PROXIMATE, MINERAL, ANTINUTRIENT COMPOSITIONS AND SENSORY PROPERTIES OF AYAN-EKPANG PREPARED WITHCASSAVA FLOUR IN AKWA IBOM STATE, NIGERIA.

BY

DR. ISONG, NKOYO B.

&

JOSEPH, SOLOMON DOMINIC
DEPARTMENT OF HOME ECONOMICS, NUTRITION AND DIETETICS.
UNIVERSITY OF UYO,
AKWA IBOM STATE, NIGERIA.

ABSTRACT

Ayan-Ekpang is a generic name for a traditional delicacy of the people of Cross River and Akwa Ibom States of Nigeria made from either freshly grated Cocoyam or cassava tubers. The problem of acridity of the tubers and drudgery involved in its preparation hinders people from accessing the nutritional benefits of this meal and also discourages people from accepting and preparing the meals often. This study aimed at preparing Ayan-Ekpang using cassava and cassava flour to determine the nutrient and anti-nutrient contents as well as sensory properties of the Ayan-Ekpang prepared from the flour. All analyses were carried out using standard procedures and preference test was carried out to evaluate the relative preference of the samples on a nine point hedonic scale where 1= like extremely and 9= dislike extremely using twenty indigenous panelists who were familiar with the dishes. Data collected from the studies were statistically analyzed. From the proximate results of Ayan-Ekpang made from cassava flour, all the parameters analysed revealed an increase when compared with the control, except crude protein where there was no significant difference. The minerals analyzed were sodium, magnesium, potassium, copper, iron, phosphorus, zinc, calcium and manganese. There was a significant difference in the flour and the control under potassium, iron, zinc except copper and manganese which shows no significant difference. The anti-nutrients analyses in this study were hydrogen cyanide, oxalate, tannin, phytate and saponin. There was a significant difference in anti-nutrients contents of Ayan-Ekpang made with flour when compared to the control under hydrogen cyanide, oxalate and tannin, both control and flour scored significantly high in energy and carbohydrate. Also under sensory evaluation, there was no significant difference in all the attributes evaluated in Ayan-Ekpang made from cassava flour when compared to their controls. Regular consumption of this indigenous delicacy will contribute substantially to nutrient intakes of population groups and thus could be exploited for their potential health benefits.

KEYWORDS: **Ayan-Ekpang, Cassava Flour, Proximate, Mineral, Composition, Anti-Nutrients, Sensory Properties.**

INTRODUCTION

Cassava is the chief source of dietary food energy for the majority of the people living in the low land tropics, and most of the sub-humid tropics of West, and Central Africa (Tsegia, 2002). Cassava is prepared and consumed in several ways and forms. First, it can be boiled and processed into some other products for consumption. Processing makes this digestible and palatable, extends the shelf life and reduces post-harvest losses.

Cassava is eaten daily in various forms such as fufu, garri, lafun, abacha, ekpang iwa, cassava chips, and tapioca (Okechukwu and okeye, 2007). Cassava can also be boiled, mashed, fried or baked. Cassava starch has also been industrially modified to provide products with physical and chemical properties for specific application, including the preparation of jelly, thickening agents, gravies, custard powders, baby food and glucose (Ene, 1992). Cassava flour has been identified to be useful in the manufacture of cassava beer in the brewery industry (Olomu, 1995).

Cassava can also be used to prepare a kind of swallow, called Ayang-Ekpang in Akwa Ibom Calabar. Ayan ekpang is a generic name for a traditional delicacy of the people of Cross River and Akwa Ibom States of Nigeria made from freshly grated cassava tubers. It is prepared by wrapping the grated tuber, in pre-treated plantain/banana leaf and cooked by streaming method to obtain a firm swallow paste. The swallow is then used to eat with soup of any choice, but especially okro and *banga* soup. Ayan-Ekpang prepared with cassava is commonly called Ekpang-Iwa, while that prepared with cocoyam is called Ayan-Ekpang ikpong. Both constitute popular delicacy across the region.

