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Qualitative and Quantitative Analyses of Phytochemicals in traditional Mixed Dishes Commonly Consumed in Enugu State, Nigeria

Davidson, G.I.[1]; Udenta, E.A.[2]; Mbah, B. O.[1]& Emeh, P. E[2].
[1] Department of Home Science and Management,
University of Nigeria, Nsukka, Enugu State
[2] Department of Nutrition and Dietetics,
University of Nigeria, Nsukka, Enugu State

Abstract

The objectives of the study were to carry out qualitative and quantitative analysis of phytochemicals in traditional mixed dishes (*Ebiriebiji, Igbangwu, Ayarayaoka,* and*Okpa*) commonly consumed in urban and rural communities in Enugu State. Recipes of the dishes were obtained from the communities through focus group discussion (FGD). Recipes were used to prepare dishes which were homogenized and screened analysis for alkanoids, tannin, saponin, steroids, teponoids, glycoside, flavonoid, and phenol. The phytochemicals present were also quantified. Phytates and oxalates were directly quantified (not screened). Data were analyzed using percentages. Results indicate that none of the screen phytochemicals was present in appreciable amount (+++) in the samples with the exception alkaloids in *Okpa*. Glycosides were present in minimal amount (+) in all the samples while teponoids were not detected in *ayarayaoka and okpa*. Saponin concentration ranged from 0.98 to 3.00% being lowest in *Igbangwuoka* and highest in *Ebiriebi ji*. *Igbangwuoka* had the highest steroids and flavonoids values (4.87% and 4.17% respectively). All the dishes had low oxalate values which ranged from 0.00 to 0.03%. it was thus concluded that traditional mixed dishes consumed in Enugu State had moderate to minimal amounts of phytochemicals though there were some exceptions. Most of the quantified phytochemicals were seen to be within their tolerable limit. The consumption of these dishes should therefore be encouraged.

Key words: Mixed Dishes, Phytochemicals, Commonly Consumed, Traditional, Analysis

Introduction

Foods can be consumed as single or mixed/multi-ingredient dishes. A single dish as the name implies is a one ingredient dish while a mixed or multi-ingredients dish is prepared with two or more ingredients (Davidson, Ene-Obong&Chinma,

2017). According to Ayogu*et al.,* (2017), commonly consumed foods in an area are those foods that have high consumption frequencies of more than three times per week. Population groups of any area always depend on such foods as their main meal and most often these foods are of traditional origin.

Traditional foods can be defined as foods that are passed through generations or which have been consumed by many generations. Such foods are said to have been consumed throughout history before the modernization and industrialization of the food supply (Katie, 2019). The foods are not only free from additives, chemicals and many of the things found in food today, but they are exceptionally nourishing. Traditional foods are valued because they showcase the culinary tradition of the people and have a lot of benefits on health (Agomuo *et al*, 2017). Specific features that distinguish traditional foods from other similar products of the same category include the use of "traditional ingredients" and traditional methods of production. The traditional foods characterize a given community and form part of their cultural heritage. Such dishes in Enugu State include *Okpa* **(**Bambara nut pudding**),** *Ebiriebiji*, *Igbangwu* and *Ayarayaoka.*

Okpa is made from Bambara flour, mixed with palm oil, salt, water and steamed into a pudding (Madukwe&Ene-Obong, 2012). According to Eze (2021), okpa is consumed by 23 percent of the population in Enugu. *Ebiriebiji* is a yam (*Dioscoreaalata*) based dish. Davidson (2017) reported that yam-based dishes were consumed daily by 54 and 76 percent of urban and rural households respectively in south-east Nigeria. *Igbangwu* and *Ayarayaoka* are both corn (*Zea mays*) based dishes of Enugu State origin. Traditional foods are mostly associated with health benefits as identified by their categories; green leafy vegetables, roots and tubers, fruit, legumes, cereals, seeds and nuts (Majova, 2011). This is because most of the plant-based dishes contain some healthful compounds known as phytochemicals attributable to their being prepared in their natural forms without much processing (Majova, 2011).

Naturally occurring biologically active chemical compounds, known as phytochemicals are thought to be largely responsible for the protective health benefits of plant-based foods and beverages, beyond those conferred by their vitamin and mineral contents (Kumari &Khatkar, 2012). These phytochemicals, which are part of a large and varied group of chemical compounds, are responsible also for the color, flavor, and odor of plant foods. The benefits of phytochemicals such as flavonoids, phytates, tannins, oxalates and carotenoids, includes reducing the risk of chronic diseases by protecting against free radical damage, modifying metabolic activation and detoxification of carcinogens, or even influencing processes that alter the course of tumor cells (Herrera *et al*, 2009).

