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Quantitative and Qualitative Analysis of Phytochemicals in Selected Traditional Soups Commonly Consumed in Rural and Urban Communities of Enugu State, Nigeria

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Abstract

This study was conducted on the quantitative and qualitative analysis of phytochemicals in traditional soups ("egusi" soup, vegetable soup and "uchakiri" soup) commonly consumed in rural and urban communities in Enugu state. Recipes of the dishes were collected from two urban (Nsukka, and Ehamufu) and rural (Obukpa and Neke) communities in Enugu State using Focus Group Discussion (FGD). These recipes were used to prepare the dishes which were homogenized and screened for alkaloids, tannin, saponin, steroids, terpenoids, glycoside, flavonoid, carotenoid and phenol. The phytochemicals present were also quantified. Phytates and oxalates were directly quantified (not screened). The statistical package for service solution (SPSS) version 22 was used to analyse the data obtained. Alkaloid was the only phytochemical found to be present in appreciable amount (+++) in the soup samples with an exception in "uchakiri" soup where it was minimally present (+). Phenol was present in minimal amount (+) in all the samples while terpenoids, glycoside and saponin were not detected in vegetable and "uchakiri" soups. Flavonoid concentration ranged from 1.39 to 4.00% being lowest in "egusi" soup and the highest in vegetable soup. "Egusi" soup had the highest saponin and steroid values (9.57 and 5.38% respectively). Terpenoids, glycoside, tannin, flavonoid and steroid and saponin were not detected in "uchakiri" soup. Traditional soups consumed in Enugu state were found to contain a variety of phytochemicals which can improve the health status of the consumers.

Key words: Vegetable Soup, Traditional Soup, Phytochemicals, Commonly Consumed, "Egusi" Soup, "Uchakiri" Soup, Traditional Food.

Introduction

Commonly consumed foods in an area are those foods that have high consumption frequencies of at least three times a week (Ayogu et al., 2017). Most of these foods are mainly plant-based which usually serve as the main meal of the people. Although animal-based proteins such as meat, contribute more protein and several nutrients such as zinc, vitamin B12, phosphorous, and iron, plant-based protein foods, these can make an appreciable contribution to intakes of magnesium, vitamin E, beta-carotene and phytochemicals (Phillips et al., 2015). Food consumption varies from household to household, however, a food consumption survey usually demonstrate the same trend of food consumed in variant frequencies. People

tend to consume what is available, affordable and have ease of preparation. The population groups of any area always depend on such foods as their main meal and most often these foods are of traditional origin (Ayogu *et al*., 2017).

Traditional foods are considered to be those that have been handed down from one generation to the next in terms of knowledge, techniques or practices used in their preparation or in the choice and use of the raw material, which is generally local, as well as the culture that produces it (Rocillo-Aquino *et al*., 2021). They are foods strongly linked to a territory, a historical depth and a constellation of associated knowledge, meanings, values and practices. These foods can be indigenous or introduced from ancient times, but dynamically integrated into the local agricultural system and regional food culture; this implies accepting and understanding their variability and particularity within a given historical context and process. The interest in traditional foods has always existed since they are the basis of nutrition in diverse cultures and societies (Rocillo-Aquino *et al*., 2021). A typical Nigerian diet is comprised of carbohydrate-based meal (cassava, flour, rice, cocoyam, potatoes, yam or plantain) consumed with soup or stew cooked with palm oil, pepper, vegetable and little protein source (Oboh & Olumese, 2010).