Ayan-Ekpang, being a well-loved delicacy among the people stands the risk of extinction in culinary collections due to the drudgery in preparation processes. Among the local people, this may not be much problem, however, those in the city with busy work and lifestyle schedules may find it difficult and time consuming to prepare and consume this meal in the contemporary way. With the advent of globalization and the resultant nutrition transition in most under-developed countries: situation where the diet tends towards that of the western regions. Most indigenous families and people prefer easily prepared convenient foods which are often highly processed than the local ones that require more time, energy and labour to prepare. The process of harvesting, peeling and grating involves a lot of energy and time which discourages people from accepting and preparing the meals often.

The presence of anti-nutrients in edible foods such as cocoyam has become a major concern for human health. Although most anti-nutritional factors are removed or partially inactivated by heat or cooking, their residual and accumulated contents have been reported to be the cause of many ill health conditions (Giacometti and Leon, 2017). Safety issues in cassava consumption particularly involved the presence of hydrogen cyanide (HCN). For an adult, consumption of 50-100mg or 2 mole of HCN within 24 hours can completely block cellular respiration leading to death (Rosling, 1994). The method of making Ayan-Ekpang entails cooking the cassava immediately after harvesting without due processing that should lower or remove the toxicity to make it safe for human consumption.

Food processing serves several advantages such as improved nutrient availability, digestibility, all year round availability, increased variety as well as saving labour, time and money. This study aimed at preparing Ayan-Ekpang using cassava flour and to determine their proximate, mineral, anti-nutrient contents and sensory properties.

The specific objectives include to:

1. Determine the proximate compositions of Ayan-Ekpang prepared with cassava flour and the control; fresh cassava
2. Determine the mineral compositions of Ayan –Ekpang prepared with cassava flour and the control.
3. Determine the anti-nutrient contents of Ayan-Ekpang prepared with cassava flour and the control.
4. Evaluate the sensory properties of Ayan-Ekpang prepared with cassava flour and the control.

Materials and Method

Preparation of Ayan-Ekpang with Fresh Cassava

Fresh cassava tubers were thoroughly washed to remove soil particles and other debris. Tubers were then hand peeled, using a clean stainless kitchen knife and thereafter washed thoroughly with clean water. About 700g of cassava was grated using a manual kitchen grater. Water was then added to the paste and mixed properly to get a soft and free flowing consistency. Fresh plantain leaves were cut along the middle stalk and then cut into smaller sizes for wrapping. Cut plantain leaves were thoroughly washed and steeped into boiling water for about 1-2 minutes. This was to prevent the leaves from breaking up during wrapping process. A cooking spoon was then used to scoop the mixture into the leaves and wrapped to produce a long oblong shaped swallow. Wrapped swallows were then placed into steamer and steamed to cook until a firm solid paste was obtained.

Preparation of Ayan-Ekpang with Cassava Flour

About 700g of cassava flour was weighed mixed with water to obtain a free flowing paste. Fresh plantain leaves were cut along the middle stalk and then cut into smaller sizes for wrapping. Cut plantain leaves were thoroughly washed and steeped into boiling water for about 1-2 minutes to soften and prevent random tearing. This was to prevent the leaves from breaking up during wrapping process. A cooking spoon was then used to scoop the cassava pastes into the leaves and wrapped to produce a long oblong shaped swallow.Wrapped swallows were then placed into steamer and steamed to cook until a firm solid paste was obtained.

Table 1: Recipe for Ayan-Ekpang with Cassava

S/N	Ingredients	Quantity Ayan-Ekpang with Fresh Cassava	Ayan-Ekpang with Cassava Flour
1	Cassava (g)	700	700
2	Water (mls)	400	700
3	Wrapping leaves (Pieces)	21	21

Chemical Analysis

Proximate Compositions and Energy Content

The proximate compositions of the samples were determined using standard methods of Association of Official Analytical Chemists, AOAC (2012) Books of Procedure. Parameters analyzed were moisture, Ash, crude fibre, lipid, crude protein, carbohydrate and energy value.