The traditional diet in Nigeria is largely made of fiber-rich carbohydrates, minimal fat and moderate protein. However, this profile has seen a gradual change over the years, starting from the period of colonization by the British due to nutrition transition (Maiyaki&Garbati, 2014). Traditional diets, which are rich in carbohydrates, protein, vitamins, mineral, dietary fibre and phytochemical, are being neglected and with preference being given to highly processed fat and sugar-rich foods that are low in fibre and phytochemical. Highly processed foods predispose the consumers to overweight and obesity which are considered risk factors to many chronic non-communicable diseases (NCDs). The Nigerian population is becoming more overweight and obese as shown by recent data from World Health Organization (WHO, 2018). Overweight and obesity may increase the risk of many health problems, including type 2 diabetes, high blood pressure, heart diseases and strokes, certain types of cancer, sleep apnea, osteoarthritis, fatty liver disease, kidney disease and pregnancy problems such as high blood sugar during pregnancy, high blood pressure, and increased risk for cesarean delivery (National Institute of Diabetes and Digestive and Kidney Diseases, 2015). Although these changes affect both rural and urban dwellers, it is more pronounced among the urban populace. These changes are brought about by changes in dietary habit, with the adoption of a westernized diet. Facilitation of social acceptance of fast food by the global media outlets and advert billboards has potentiated this nutritional transition (Maiyaki&Garbati, 2010).

Urbanization is not merely a modern phenomenon, but a rapid and historic transformation of human social roots on a global scale, where predominantly rural culture is being rapidly replaced by predominantly urban culture. This created changes in food consumption patterns with more processed foods being available in cities, hence resulting in the use of fewer species, decreased dietary diversity leading to household food insecurity and consequently poor health statues (Yetunde &Ene-Obong, 2016). Consequently, in many cases, some indigenous foods have been removed from circulation despite the potential health benefits due to their natural and non-toxic or non-chemical nature. There appears to be a dearth of knowledge on the nutrients and phytochemical potentials of traditional dishes. Lack of information is, therefore, a problem to the consumption of traditional dishes. Lack of nutrition education contributes to the inappropriate uses of foods or wrong choice of food and also contributes to malnutrition and ill-health. This study is therefore expexred to document the phytochemicals present in traditional dishes commonly consumed by rural and urban dwellers in Enugu state, to provide evidence-based information that can be used by nutrition educators to promote healthy consumption

pattern among urban and rural dwellers in South-eastern Nigeria.

Objectives of the study

The general objective of the study focused on qualitative and quantitative evaluation of phytochemicals in traditional mixed dishes commonly consumed in Enugu State, Nigeria.

Specifically, the study carried out:

1. qualitative analyses of phytochemicals in traditional mixed dishes(*Ebiriebi ji, Igbangwu, Ayarayaoka* and *Okpa*) commonly consumed by rural and urban community in Enugu state.
2. quantitative analyses of phytochemical in the traditional mixed dishes(*Ebiriebiji, Igbangwu, Ayarayaoka* and *Okpa*) commonly consumed by rural and urban community in Enugu state.

Materials and methods

***Study design*:** Experimental study design was employed in this study.

Purchase of ingredients: All the ingredients used in preparing the dishes were purchased from the local market in each of the communities where the recipes were collected.

Food sample preparation

The traditional mixed dishes documented in each community were prepared by women from those communities using the recipes collected through Focus Group Discussion (FGD), as detailed below. The food preparation was done in the Diet Therapy Laboratory, Home Science, Nutrition and Dietetics Department, University of Nigeria Nsukka, Enugu State.

Recipe name: *Ayarayaoka*

Ingredients	**Quantity (g)**
Corn	960
Pigeon pea	552
Bitter leaves	96
African spinach	650
Palm oil	340
Fermented oil bean seed	144
Onions	132
Pepper	30
Maggi	8
Salt	42
Water	400
Yield	2568

Method of Preparation

1. Boil the corn for 10 minutes and soak over night
2. Drain the water and grind to coarse texture
3. Pick, wash the pigeon pea and bring to boil
4. Add the bitter leaves (washed just once) and cook till the pigeon pea is almost done
5. Wash and cut the vegetables
6. Mix the ground corn with one table spoon of the palm oil
7. Turn a small local basket upside down inside the pot of pigeon pea, spread the vegetables on it and spread the ground corn on the vegetables so that it does not come in contact with the boiling water.
8. Cover the pot and cook for about 30 minutes, turn intermittently to ensureuniform cooking until the corn is cooked.

