academicJournals

Vol. 8(1), pp. 25-29, January 2014
DOI: 10.5897/AJFS2013.1093
ISSN 1996-0794 ©2014 Academic Journals
http://www.academicjournals.org/AJFS

African Journal of Food Science

Full Length Research Paper

Visual defects among consumers of processed cassava (gari)

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Accepted 12 December, 2013

The incidence and degree of visual defects was studied among 180 subjects (100 consumers and another 80 non consumers of gari at Zaria metropolis town). Visual acuity and color vision tests were accessed using the Snellen's chart and the Ishihara's chart, respectively. The visual acuity of consumers of gari showed a significant decrease (P<0.05) when compared with that of the non consumers of gari. The incidence of color blindness is higher in gari consumers than the non consumers. Visual defects are correlated to the frequency of eating gari, for how long gari has been eaten and age. The high prevalence of visual defects among the consumers of gari may be due to the exposure to unsafe amount of cyanide in gari that was consumed over a long period of time. This may consequently contribute to high prevalence of blindness and severe visual impairment especially among those aged ≥40 years.

Key words: Visual defect, visual aquity, gari, vision, cyanide, consumption, cassava, consumers, non consumer.

INTRODUCTION

Cassava or manioc (*Manihot esculenta Crantz*), a perennial shrub of the New World, currently is the sixth world food crop for more than 500 million people in tropical and sub-tropical Africa (El-Sharkawy, 2004). Insufficiently processed products from cassava roots may contain residual amounts of cyanogenic glucosides, mainly linamarin, which is hydrolysed in the intestinal tract of both men and animals by microbial flora and hydrogen cyanide (HCN), a toxic metabolite is released which sometimes causes death (Nhassico et al., 2008). Nigeria is the largest producer of cassava in the world. Its production is currently put at about 34 million metric tons a year (FAO/WHO, 1991). Presently, cassava is primarily produced for food especially in the form of gari, lafun and fufu (Padmaja, 1995). It is made by a series of operations such as grating, dewatering, fermenting and roasting. But the crop can be processed into several secondary products of industrial market value. These products include chips, pellets, flour, adhesives, alcohol and starch, which are vital raw materials in the livestock, feed, alcohol/ethanol, textile, confectionery, wood, food and soft drinks Industries. They are also tradable in the international market (Kormawa and Akoroda, 2003).

In Nigeria, and other regions of Africa where processed

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cassava is a main staple food, illnesses due to consuming smaller amounts of cyanide taken in over a long period of time can occur if cassava roots are not processed properly. Effects can include poor vision and hearing, paralysis of the legs and unsteady walking. Malnutrition can also occur when cassava is a major part of the diet because the plant is low in protein (Aregheore and Agunbiade, 1991). Despite all the effects, processed cassava in the form of gari is still a widely acceptable stable food in Nigeria. There is a high prevalence of blindness and severe visual impairment especially among those aged ≥40 years in Nigeria. It is estimated that 4.25 million adults in Nigeria aged > 40 or =40 years have moderate or severe visual impairment or blindness (<6/18 in the better eye) (Kwari et al., 2009). It was reported that tropical ataxic neuropathy (TAN) or similar degenerative neuropathies that causes poor vision occur in Nigeria mainly amongst older people who have consumed cyanide mainly from gari over many years (Oshuntokun, 1994; Nhassico et al., 2008).

The country is the world's largest producer of cassava and with a daily per capital consumption of 294 g which is twice that of Indonesia. Increased processed cassava (gari) consumption presents a problem because of the effects of the high amount of cyanogenic glucosides present in it (Nhassico et al., 2008). The World Health Organization safe level for cyanide in cassava flour is 10 ppm (10 parts per million or 10 mg per Kg) (FAO/WHO, 1991) The total cyanide content of gari is in the range of 0-40 ppm, with an average of 20 ppm (Oke, 1994; Aletor, 1993; Adindu et al., 2003) which is twice the WHO safe level of 10 ppm (FAO/WHO, 1991). Apart from uncorrected refractive errors, other major factors of high visual impairment prevalence rate especially among the aged includes hypertension, diabetes, macular degeneration, cataract and glaucoma (Kwari et al., 2009). The aim of this work was to determine: the visual acuity of consumers of gari (processed cassava) and colour vision of consumers of gari.