Carbohydrate was obtained by difference.

Mineral Analysis

The minerals sodium (Na) and potassium (K) were determined from the solution using the standard flame emission photometer. NaCl and KCl were used as the standards (AOAC 2012). Phosphorus was determined calorimetrically using the spectronic 20 (Gallenkamp, UK; Kirk and Sawyer 1991) with KH2P04 as the standard. Calcium (Ca) magnesium (Mg), Zinc (Zn), Copper (Cu), manganese (Mn) and Iron (Fe) were determined using an atomic absorption spectrophotometer (AAS, Model SP9, Pye Unicam Ltd, Cambridge, UK). All values were express in mg/100g.

Anti-nutrient Analysis

The anti-nutrient oxalate, hydrogen cyanide, phytate, trypsin, tannin and saponin levels in the samples "Äyan-Ekpang" produced were determined using the rapid test method of AOAC (2012).

Determination of Cyanide was carried out by the alkaline picrate method by Spectrophotometer AOAC (2012) Association of Official Methods of Analytical Chemists Washington DC USA, Edited by Sidney Williams 14th Edition.

Determination of Phytate

Phytate was determined using a method described by Mecance and Widdowsan (1953).

Determination of Tannin was carried out by the Folin-Denis Spectrophotometric and was described by the method of Pearson (1976).

Saponin content of the sample was determined by the double solvent extraction gravimetrical method (Harbone, 1973).

Sensory Evaluation of Ayan Ekpang (Fresh and dried)

Sensory evaluation was done using acceptance test adopted in determining the degree of consumer acceptance of the product. Hedonic test was designed to measure the degree of liking for a product using nine point Hedonic scales. Samples were presented in identical containers, coded with three digit random numbers. Twenty (20) panelists who were familiar with the dishes

were chosen to participate in the evaluation. The result generated were analyzed using t-test because two samples were used during preference test. The mean scores received by each samples were compared using the t-test to find out if there is a significant differences in the two samples.

Statistical Analysis

The data were analyzed using IBM SPSS version 20.0 (IBM SPSS statistic for windows, IBM Corp., Armonk, NY). The mean and standard deviation (SD) of the triplicate analysis were calculated. T-test was perform to determine significance differences between the mean ($p<0.05$), while the means were separated using the paired sample t-test.

Table 2: Proximate Compositions (g/100g) and Energy Contents (Kj) of Ayan- Ekpang made with Cassava Flour

Sam-ple	Moisture	Ash	Fibre	Crude Protein	Lipid	Carbohy drate	Energy
C	70.43±7 .505	0.51±0. 656	0.34±0. 100^{c}	0.63±0. 090^{c}	0.10±0. 050^{c}	27.99± 810^{c}	490.18±1 29.39^{c}
D	58.58±7 .490	0.66±0. 101^{c}	0.34±0. 954^{c}	0.63±0. 101^{c}	0.10±0. 046^{c}	27.99±7. 830^{c}	490.18±1 29.75^{c}

Mean ± SD of 3 determination: C = Control (Ayan-Ekpang made with fresh cassava):
D= Ayan-Ekpang made with cassava flour
Values with different letters in the same column are significantly different ($P<0.05$)

Table 3: Mineral Compositions (mg/100g) of Ayan- Ekpang made with Cassava Flour

Sample	Na	MgK	Cu	Fe	P	Zn	Ca	Mn	
C8.	71±2.	28.48±4.83±	10.05±	0.43±	08.43±	10.30±0	32.18±	0.15±	
995[c]	7.190[c]	995[c]	0.021[c]	.105[c]	.000[c].	205[c]	0.995[c]	0.046[c]	
D19.87±	45.21±	12.05±	0.09±	0.02±0.	3.61±2	0.49±0	28.22±	0.15±	
1.995[d]	9.995[d]	1.000[d]	0.042[c]	.010[d].	005[d]	.205[d]	2.010[d]	0.046[c]	

Mean ± SD of 3 determinations*; C=Control (Ayan-Ekpang made with fresh cassava);*

D= Ayan- Ekpang made with cassava flour

DR. ISONG, N. B & JOSEPH, S. D.

