Journal of Anatomical Sciences

Email:anatomicaljournal@gmail.com

J Anat Sci 10 (2)

Correlation Between Carcinogens Found in Local Foodstuff Cassava and the Development of Cancer in Eastern Nigeria: Afara Village Umuahia in Abia State as Case Study

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ABSTRACT
Cassava is a root vegetable widely consumed in developing countries. It provides some important nutrients and resistant starch, which may have health benefits. Cassava can have dangerous effects too, especially if it is eaten raw and in large quantities. Of immense significance is the presence of cyanogenic glycosides linamarine and lotaustralin in cassava which may lead to cancer if consumed in large quantities over a long period. The effect of these cyanogenic compounds were examined within Afara community in Umuahia north local government area of Abia state where cassava is cultivated in large proportions and serves as the major staple food of the community. The study was done in order to determine if there was a correlation between consumption of cassava and the development of cancer within the community. A total of 836 members in 105 homes visited for the study were profiled. Of these, males were 311in number comprising 37.20% of the population while females were 525 or 62.79% of the population. A total number of 169 persons or 20.21% of the study population were children and infants between the ages of 0 to 10 years, 112 individuals or 13.39% were aged between 11 and 20 years, 108 or 12.91% were between 21 and 30 years old, 193 or 23.09% were aged from 31 to 40 years old, 137 persons or 16.39% were aged between 41 and 50 years while a total of 117 members of the study population or 14.00% were over 50 years of age. A total of 629 persons or about 75.24%of the study population currently resided within the community while 207 former residents or 24.76% were said to have migrated to places outside the community, but had resided for at least 10 years and above in the community before migration. 23 cases of cancer afflictions were recorded within the community giving a total percentage of 2.75% of afflicted community members. Mortalities recorded were 14 while cancer survivors in the community were 9 in number, thus giving a mortality: survival ratio of 1.6:1 for the community.

Key words: Cassava, Cyanogenic glycosides, Linamarine, Lotaustralin

INTRODUCTION
Afara village is a known village or semi-town that lies in the northwest part of Umuahia town, the capital of Abia state, a state in the Eastern part of Nigeria and tha villagers are known to be farmers who locally produce most of their daily consumed foodstuffs. They also engage in petty trading while some of their young ones are known to have migrated to other parts of Nigeria and the world in search of greener pastures.

The community is known to indulge more on cassava farming as cassava serves as the staple food consumed predominantly in the community, alongside other foods like yam, maize and cocoyam. Cassava is a root vegetable widely consumed in developing countries[4]. The most commonly consumed part of cassava is the root, which is very versatile. It can be eaten whole, grated or ground into flour to make bread and crackers. Also cassava root is well known as the raw material that is used to produce tapioca and garri, a product similar to tapioca[4].
The cassava is processed into various edible forms such as fufu, garri, tapioca commonly known as abacha in local parlance. While the fufu and garri are eaten with soups, garri can also be soaked in water and drunk directly. The tapioca or abacha is a local delicacy usually served to guests during festivals or ceremonies such as weddings, child-dedications, chieftancy ceremonies, house-warming parties or burials.

Either way, cassava serves as the major staple food consumed by the community for most of the seasons. It provides some important nutrients and resistant starch, which may have health benefits. Cassava however is often dangerous when consumed raw especially in large amounts or when it is improperly prepared [9, 12]. This is because raw cassava contains chemicals called cyanogenic glycosides[2], which can release cyanide in the body when consumed. Of particular concern are the cyanogenic glycosides of cassava called linamarine[5] and lotaustralin[9], which upon hydrolysis, release hydrocyanic acid HCN[1,12]. When eaten frequently, these increase the risk of cyanide poisoning, which impairs thyroid and nerve function.[1] It is also associated with paralysis and organ damage, and can be fatal[6]. Those who have an overall poor nutrition status and low

protein intake are more likely to experience these effects, since protein helps rid the body of cyanide. This is why cyanide poisoning from cassava is a greater concern for those who live in developing countries[6]. Many people in these countries suffer from protein deficiencies and depend on cassava as a major source of calories.

Excess cyanide residue from improper preparation is known to cause acute cyanide intoxication, and goiters, [3, 9] and has been linked to ataxia (a neurological disorder affecting the ability to walk, also known as konzo)[21]. It has also been linked to tropical calcific pancreatitis in humans.[7] leading to chronic pancreatitis.[17] The presence of cyanide in cassava is of great concern for human and for animal consumption and the concentration of these anti-nutritional and unsafe glycosides varies considerably between varieties and also with climatic and cultural conditions[6,20]. Selection of cassava species to be grown, therefore, is quite important and once harvested, bitter cassava must be treated and prepared properly prior to human or animal consumption, while sweet cassava can be used after simple boiling.

Again in some areas of the world, cassava has been shown to absorb harmful chemicals from the soil, such as arsenic, cyanide and cadmium.[27, 28] This may increase the risk of cancer in those who depend on cassava as a staple food, thus cassava is not a food that needs to be a regular part of daily diet unless it is prepared properly and eaten in reasonable portions.
The aim of this study was to find out if the heavy consumption of cassava and its by-products in the community had predisposed the villagers to developing carcinomas secondarily to consumption of carcinogens contained in cassava.[30,31]

MATERIALS AND METHODS

The study was a retrospective one that entailed the collection of data from members of the community. Information collected spanned a period of 10 years and about 105 homes were visited and members of the households questioned retrospectively to determine the health, family and social status of each individual members, both living, dead, currently residing or formerly residing or recently relocated, but who resided in the village for a minimum of 10 years before departing from the village.