MATERIALS AND METHODS

Research design

Random sampling method was used (Mohamed et al., 2009). The research design for this study is a survey research design and subjects used are all adult between the ages of 18-56 years. Their consent was sought and the purpose and methodology was first explained clearly to them. The procedures followed were in accordance with the ethical standards of research process.

Research setting

This research project was carried out in Zaria metropolis. Higher institutions were strongly included because there is high gari consumption: they include Ahmadu Bello University, Zaria, Federal College of Education Zaria, Nuhu Bamalli Polytechnic, Zaria and Neighboring gari processing/consuming communities within Zaria (Sabon gari and Samara areas).

Zaria is in the boundary between soba in the east, Giwa in the west, Kudan in the north and Igabi in the South. The average daily temperature ranges between 29-35°C but these may change. Zaria has many tribe with Hausa and Fulani as dominant others includes Yoruba, Igbo, Nupe, Ebira, Tiv, and many more with various cultural and religious background.

Sample size

180 subjects divided into two groups: 100 for the experimental group (consumers of gari) with age range between 18-56 years. Another 80 subject as control group (non consumers of gari) with age range between 18-42 years. Therefore a total of 180 subject were used

Questionnaires

Questionnaires were designed to obtain personal information and history of the subjects including their ages, sex, occupation, medical condition, use of alcohol or drugs, frequency of consuming gari, etc. Their visual acuity and color vision test was recorded in the questionnaires. These were also introduced for collecting information

Snellen's letter chart, meter tape, weighing scale, digital sphygmomanometer: OMRON MX2 Basic, digital automatic blood pressure monitor, Ishiara's chart were used.

Data collection

The test for the control group and the experimental group was carried out in the conference halls, lecture theaters and class premises of Ahmadu Bello University, Zaria, Nuhu Bamalli Polytechnic Zaria, Federal College of Education, Zaria and premises within the neighboring communities, respectively.

Visual acuity test

For visual acuity test, the Snellen's letter chart was used. The subjects were positioned 6 m away from the chart which was measured using a meter tape. The eye not evaluated was occluded by the subjects. They were then instructed to read the letters from right to left and from the biggest letter up to the smallest letters downwards. The line was read and the result recorded in the subject's questionnaire (Drentlaw, 2011). For a visual acuity of 6/6, the first number represents the test distance, 6 m. The second number represents the distance that the average normal eye can see the letters on a certain line of the eye chart. So, 6/6 means that the eye being tested can read a certain size letter that a normal eye can read at 6 m when it is 6 m away from the subject (Wendy, 2003).

Test for color vision

The Ishihara's chart was used to test for color blindness in the subjects. The subjects were given the charts and were asked to trace the dotted patterns and also asked if they can identify the figures within the dotted spots. The result was recorded on the subject's questionnaire as normal if he could identify the figures and patterns. But if he confuses red and green it was recorded as protanopia, and depending on the colors they confuse, it could also be deutanopia if he confuses green or tritanopia if he confuses blue (Guyton and Hall, 2006).

Table 1. History of visual problem among consumers and non consumers of gari.

Status	Control (NC)		Experimental (C)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Symptomatic	8	10.0	27	27.0
Asymptomatic	72	90.0	73	73.0
Total	80	100.0%	100	100.0%

Table 2. Percentage distribution of frequency of consuming gari.

Variable	Control (NC)		Experimental(C)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Not applicable	15	18.8	0	0.0
Once a day	7	8.8	29	29.0
> Than once a day	2	2.5	5	5.0
Once in two days	15	18.8	38	38.0
Once in several days	41	51.3	28	28.0
Total	80	100%	100	100%

Blood pressure and anthropometric data collection

Blood pressure

A digital blood pressure monitor was used. The arm band of the monitor was tied around the left arm of the subject just 1-2 cm above the median cubital fossa. The monitor measured the systolic blood pressure, diastolic blood pressure and pulse rate.

Height

The height was measured by the use of a metre rule. It was recorded in meters.

Weight

The weight was measured with a bathroom scale weight. The subjects stood on the scale without phones or any encumbrances that could alter their appropriate weight, and their weight was taken.

Statistical analysis

All the data was edited, coded and fed into the computer and expressed as mean ± SEM. The data obtained were analyzed using student T-test. The $P < 0.05$ was accepted as significant. The data was processed at processing unit of Institute of Agricultural Research (IAR), Ahmadu Bello University, Zaria.