Values with different letters in the same column are significantly different (p<0.05)

Table 4: Anti-Nutrients Contents of Ayan- Ekpang made with Cassava Flour

Sample	HCN	Oxalate	Tannin	Phytate	Saponin
C	0.37±0.100^{c}	41.17±6.635^{c}	0.69±0.100^{c}	2.73±0.895^{c}	0.85±0.121^{c}
D	0.35±0.100^{c}	24.04±14.96^{d}	0.68±0.100^{c}	1.17±0.495^{d}	0.53±0.300^{d}

Mean ± SD of 3 determinations*; A=Control (Ayan-Ekpang made with fresh cassava);*

B= Ayan- Ekpang made with cassava flour
Values with different letters in the same column are significantly different (p<0.05)

Table 5: Sensory Evaluation Of Ayan-Ekpang Made With Cassava Flour

Sample	Appearance	Texture Acceptability	Flavour	Overall
C	2.18±1.168^{c}	2.55±1.508^{c}	2.18±1.537^{c}	2.09±1.044^{c}
D	2.64±1.859^{c}	3.55±1.583^{c}	3.27±2.412^{c}	2.82±1.888^{c}

Mean ± SD of 3 determination: C = Control (Ayan-Ekpang made with fresh cassava):
D= Ayan-Ekpang made with cassava flour
Values with different letters in the same column are significantly different (P<0.05)

RESULTS AND DISCUSSIONS

Proximate Compositions of Ayan-Ekpang with Fresh Cassava and Cassava Flour

The results of the proximate compositions of Ayan-Ekpang prepared from fresh cassava (control) and cassava flour are as presented in Table 2. Moisture contents of Ayan-Ekpang made with fresh cassava (control) were 70.43g. The low moisture content of Ayan-Ekpang made with cassava flour will be an advantage during storage of the product at ambient temperature. Literature report from Soluski (2003)showed that product with low moisture content could have longer shelf life. From statistical analysis, a significant difference was observed between the two samples (p<0.05).

Ash content of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were cassava flour were 0.51g and 0.66g respectively. The ash content reported in this study are below the value reported by Bamidele *et al*.,(2014), who evaluated on garri analog from cassava. Increase in ash content up to 0.05% shows an increase in the mineral content of the product (Adeleke and Odedji, 2010). A significant difference (p<0.05) occurred between the samples.

Fibre content of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 0.34g and 0.44g respectively. Ayan-Ekpang made with flour contains the highest fibre content. Crude fibre by it characteristics is known to aid peristaltic movement of food through

the Digestive Intestinal Track (DIT)(Abu, *et al.,* 2010). A significant difference ($p<0.05$) occurred between the samples.

Protein content of the Ayan-Ekpang made with fresh cassava and cassava flour were 0.63g and 0.66g respectively. These values are below the values reported by Bamidele *et al.,*(2014), who evaluated on fufu analog produced from cassava revealed a protein content of 1.57g. Cassava tubers generally are poor sources of protein. The protein content of cassava could be improved by addition of protein sources into diets. Proteins are essential components of human diet with the basic function of supplying adequate amounts of required amino acids.

Lipid content of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 0.10g and 0.14g respectively. These values are below the values reported by Bamidele *et al.,*(2014), who evaluated on fufu analog produced from cassava. The low level of lipids in cassava means it is also a poor source of fat soluble vitamins (Onwueme, 1978). Lipids are essential because they provide the body with maximum energy, approximately twice for an equal amount of protein or carbohydrate and facilitate intestinal absorption and transportation of fat-soluble vitamins. The lipid content in the tubers was very low. They are ideal tubers for individuals with increased serum lip levels, high blood pressure and other ischemic heart diseases. From the statistical analysis, a significant difference ($p<0.05$) occurred between the samples.