9. Remove the corn and vegetables and drain the pigeon pea and biter leaves
10. Heat the oil, add the onion and fry gently
11. Add water, bring to boil and add the pepper, fermented oil bean seeds, maggi cubes and salt
12. Simmer for five minutes to properly cook the local stew
13. Add the cooked corn, vegetables and pigeon peainto the local stew and mix very well

Recipe name: *Igbagwuoka*

Ingredients	**Quantity (g)**
Corn	1280
Fluted pumpkin leaves	186
Garden egg leaves	432
Fermented oil bean seed	222
Palm oil	340
Water	604
Onions	170
Pepper	32
Maggi	8
Salt	48
Yield	2485

Method of Preparation

1. Boil and soak the corn over night
2. Drain and wet mill to fine texture
3. Wash, drain and slice the vegetables
4. Add oil to the corn and mix very well.
5. Add the vegetable and other ingredients and mix very well
6. Scoop spoonful into cellophane bags, wrap and cook till done

Recipe name: *Ebiriebi ji*

Ingredients	**Quantity (g)**
Yam	1411
Africanspinach	279
Palm oil	170
Fermented oil bean seed	128
Fresh pepper	25
Onion	107
Maggi	4
Salt	15
Yield	1953

Method of Preparation

1. Peel, slice, wash the yam and cook till done
2. Drain the cooked yam and set aside
3. Wash and slice the vegetable
4. Heat the oil and fry the onion
5. Add other ingredients and simmer till the vegetable is tender
6. Add the boiled yam and stir to a uniform mixture

Recipe name: *Okpa*

Ingredients	**Quantity (g)**
Okpa flour	700
Palm oil	175
Fresh pepper	26
Uziza seed	8
Salt	28
Water	1100
Yield	2000

1. Heat enough water in a pot and bring out 1100g
2. Put the okpa flour in a bowl, add oil and mix
3. Add the pepper, ground *uziza*seed and salt and mix as well
4. Add the water gradually and continue to mix until all the water is added

5. Scoop spoonful into cellophane bags and cook till done

Preparation of samples for chemical analysis: After cooking, the food samples were homogenized, properly packaged, labelled and taken to the Food Analytic Laboratory, Department of Home Science, Nutrition and Dietetics University of Nigeria Nsukka for quali tative and quantitative evaluation of p hytochemicals.

Chemical analysis

Quantitative and qualitative evaluation of phytochemicals in all samples where done in duplicate.

Phytochemical screening: For the presence of an alkaloid, Mayer's test described by Ajuru, Williams &Ajueonru, (2017) was used. Ejikeme, Eneonu & Eboatu (2014) test was used to detect the presence of terpernoids. The test solution was shaken with water. Copious lather formation after shaking the test solution in water, indicated the presence of saponin. For tannin, test solution was mixed with basic lead acetate solution. Formation of White precipitate indicated the presence of tannin. For glycosides test, the exatract was boiled with dilute sulphuric acid, chloroform was added and shaken well. The organic layer was separated to which ammonia was added slowly. Presence of glycoside was denoted by pink to red colour. To 2ml of the test solution, a few magnesium turning and a few drops of concentration hydrochloride acid were added and boiled for 5 minutes. Appearance of red or orange colour indicates the presence of flavonoid. To 2ml of the test solution, a few drops of ferric chloride solution were added. Bluish green colour indicates the presence of phenol. To 2ml of the test solution, a few drops of chloroform, 3-4 drops of acetic anhydride and one drop of concentrate sulphuric acid were added. Appearance of purple colour, which changes to blue or green colour, showed the presence of steroid.

Quantitative analysis of phytochemicals

Alkaloids content was determined by the alkaline precipitation-gravimetric method described by Harborne (1973). Total oxalate in the sample was assayed using the method of AOAC (1995) while AOAC, (2010) was used for tannin and phytate determination. Saponin was determined according to the Ochuko and Obadni method (2001). Boham and kocipia-Abyazan method (1994) was used for flavonoids determination. Method of analysis of analytical methods committee of royal society of chemistry, A.M.C.R.S was used for phenols determination.

Statistical analysis: Data obtained from chemical analysis were analyzed using percentage.