Soup is the food made by boiling solid ingredients in liquid until the flavours are extracted, forming a broth (Ayogu *et al*., 2017). Soup is a liquid or semi-liquid mixture of vegetables and non-vegetable items such as meat, seafood, poultry, and herbs and spices. Although soup is a flavorful and nutritious liquid food usually served at the beginning of a meal or a snack (De Ancos & Sánchez-Moreno, 2017). It offers a sustainable means to mix several food ingredients into one wholesome meal, thereby contributing to dietary diversity, a unique flavour, taste and aroma (Maseko, 2018). According to Kristbergsson and Oliveria (2016), traditional soups are passed through generations with specific traditional ingredients (raw material of primary products) or traditional composition and preparation methods. It is prepared with traditional ingredients which are characterized by their availability, affordability and acceptability, and these soups tend to be commonly consumed within their specific culture. The consumption of more traditional foods signifies higher intakes of several important nutrients and higher overall diet quality which includes fewer calories, more calcium and iron, which has led to a considerable reduction in the risk of heart disease, high blood pressure, osteoporosis, reduces inflammatory activities in the immune system, protects the body from damaging cell distortions, keeps eyesight healthy and the body cells communicating. However, these qualities have been attributed to the phytochemicals present in foods (Wright, 2017; Kuhnlenin & Humphries, 2017; Kristbergsson & Oliveria, 2016).

Phytochemicals are chemical compounds produced by plants (Group, 2014). They are commonly found in fruits, vegetables, nuts, legumes and grains. Phytochemicals are frequently confused with phytonutrients (Group, 2014). Whereas phytochemicals include beneficial compounds as well as those that are detrimental, phytonutrients

specifically refer to compounds that have effects. In other words, all phytonutrients are phytochemicals but not all phytochemicals are phytonutrients (Rock *et al.*, 2014). Phytochemicals are bioactive compounds found in plants that work with nutrients and dietary fibre to protect against diseases. They have been shown to have antioxidant, anti-carcinogenic, anti-microbial, anti-allergic, anti-mutagenic, and anti-inflammatory properties (Madikizela et al., 2017). These phytochemicals are the secondary metabolites present in smaller quantities in higher plants and they include the alkaloids, Steroids, flavonoids, terpenoids, tannins and many others. Many phytochemicals have antioxidant activity and reduce the risk of many diseases. These antioxidants are substances that may protect our body cells against the effects of free radicals. Free radicals are molecules produced when our body breaks down food (Vasanthi et al., 2014). Phytochemicals, also referred to as phytochemicals are found in fruits, vegetables, whole grain, legumes, beans, herbs, spices, nuts and seeds and are classified according to their chemical structures and functional properties. (Murphy *et al.*, 2012). These phytochemicals, which are part of a large and varied group of chemical compounds, are also responsible for the colour, flavour, and odour of plant food, such as blueberries' dark hue, broccoli's bitter taste, and ginger's pungent odour (Slavin & Lloyd, 2012).

Traditional crops which are the chief ingredient for preparing traditional delicacies have been largely ignored by commercial farming, research, and development, thus becoming less competitive than well-established major crops and losing gradually their diversity and their associated traditional knowledge (Mbhenyane, 2017). Because of the increasing globalization and internationalization of the food market, many traditional foods are at risk of disappearing. The documentation of traditional foods and dishes is essential for sustaining traditional foods, which are an important part of cultural heritage (Glibetic *et al.*, 2018). Infertility, heart diseases, diabetes, autoimmune diseases, mental illnesses, obesity, dental cavities, and other diseases are largely absent in cultures subsisting on a native diet of unrefined foods (McGruther, 2014). Provision of and access to traditional food sources are declining as natural habitats come under increasing pressure from development, conservation exclusion, and agricultural expansion. Despite the value of traditional foods, they are excluded from official statistics on the economic value of natural resources (Mbhenyane, 2017). The lack of data on the phytochemical content of the traditional dishes gives rise to non-communicable chronic diseases associated with the changing diet and lifestyles (Traka & Mithen 2011). Although, many rural communities have access to traditional crops that are rich in micronutrients and phytochemicals, which are likely to serve as a long-term strategy to eliminate food insecurity, nutrition information of the traditional foods is lacking (Mbhenyanne, 2017). This study therefore is aimed at providing empirical nutrition data of traditional soups with a view to adding to the body of knowledge on the nutritional benefits of local foods.