Carbohydrate content in fresh cassava and cassava flour Ayan_Ekpang samples were 27.99g and 39.52g respectively. The Ayan-Ekpang samples were very high in their carbohydrate contents. From the results, it has been observed that Ayan-Ekpang made with cassava flour contains the highest carbohydrate contents. Ayan-Ekpang prepared from fresh cassava flour are good sources of carbohydrate. From the statistical analysis, a significant difference ($p<0.05$) occurred between the samples.

Energy content in fresh cassava and cassava flour Ayan-Ekpang samples were 490.18Kj and 688.24Kj respectively. The Ayan-Ekpang made with fresh cassava and cassava flours are good sources of energy. A significant difference ($p<0.05$) was observed between the samples.

Minerals Contents of Ayan-Ekpang Prepared From Cassava Flour

The results of the mineral contents of Ayan-Ekpang prepared from fresh cassava (control) and cassava flour are shown in table.3. The calcium contents of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 32.18 and 28.22mg/100g respectively. These values are greater than calcium content reported by Bamidele *et al.,*(2014). From the results, a decreased was observed in Ayan-Ekpang made with cassava flour. Daily required intake (DRI) of calcium is 100mg per day for female and 1200mg per day for men (FNB, 2011). A significant difference ($p<0.05$) was observed between the samples. Calcium helps in regulation of muscle concentrations, transmission of impulses and help in bone and teeth formations. It is also indicated in the regulation of blood pressure.

The potassium contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 4.83 and 12.05mg/100g respectively. From the result increased was observed in Ayan-Ekpang made with cassava flour. A significant difference ($p<0.05$) was observed between the samples. The daily adequate intake (DAI) of potassium for adults is 4700mg (IOM, 2004). Therefore consumption of cassava only would not contribute substantially to daily potassium intake. Adequate daily potassium is important for heart and bone health and reduces the risk of stroke and coronary heart disease (Connie M. Weaver, 2013).

The sodium contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 8.71 and 19.87mg/100g respectively. From the result, increase was observed in Ayan-Ekpang made with cassava flour. A significant difference ($p<0.05$) was observed between the samples. The daily adequate intake of sodium is 1500mg (3.9g of salt) per day (James *et al.,* 2016). Sodium is required for regulation of acid-base equilibrium, maintenance of osmotic balance and protects against dehydration in the body. A low sodium diet has been reported to be beneficial in the prevention of high blood pressure and high potassium has been reported to have a protective effect against excessive sodium intake (Lichtenstein *et al.*, 2006).

The magnesium contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 28.48 and 45.21mg/100g respectively. This report shows that Ayan-Ekpang made with cassava flour had the highest Magnesium content. A significant difference ($p<0.05$) was observed between the samples. The daily required intake for magnesium is 320mg for female adults and 400-420mg for male adults (FND, 2011). Magnesium is fundamental in most reactions involving phosphate transfers and plays a major role in relaxing muscles along the airway to the lung thus allowing asthma patients to breathe easier (Apple et *al.,* 1999).It also plays a vital role in the activity of many enzymes.

The iron contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 0.43 and 0.02mg/100g respectively. From the result, a decrease was observed in Ayan-Ekpang made with cassava flour. A significant difference ($p<0.05$) was observed between the samples. The recommended daily allowance for iron is given as 8mg/day and 18mg/day for men and women respectively (IOM, 2004). Foods should therefore be combined with other iron rich foods for pregnant women and women who are still menstruating to help build iron stores.

Zinc is an important metal for normal growth and development in human beings and also to be essential for protein and nucleic acid synthesis (Divrikli *et al.,*2000). It is required for the proper functioning of the reproductive system (Hambidge, 2006). Zinc contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 0.30 and 0.49mg/100g respectively. From the result, increase in zinc content was observed in Ayan-Ekpang made with cassava flour. A significant difference ($p<0.05$) was observed between the samples. The recommended daily allowance is 11mg/100g and 8mg/100g for men and women respectively (FND, 2011).