Nutritional and toxicological values of raw cassava obtained from the community were also determined using the AOAC methods with modifications[11, 15] while cyanide content was determined using the picric acid method of spectrophotometric determination.[16]

RESULTS

Raw cassava measuring 100g in weight comprised of 60% water, 38% carbohydrates, 1% protein, and had negligible fat. In a 100 gram amount, raw cassava provided 160 calories of energy and contained 25% of the Daily value amount (DV) for vitamin C, but otherwise had no micronutrients in significant content. The cooked cassava starch had a digestibility value of over 75%. A 100g serving of boiled cassava root contained 112 calories and 98% of these were from carbohydrates while the rest came from a small amount of protein and fat. This serving also provided fiber, as well as a few vitamins and minerals.

Boiled cassava root also contained small amounts of iron, vitamin C and niacin. Some of the important anti-nutrients found in the cassava samples included Saponins, which are antioxidants that have negative effects such as causing reduced absorption of some vitamins and minerals; Phytate, an anti-nutrient that sometimes interfere with the absorption of magnesium, calcium, iron and zinc; Tannins, known for reducing protein's digestibility and interfering with the absorption of iron, zinc, copper and thiamine; as well as Cyanogenic Glycosides Linamarine And Lotaustralin known to be carcinogenic.

A total of 836 members of the 105 homes visited for the study were accounted for. Of these, males comprised of 311 or 37.20% of the population while females were 525 or 62.79% [Table 1].

A total of 169 persons or 20.21% of the study population were infants and children aged between 0 to 10 years; 112 persons or 13.39% were aged between 11 and 20 years; 108 or 12.91% were between 21 and 30 years old; 193 or 23.09% were aged between 31 to 40 years old; 137 persons or 16.39% were aged between 41 and 50 years while a total of 117 members of the study population or 14.00% were over 50 years of age [Table 2].

A total of 629 persons or about 75.24% currently resided still in the community while 207 former residents or 24.76% were said to have migrated to other places but had spent at least 10 years and above in the community before migration [Table 3].

Proper interrogation and detailed information elicited showed that the cancer cases recorded in the community thus far included breast, prostate, liver, cervical cancers, retinoblastoma, nephroblastoma, leukemia, osteosarcoma and a case suspected to be colorectal carcinoma but which was recorded as others due to insufficient knowledge of the informant. The distribution chart of the malignances is illustrated in Table 4.

The total number of cancer cases recorded in the community over the 10 year period of the study was 23 cases, giving a total percentage of 2.75% of afflicted members. Mortalities recorded were 14 while cancer survivors in the community were 9 in number, giving a mortality : survival ratio of 1.6:1 for the community.

Table 1: Sex Distribution of villagers

Sex	Male	Female
Number of respondents	311	525
Percentage distribution	37.21%	62.79%

Table 2: Age Distribution of villagers

Age (Years)	0 - 10	11 - 20	21 -30	31 -40	41 -50	>50
Number of respondents	169	112	108	193	137	117
Percentage distribution	20.21%	13.39%	12.91%	23.09%	16.39%	14.00%

Table 3: Residency Distribution of villagers

Total number of Residents in the village	Total no of Residents outside the village
629	207
75.24%	24.76%

Table 4: Types of cancers Encountered in the village

Type of cancers	No of Dead patients	No of Alive patients	Total
Breast cancer	3	2	5
Prostate cancer	2	2	4
Liver carcinoma	2	2	4
Cervical cancer	2	0	2
Retinoblastoma	1	2	3
Nephroblastoma	1	1	2
Leukemia	1	0	1
Osteosarcoma	1	0	1
Others	1	0	1
Total No of cases	14	9	23

DISCUSSION

Breast cancer was the malignancy with the highest number of cases within the community, with prostate and liver cancers being the second highest. All breast cancer patients were female with 3 mortalities and 2 cases of survivors. Most of affected members were related thus supporting the motion that genetics played a major role in its transmission rather than external factors like diet. The liver cancer patients were known alcoholics in the community, while prostate cancer occurred in 4 males all aged above 50 years, with 2 mortalities and 3 survivors.

The two cases of Nephroblastoma and three of Retinoblastoma were recorded within the age range of 0 – 10 years and both had one fatality each while two cases of retinoblastoma and one case of nephroblastoma survived after successful surgeries. Sporadic cases of leukemia, osteosarcoma (single case each) as well as a case suspected to be colo-rectal cancer were also recorded with all being fatal.

The incidence of cancer in the community was only 2.75% which was statistically insignificant at $P < 0.05$. Mortality ratio to survival ratio was 1.6:1 and statistical testing using ANOVA in comparison with known cancer occurring rates in other communities showed that the null hypothesis which stated that there was no correlation between consumption of cassava and the development of cancer, was true. The effects of anti-nutrients became pronounced when consumed frequently especially as part of a nutritionally unbalanced diet.[18]

CONCLUSION

From the above study, it was concluded that the occurrence of certain cancers in the community had no relationship with their heavy consumption of cassava but rather had genetic and other environmental causative factors such as alcohol abuse, exposure to charcoal from firewood, poor diet as well as other unknown causes.

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