Results

Table 1: Qualitative analysis of phytochemicals in traditional mixed dishes

Samples	Alkaloids	Saponin	Terponoids	Steroid	Glycosides	Flavonoids	Tannin	phenols
Ebirebi ji	++	++	+	+	+	++	-	++
Ayarayaoka	++	++	-	+	+	++	++	+
Igbangwu	+	+	+	+	+	+	++	-
Okpa	+++	++	-	-	+	-	-	+

Key- Absent, + present in minimal amount, ++ present in moderate amount , +++ present in appreciable amount Ebirebi ji: Yam and vegetable porridge. Ayarayaoka: Corn and pigeon pea porridge. Igbagwu: Corn pudding. Okpa: Bambara nut pudding

Table 1 revealed the phytochemicals that were screened in the mixed dishes. Alkaloids were present in appreciable amount (+++) in *okpa*. Alkloids, saponin and tannin were present in moderate amount in a good number of the dishes while glycosides were present in minimal amount (+) in all the dishes. Steroids and phenol were also present in minimal amounts in most of the dishes, however, teponoids were not detected in most of them.

Table2: Quantitative phytochemical analysis of some traditional mixed dishes

S	Alk (%)	Sap (%)	Phe (%)	Phy (%)	Ste (%)	Ter (%)	Tan (%)	Fla (%)	Gly (MG)	Ox (%)
Eji	0.00	3.00	0.58	0.16	0.16	4.15	-	3.10	1.64	0.00
Ay	2.97	5.59	0.52	0.10	-	-	0.31	2.15	-	0.00
Igb	0.01	0.98	0.58	0.15	4.87	-	0.17	4.17	-	0.03
Ok	0.77	0.99	-	0.15	-	-	-	-	-	0.01

S = sample; Alk = Aikalodis; Sap = Saponin; Phe = Phenols; Phy = Phytate; Ste = Steroids; Ter = Terpeniods; Tan = Tannin; Fla = Flavonoids; Gly = Glycoside; Ox = Oxalate

Table 2 shows thatb alkalodis and saponin values ranged from 0.00-2.97 and 0.98-5.59% respectively. Oxalate was within the range of 0.00-0.3% while phytate ranged from 0.10-0.16. Okpa had no alkaloids, saponin, steroids, terpenoids, tannin, flavonoids and glycosides values. The highest steroids and flavoids values were in *Igbangwu (*4.87 and 4.14% respectively).

Discussion

Ebirebi ji (yam-based dish) had moderate amount (++) of alkaloids, saponin, flavonoidsand phenol. Apart from phenol, these phytochemicals were found to be in minimal amountsin raw trifoliate/bitter yam from Agenebode farm in Edo State.It could be that vegetablesused in preparing the dish might have boosted its phytochemical composition. Leafy vegetables are considered as sources of human health promoting components such as phytochemicals (Duma et al, 2014). The differences observed could also be due to location and the variety of the yam used. The age, cultivar, geographical location of plant or the storage condition after harvest could

affect phytochemical and anti-nutritional content in yam. Phytochemical compositions of plants are mostly found to differ both qualitatively and quantitatively depending on exposure to stimuli, geographical location and soil type.

Ayarayaoka and *Igbangwu* are corn-based traditional dishes. It is however interesting to note that *Ayarayaoka* contained moderate amounts of alkaloids, saponin and flavonoids as against the minimal presence observed in *Igbangwu*.A legume such as pigeon pea or cowpea is a major ingredient in *Ayarayaoka* and must have accounted for the higher phytochemical screening results observed in the dish in relation to *Igbangwu*where pigeon pea or cowpea is not added. Mbagwu*et al*., (2011) found varying amounts of alkaloids, saponin and flavonoids in four different legumes. This result disagrees with findings ofAmadi, Ayalogu and Onyeike (2011) who reported the phytochemical contents of *Onunu* and *Mgbam*- traditional dishes of Ikwere ethnic nationality of South-southern Nigeria which revealed that in *Onunu*, tannins and phytates were moderately present (++), saponins, cyanogenic glycosides, alkaloids and oxalates were present (+) and flavonoids were absent (-) while in *Mgbam*, tannins and phytates were highly present (+++), saponins, cyanogenic glycosides, alkaloids and oxalates were present (+) and flavonoids were absent (-). The differences could be as a result of the type of food analyzed as well as the ingredients used in their preparation.

Okpa contained appreciable amount (+++) of alkaloids moderate amount (++) of saponin and minimal amount (+) of glycoside. Other phytochemicals such as terponiods, steroids, flavonoids, tannin and phenols were not detected. Though *Okpa* and *Uza-akwuagworagwo* are legume-based dishes, the result of this study disagrees with that of Agomuo, Eboagwu, Nwadike, Ezekwe and Onedibe (2017) who reported the presence of alkaloid (++), Flavonoid (++), tannin (+), saponin (+) and phenols (+) in *Uza-akwuagworagwo*- a traditional food of Nkanu people of Enugu State, Nigeria. The observed differences could be attributed to food type, cooking time, added ingredients as well as processing involved. Atli, (2017), noted that cooking and certain food processing method reduces the amount of phytochemical in foods.