Copper contents of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 0.05 and 0.09mg/100g. From the result, Ayan-Ekpang made with cassava flour contains the highest copper content. Daily required intake of copper is 0.9mg/100g (FNB, 2011). Copper is an essential micro nutrient which functions as a biocatalyst required for body pigmentation in addition to iron. It also helps to maintain a healthy central nervous system and to prevent anaemia. Copper deficiency is known to cause cardiovascular disorders as well as anaemia and disorders of the bone and nervous system (Mielcarz et al., 1997).

The phosphorus contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 8.43 and 3.61mg/100g. From the result, Ayan-Ekpang made with fresh cassava contains the highest phosphorus content. Daily required intake for phosphorus is 700mg/100g (FNB, 2011). From this report, the phosphorus content is not up to the daily required intake, this delicacy should be taken alongside with meals that are rich in phosphorus.

Manganese contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 0.15 and 0.15mg/100g respectively. From the results, Ayan-Ekpang made from both fresh cassava and cassava flour had the same manganese contents. The daily required intake of Manganese aids in the formation of connective tissue, bones, blood clotting factors, and sex

hormones. This delicacy should be taken alongside with meals that are rich in manganese since the have low contents.

The values obtained for minerals in this study are less than the daily requirement but could be augmented by either increasing the quantity of both fresh cassava and cassava flour consumption or complementing it with other food sources that are rich in the minerals.

Anti-Nutrients Contents of Ayan-Ekpang Prepared From Cassava Flour

The results of the anti-nutritional contents of Ayan-Ekpang prepared with fresh cassava (control) and cassava flour are shown in table 4.

HCN contents of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 0.37 and 0.35mg/100g respectively. According to Lehman (1959), the acute toxic lethal dose of HCN is usually given as 50-100mg. from the result, a slight decrease has been observed in Ayan-Ekpang made with cassava flour, indicating that processing methods like cooking, boiling, sun drying can reduce or lower HCN in a food product (Kendirim *et al.,* 1995, Food info.net, 2010). The HCN values reported in this study were found below the permissive level, indicating that the samples were safe for human consumption.

Oxalate contents of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 41.17 and 24.04mg/100g respectively. Oxalate is detrimental to human health when the amount exceeds 780mg/100g. Oxalate in food products can be reduced by grating, steaming, boing etc (food-info.net, 2010, Aniekwe, 2015, Ramanatha *et al*., 2010). FAO (2013) reports that oxalate are major anti-nutritional factors present in cassava. Studies by Noonan *et al.,* (1999) has it that oxalate has a deleterious effect on human nutrition and health particularly by decreasing calcium absorption and aiding the formation of kidney stones. The oxalate values reported in this study were found below permissive level, indicating that the samples were safe for human consumption. From the statistical analysis, a significant difference ($p<0.05$) was observed between the samples.

Tannin contents of the Ayan-Ekpang made with fresh cassava (control) and cassava flour were 0.69 and 0.68mg/100g respectively. From the result, a slight decrease in tannin has been observed in food products can be reduce by grating, steaming, boiling sun-drying etc (food-info.net, 2010, Aniekwe, 2015, Ramanatha *et al.,* 2010). Food rich in tannin are considered to be low nutritional value because they precipitate protein, inhibiting digestive enzymes and iron absorption and affect the utilization of vitamins and mineral from meals, according to reports by Tinko and Uyano. (2001). Tannin can cause growth depression and toxicity when consumed in excess amount. Lethal dose of tannin is from 25-50mg/100g. They tannin values reported in this study were found below permissive level, indicating that the samples were safe for human consumption.

