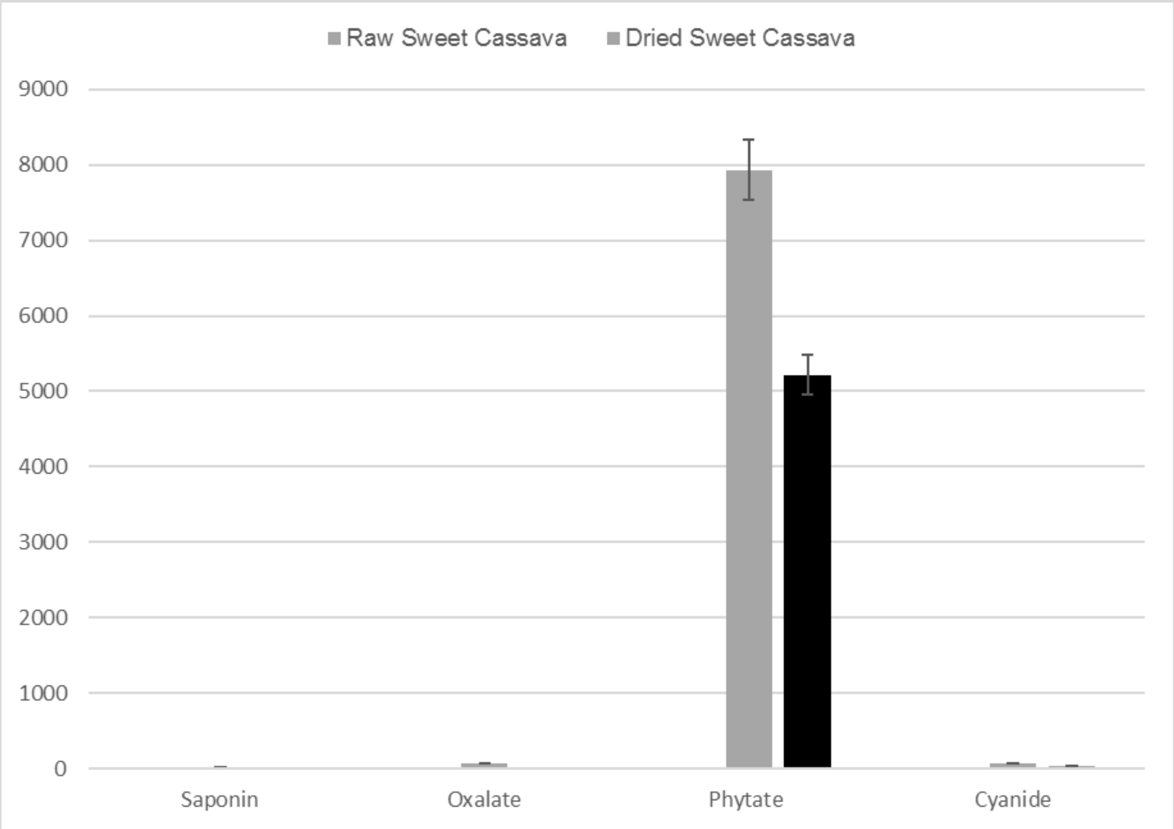

Fig. 1: Concentrations of Saponin, Oxalate, Phytate and Cyanide of Raw and Dried Bitter Cassava.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014