The alkaloid and oxalate content of *Ebirebi ji* was 0.00% each. Tannin was not detected while saponin was 3.00%. This disagrees with the result of Olajumoke*et al.,* (2014), who showed that pounded yam contains phytate (4.37%), oxalate (0.54%), tannin (0.38%), saponin (12.71%) and alkaloids (2.02%). The disparity in these results could be due to effect of variety and other conditions that affect the phytochemical content of foods. The age, cultivar, geographical location of plant or the storage condition after harvest could affect phytochemical and anti-nutritional content in yam (Polycarp *et al*., 2012).

The alkaloids and saponin content of *Ayarayaoka* were quite higher than

what was obtained in *Igbaingwu* which could be explained by the additional ingredient (pigeon pea/cowpea) found in *Ayarayaoka*. This finding reveals that a slight change in the ingredient composition of a recipe reflect automatically not just in its nutrient composition as reported by Davidson, et al (2017) but in its phytochemical composition as well.

Phytate, oxalate and saponin content of *okpa* were 0.15, 0.01 and 0.99% respectively while tannin was not detected. These values were all lower than what were obtained (phytate (5.768mg), alkaloids (0.340%), oxalate (8.56mg), saponin (1.45%), tannin (0.790mg)) by Aniebet and Olanrewaju, (2018) from Bambara groundnut. It could be that the researchers analyzed the whole Bambara nut seed instead of the flour which was used in*Okpa* preparation. Various studies have shown that processing methods such as boiling, milling, fermentation and roasting can significantly reduce phytochemicals such as phytate and tannin to a low level (Wada, Feyissa&Tesfaya, 2019). Phytic acid content may also vary depending on the crop variety, climatic conditions, irrigation conditions, soil type and growing season of the plant (Lewu, Adebola &Afolayan, 2010).

The alkaloids content of *Okpa* (0.77%) found in this study was higher than that reported by Mbangwu, Okonkwo &Ekeanyanwu, (2011) for bambaranut (Vigna subterranean) flour (0.41%). *Uziza*(*Piper guineense*), a traditional spice added to *Okpa*might have boosted the alkaloid content of the dish since spices are phytochemical rich food ingredients.

Nutritional/health implications of the study

In all the dishes, alkaloids, phenols, tannin and oxalate values were within their tolerable limit of 20% (Cantwell, 2001), 2% (Micalowicz & Duda, 2007), 3.3% (Elfadil *et al.,* 2013) and 5% (Caser, 2003) respectively, except for the alkaloids value of *Ayarayaoka*. Alkaloids have many pharmacological activities including antihypertensive effects, antiarrhythmic effect, antimalarial activity and anticancer actions. Polyphenols may help to reduce the risk of developing type 2 diabetes. Polyphenol significantly lowers level of chemicals that signal inflammation and muscle damage in the blood. It also decreases blood pressure, decreases LDL or 'bad' cholesterol, and raises HDL or 'good' cholesterol (Ware, 2017). Phytic acid reduces iron-induced oxidative injury and reverses stimulation colorectal tumorigenesis (tumor formation) due to its mineral chelating potential (Gemede&Ratta, 2014). Oxalate is a potent antinutrient in foods. However, oxalate functions as chelating agent when present in foods at tolerable limit (2mg or 5% per 100g food) and may chelate many toxic metals such as mercury and lead (EgbunaandIfemeje, 2015). The traditional mixed dishes, therefore, contain some phytochemicals that have potentials for the control and prevention of some nutrition-related diseases if traditional dietary habits are maintained.

However, saponin and phytate rich ingredients should be used with caution since they exceeded their tolerable limit of 0.2 (Codex Akimentarius, 2017) and 0.035% (Onomi, *et al*. 2004) respectively, in all the dishes.

Conclusion

Traditional mixed dishes consumed in Enugu State had moderate to minimal amounts of phytochemicals except for okpa where terpenoids, steroids, flavonoids and tannin were not detected while saponin was found in appreciable amount. Most of the quantified phytochemicals were seen to be within their tolerable limit except for saponin and phytate. The consumption of these dishes should therefore be encouraged.

Recommendation

Based on the findings of this study, the following recommendations are made:

1. Appropriate processing method for saponin and phytate rich ingredients should beidentified and adopted to reduce their levels in the traditional mixed dishes.
2. Due to the health benefits of phytochemicals, consumption of traditional mixed dishes (particularly those that had tolerable limits of phytochemicals) should be encouraged.
3. Indebt studies on traditional dishes are needed to help Nutritionists and Dieticians compact the problem of nutrition transition through evidence-based nutrition counselling.

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