Phytate contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 2.73 and 1.17mg/100g respectively. From the result, a slight decrease in phytate has been observed in Ayan-Ekpang made with cassava flour indicating that phytate in food products can be reduce by grating, steaming, boiling, sun-drying etc. (Food-info.net, 2010, Aniekwe, 2015, Ramanatha *et al.,*2010). High content of phytate in foods is of nutritional significance because phytate phosphorus is unavailable to human, but its presence lowers the availability of many other dietary minerals such as iron and zinc. The lethal dose of phytate is reported to be from 250-500mg/100g (Bushway, 1998). Phytate have been shown to reduce the blood glucose response to starchy foods, plasma cholesterol and tiracylglycerols when used as=t low levels (Shahidi *et al.,* 1992). The effect of reducing the blood glucose response may be exerted by influencing the rate

of starvh digestion. Phytic acid has also been implicated as having a significant effect on reducing plasma cholesterol and levels of triacylglycerols. The effect is thought to be related to the ability of phytic acid to bind to zinc and thus lower the ratio of plasma zinc to copper which is known to depose humans to cardiovasvular disease. From the statistical analysis, a significant difference ($p<0.05$) was observed between the samples.

Saponin contents of the Ayan-Ekpang made with fresh cassava and cassava flour were 0.86 and 0.53mg/100g respectively. The lethal dose of saponin with 300mg/kg body weight was found to be detrimental to the body (Lalitha 1990). Saponin help to protect the body against cancers, and also lower cholesterol levels. From the result, a slight decrease in tannin has been observed in Ayan-Ekpang made with cassava flour indicating that tannin in food products can be reduce by grating, steaming, boiling, sun-drying etc (Food-info.net, 2010, Aniekwe, 2015, Ramanatha *et al.,* 2010). From the statistical analysis, a significant difference ($p<0.05$) was observed between the samples.

Sensory Evaluation of Ayan-Ekpang made with Cassava Flour

The detailed results of the sensory evaluation of the Ayan-Ekpang made with fresh cassava (control) and cassava flour are shown table 5. Both Ayan-Ekpang made with flour and fresh cassava (control) was mostly preferred by the 20 panelists of sensory assessors.

On the whole, Ayan-Ekpang made with fresh cassava (control) scored highest in all the attributes evaluated. Under texture and overall acceptability, Ayan-Ekpang made with fresh cassava (control) were preferred because it was still in a moist form which makes the texture softer and finer than Ayan-Ekpang made with cassava flour which requires more water to make it soft and acceptable because it was in a dried form.

From the statistical analysis, in all the attributes evaluated there was no significant difference ($p<0.05$) between Ayan-Ekpang made with fresh cassava and cassava flour, indicating that both samples were generally acceptable by all also, no one was better than the other.

Conclusion

In conclusion, Ayan-Ekpang prepared from fresh and cassava flour are good sources of carbohydrate energy. They may as well be regarded as fair sources of minerals due to the ash content observed in the product. The anti-nutrients observed in this study are less than lethal dose which cannot be detrimental to human health. Also, anti-nutrients when taken at a lower amount has no potential health effect to the body. From the statistical analysis, in all the attributes evaluated during sensory evaluation there was no significant difference ($p<0.05$) between Ayan-Ekpang made from both cassava flour when compared to their controls, indicating that both samples were generally acceptable by all. Also, no one was better than the other.

Recommendation

1. Consumers should be sensitized on effective methods of cassava processing and be encouraged to use them before consumption of the tubers,
2. Communities should be educated on the importance and health benefits of eating indigenous meal Ayan-Ekpang.
3. The utilization of Ayan-Ekpang should be encouraged at all level as they provide a good source of nutrition.

4. Relevant government agencies should mount aggressive campaign to sensitize and educate the consumers of Ayan-Ekpang and the dangers of taking poorly processed cassava meals and the diseases associated with the intake of this meal.

REFERENCES

Abu. J. O., Achangu, E., & Lyordye-Abien, E. (2010). Quality Evaluation of White and Yellow Garri slod in Markurdi Metropolis. Port Harcourt, 34th Annual Conference and General Meeting of Institute of Food Science and Technology (NIFST) p. 155-156.

Adeleke. R. O., and J. O. Odedeji. 2010. Functional properties of wheat and sweet potato flour blends. Pak. J. Nutr. 9:535

AOAC. (2012). Association of official analytical chemists. 18th Edition. Washington D.C. USA

Bamidele, O. P., F. G. Ogundele, B. A Ojubanire, M. B Fashogbon and O.W. Bello. 2014. Nutritional composition of fufu analog flour produced from cassava (Manihot esculenta) and Cocoyam (Colocasia esculenta) tuber. Food Sci. Nutr. 2:706-711.