RESULTS AND DISCUSSION

The summary of all parameters in the 80 and 100 subjects of the control group and experimental group of non consumers and consumers of gari, respectively, were recorded and tabulated alongside the correlation of the parameters (Tables 1 to 5).

The age distribution of the consumers of gari ranges from 18-56 years. The majority of the consumers fall within the range of 21 - 30 years, for both groups, that is, the subjects from non consumers and consumers of gari. The percentage was however higher in the control group as the majority took 77.5% as against 38% for the experimental group as shown in Table 1.

Table 1 shows that 10% of the control group had history of visual problems while an alarming 27% of the experimental group had visual problems. Table 2 shows that 15% of the control groups do not consume gari, and 41% only consume gari just once in several days. Another 15% consume gari once in two days and only 7% consume gari once a day. The table also shows that of the experimental group, 29% consume gari once a day and 7% more than once a day. While 38% consume gari at least once in two days but a lesser 28% consume gari only once in several days. Table 3 shows the visual equity (the ability of an eye to recognize two separate objects on a line) of the left and right eye of the consumers and non consumers. The ratios 1/6, 3/6, 6/60, 6/36, 6/24, 6/18, 6/12, 6/9, 6/5 represents the ratio of the distance at which test is made/distance at which the smallest optotype identified subtends an angle of 5 arcminutes. It also reveals that there is difference between right and left visual equity. Table 4 gives the color vision of consumers and non consumers of gari. A 97.5% was recorded for normal eye vision for the control and 92% for experimental. 2.5% was recorded for protanopia (inability to differentiate red color) color eye vision for the control and 5% for experimental. 0% was recorded for normal eye vision for the control and 100% for experimental. Table 5 shows that a total of 41 subjects have poor visual acuity of which 6 are in the non consumer of gari group and an alarming 35 subjects are from the consumer group, representing 7.5% and 35% of their groups, respectively. Of a total of 10 subjects, 2 subjects are color blind in the non consumer and 8 subjects in the gari consumer group,

Table 3. Visual acuity of right and left eye of gari consumers.

Visual acuity	Eye	Control (NC)		Experimental (C)	
		Frequency	Percentage (%)	Frequency	Percentage (%)
0	R	1	1.3	4	4
	L	0	0.0	5	5
1/6	R	1	1.3	0	0
	L	1	1.3	0	0
3/6	R	1	1.3	0	0
	L	1	1.3	0	0
6/60	R	0	0.0	1	1
	L	0	0.0	1	1
6/36	R	1	1.3	2	2
	L	0	0.0	1	1
6/24	R	1	1.3	3	3
	L	1	1.3	5	5
6/18	R	0	0.0	2	2
	L	0	0.0	4	4
6/12	R	2	2.5	8	8
	L	2	2.5	7	7
6/9	R	10	12.5	15	15
	L	11	13.8	12	12
6/6	R	45	56.3	21	21
	L	45	56.3	21	21
6/5	R	18	22.5	44	44
	L	19	23.8	45	45
TOTAL	R & L	160	200%	200	200%

R- Right, L- left.

Table 4. Color vision of consumers of gari.

Status	Control (NC)		Experimental (C)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Normal	78	97.5	92	92.0
Protanopia	2	2.5	5	5.0
Visual impaired	0	0.0	3	3.0
Total	80	100.0%	100	100.0%

Table 5. Distribution of visual defects among non-consumers (NC) and comsumers (C) of gari.

Parameters	NC	%	C	%	Total	%
Visual acuity	6	7.5	35	35	41	42.5
Color vision	2	2.5	8	8	10	10.5
Total	8	10%	43	43%	51	53%

representing 2.5 and 8%, respectively. This is in accordance with the work of Aregheore and Agunbiade (1991) who suggested that illnesses due to consuming smaller amounts of cyanide taken over a long period of time can occur if cassava roots are not processed properly and the effects include poor vision.

Conclusion

The result of this study shows that consumers of gari have poorer visual acuity and color vision when compared with the non consumers of gari; this may be due to the exposure to unsafe amount of cyanide in gari, that is, greater than 10 ppm (FAO/WHO, 1991) which was consumed over a long period of time. Consumption of processed cassava (gari) increases the high incidence of refractive errors among the consumers, which may consequently contribute to high prevalence of blindness and severe visual impairment in the study area.

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