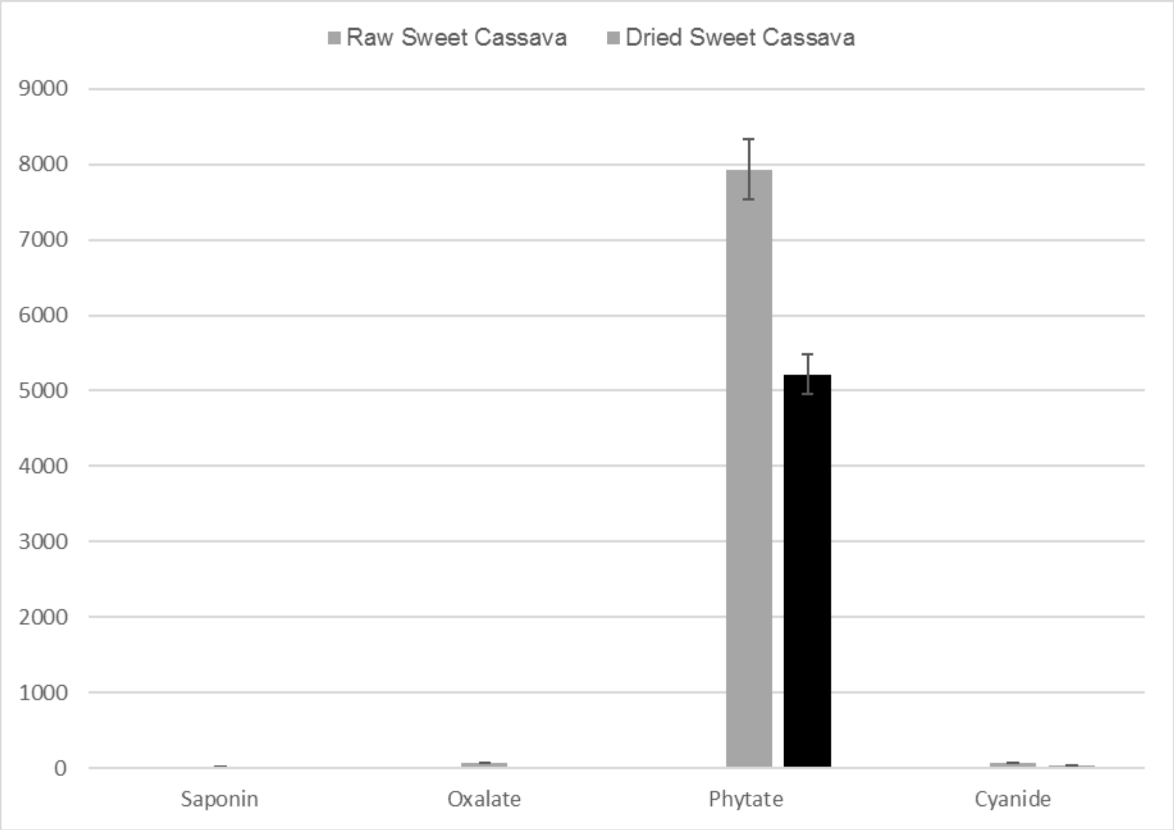

Fig. 2: Concentrations of Saponin, Oxalate, Phytate and Cyanide of Raw and Dried Sweet Cassava.

IV. DISCUSSION

The values of the studied anti-nutrients obtained for dried bitter and cassava are generally lower than those obtained for the raw samples. This is as a result of the post-harvest treatment into which the cassava was subjected (i.e. grinding and drying) and this is in agreement with the claims of Osagie (8). However the concentrations of the anti-nutrients studied in the bitter varieties are much higher than those of the sweet varieties in both raw and dried samples.

In all the cases studied, the values of phytate and cyanide are higher than those of the saponin and oxalate, thus making bitter cassava a source of phytate which can inhibit digestibility of food materials by chelating calcium binding with substrate or proteolytic enzyme (8) and cyanogenic glycosides which yields poisonous hydrocyanic acid following enzyme hydrolysis. However, as revealed by the lower values of these anti-nutrients in dried samples, elimination of liquid content or heat/hot water treatment during processing is adequate for detoxifying cassava food (8).

V. CONCLUSION

This study has established the presence of anti-nutritional factors in cassava species, the concentration of these anti-nutrients being higher in bitter cassava than in sweet cassava. These anti-nutrients are reduced with loss of moisture content caused by drying which is a common method of cassava processing in Nigeria.

It is recommended that cassava be properly processed through methods such as fermentation, pressing, frying, cooking or drying in order to further reduce the amounts of anti-nutrients in the foodstuff.

REFERENCES

[1] Janick, T. (1974): Medical Importance of Saponin, American Journal of Anti-nutrients, 62; 19-22.

[2] Onwueme, I.C. (1978): The tropical tuber crops: yams, cassava, sweet potato, cocoyams, Chichester, England: Wiley Publishers.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 3, Issue 4, July 2014
[3] Afolabi, O.O, Oshuntogun, B.A, Adewusi, S.R, Fapojuwo, O.O., Ayorinde, F.O., Grissom, F.E. and Oke, O.L.(1985): Preliminary nutritional and chemical evaluation of raw seeds from Mucuna solanei. An underutilized food source. Journal of Agriculture Food Chemistry, 33: 122-124.

[4] Eka, O.U. and Hobbs, T. (1979): Studies on Levels of Cyanide and Polytate in Shrub Trees. Appl. Chemistry, 28; 96-99.

[5] Norman, H and Tang. S. (1984): Effects of Saponins, Phytate and Oxalate in Nutrition. Biotechnol Environ. 3; 207-208.16.Anthony, Z.T. (1998): India Medical Plants, Bishen Single Mahendrapal Singh, Deharadun; 15-16.

[6] Anthony, Z.T. (1998): India Medical Plants, Bishen Single Mahendrapal Singh, Deharadun; 15-16.

[7] Eka, O.U. (1979): Studies on Levels of Oxalic Acid and Phytic Acid in Traditional Food of Northern Nigeria. W. AF. Journal Biol and Appl. Chems. 20: 81-87.

[8] Osagie, A.U. (1998): Some Anti-nutritional Constituents in Ten Staple Food Items Grown in Nigeria. Trop. Sc. (U.K) 36; 109-112.

[9] Sofowora, A. (1987): Medicinal Plants and Traditional Potential Medicine in West Africa (1st Edition) John Wiley and Sons, London; 5-12.

[10] Asakawa, Y. (1990): Biologically Active Substances from bryophytes. In: Bryophyte Development: Physiology and Biochemistry, R.N. Chopra, S.C. Bhatla(Eds), 259-287, CRC Press, Boca Raton.

[11] Ogun, P.O.; Markakis, P. and Weth, W. (1989): Effect of Processing on Certain Anti-nutrients in Cowpea (Vigna unguiculata) J. fd Sc. 54; 1084-1085.

[12] Mahato, S.B. and Nand, A.K. (1991): Triterpenoid Saponin Discovered with Gossypol, Arch Biochem. Biophys. 84; 486-489.

[13] Osakenful, D. and Sidhu, A.S. (1989): Saponins in “Toxicants of Plants Origin” Vol. 11, Acad. Press, N.Y 78-113.

[14] Oke, O.L. (1968): Chemical Changes in Some Nigerian Vegetable during Growth, Euplt. Agric.: 345-346.

[15] Oboh, S.A. and Tenic, O. (1986): Some Aspects of the Biochemistry and Nutritional Value of the Sweet Potato (Ipomea batatas). Ed. Chem. 31; 9-12.

[16] Harringer, L. (1994): Nutrient and Minerals in Cowpea and Pigeon Pea: A Review, Food Chem., 15: 2719.

[17] Young, W. (1936): Manihot Esculenta (Cassava) Cyanogenic, Ultra structure and Seed Germination, Munksguard Press, Copenhagen, Denmark, 2; 93-114.

[18] AOAC (2005): Official Methods of Analysis. 26th Edition. Association of Official Analytical Chemists, Washington DC, USA.