Bushway, R. J., Burea, J. J., and Gann, D, F. 1998. Phytate and cyanide contents of edible mushrooms. Journal of Food Science, 48,84-86.

Ene, L.S.O. (1992). Prospects for Processing and Utilization of Root and Tuber Crops. In National Root Crops Promotion of Root Crop-Based Industries Pp.7-11.

F.M. Ugwu, 2009. The Potential of Roots and Tubers as weaning. Foods Pakistan Journal of nutrition,, 8: 1701-1705.

FAO (2013). FAO statistical yearbook. World food and agriculture. Rome, Italy: Food and Agriculture Organization of the United Nations.

FAO. (Eds. J.E Hernaldo & J Leon), Rome, Italy. 1994:253-258.

FNB, (2011). Recommended Dietary allowance for Vitamin and Mineral Intake. USA and Canada: National Academy of Scienc.

Giacometti DC, Leon J. Tannia. Yautia (Xanthosoma Sagittifolium). In: Neglected Crops: 1492 from a different perspective. Plant Production and Protection Series No. 26. Rome, Italy:

Hambidge, M. (2006). Human zinc deficiency. Journal of nutrition, 130:1344S-1349S.

Kemdirin, O. C., O. A. Chukwu and S. C. Achinewhu, 1995. Effect of Traditional Processing of Cassava on the Cyanide Content of Garri and Cassava Flours. Plant and Foods Hum. Nutri, 48:335-339

Lebot, V., 2009. Tropical root and tuber crops: Crop production science in horticulture (17). Cab books, CABI, Wallingford UK.

Lichtenstein, A. H., Apple, L. J., Brands, M., Carnethon, M., Daniels, S., Franch, H. A., Franklin, B., Kris-Etherton, P., Harris, W. S., Howard, B., Karanja, N., Lefevre, M,. Rudel, L., Sacks, F., Van Horn, I., Winston, M. and Wylie-Rosett, J. (2006). Summary of American heart association diet and lifestyle recommendations revision. Arteriosclerosis Thrombosis and Vascular Biology, 26: 2186-2191.

Noonan S, Savage GP. Oxalate content of food and its effect on humans. Asia Pacific Journal of Clinical Nutrition. 1999:8(1):64-74.

Olomu, J.M. (1995). Monogastric Animal Nutrition. Principles and Practices. Benin. Ajachem Publications. Pp. 130-133.

Ramanatha, R. B., Matthews, P. J., Eyzaguirre, P. B., & Hunter, D. (2010). The global diversity of taro: Ethnobotany and conservation. Rome, Italy: Biodiversity International.

Rosling, H. (1994). Measuring effects on humans of dietary cyanide exposure from cassava. Acta Horticulture, 375, 271-284.

Shashidi, F: Wanasundara, P. K. J. P. D. In Phenolic Compounds in Foods and Their Effects on Health. I; Ho, C-T; Lee, C. Y; Huang, M-T., Eds; Acs Symposium series 506; American Chemist Society: Washington, DC, 1992, pp. 214-222.

Soluski, F. W. (1962). The centrifuge methods for determining flour absorption in hard red spring wheat. Journal of Cereal Chemistry, 39, 344.

Tinko N, Uyano K. Spectrophotometric Determination of the Tannin Contents of Various Turkish Black tea, Beer and Wine samples. International Journal of Food Sciences and Nutrition. 2001; 52: 289-294.

Tsegai, D. and P. C. Kormawa (2002). Determinants of Urban Household demand for Cassava Products in Kaduna, Northern Nigeria. In: Conference of International Research for Development, Witzenhause, 9-10 October 2002.

Weaver C. M, Alekel D. L, Ward WE, Ronis M. J. Potassium and health. Adv Nutr. 2013 May; 4 (3):368-377