Objectives of the study: The general objective of the study was qualitative and quantitative evaluation of phytochemicals in traditional soups commonly consumed in Enugu State, Nigeria. Specifically, the study carried out:

1. qualitative analyses of phytochemicals in traditional soups ("Egusi" soup, Vegetable soup and "Uchakiri" soup) commonly consumed in rural and urban community Enugu state.
2. quantitative analyses of phytochemical in the traditional soups ("Egusi" soup, Vegetable soup and "Uchakiri" soup) commonly consumed in rural and urban community of Enugu state.

Materials and methods

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

Soup sample preparation: The traditional soups documented in each community were prepared by women from those communities using the recipes collected from Focus Group Discussion as detailed below. The soup preparation was done in the Diet Therapy Laboratory, Home Science and Management Department, University of Nigeria Nsukka, Enugu State.

Preparation of samples for chemical analysis: After cooking, the soup samples were homogenized, properly packaged, labelled and taken to the Food and Nutrition Laboratory, Department of Home Science and management, University of Nigeria Nsukka for qualitative and quantitative evaluation of phytochemicals.

Recipe: "Egusi" soup

Ingredients	Quantity
"Egusi" seed (melon seeds)	1 cup
Meat, chicken or fish	675g
Dried crayfish or shrimp	½ wrap
Leafy spinach, bitter leaf or other greens	½ wrap
Palm oil	1 cup
Chili peppers	2-3 tablespoon
Onions (chopped)	1 big bulb
Salt	to taste
Bouillon cubes	4 cubes

Method of Preparation

1. Chop finely and fry the onions, and pepper for 5 minutes in palm oil.
2. Grind or crush the "Egusi" seeds and mix it with enough water to make a paste and add to the above together with shrimp or crayfish.
3. Cut the meat into bite-sized chunks and add I cup of water, half teaspoon of salt, onions and bouillon cubes and boil.
4. When the meat gets brownish, add it to the above sauce and cook until tender.
5. Add the bunch of washed bitter leaf (finely chopped) or any other vegetable of choice (washed and chopped) 10 minutes before the end of cooking time.

Recipe name: Vegetable soup

Ingredients	**Quantity**
"Ugu"(pumpkin leaf)	150g
Green	100g
"Anyara"(garden egg leaf)	100g
Akparata	100g
Crayfish	50g
"Okpei" (locust bean)	25g
Pepper	30g
Salt	to taste
Bouillon cubes	2 cubes

Method of preparation:

1. Bring everything to a boil
2. Dissolve "Akparata "with palm oil and add to boiling water
3. Bring to boil and add the vegetables
4. Cook for few minutes and taste
5. Serve with "Akpu"

Recipe name: "Uchakiri" Soup

Ingredients	Quantity
Dried "uchakiri" leaf	100g
Palm oil	½cup
Crayfish	25g
"Okpei" (locust bean)	10g
Pepper	10g
Salt	to taste
Bouillon cubes	2 cubes

Method of preparation

1. Soak the "uchakiri" leaf in boiled water till soft, drain water and pound.
2. Melt palm oil.
3. Add pepper, "okpei" (locust bean), salt, water, pounded "uchakiri" to the palm oil and mix together.
4. Cook for 2-3 minutes.
5. Serve with boiled yam.

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 et al., (2017) was used. Test recommended by Ejikeme et al., (2014) was used to detect the presence of terpenoids. 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 extract 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 indicated the presence of flavonoid. To 2ml of the test solution, a few drops of ferric chloride solution were added. Bluish green colour indicated 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 changed to blue or green colour, showed the presence of steroid. 1g of each sample was extracted with 10ml of chloroform in a test tube with vigorous shaking. The resulting mixture was filtered and 85% sulphuric acid added, a blue colour at the interface showed the presence of caroteniod.

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 (AMCRS) was used for phenols determination. To determine terpenoid, about 10g of the sample was taken and soaked in alcohol for 24hours.

It was filtered and filtrate extracted with petroleum ether; this ether extract was treated as total terpenoids. Onwuka G. I. (2005) was used to determined glycoside. To determine steroid, 1ml of Methanolic extract steroid solution was transferred into 10ml volumetric flask. Sulphuric acid (4N, 2ml) and iron (III) chloride (0.5% w/v, 2ml), were added, followed by potassium hexacyanoferrate (III) solution (0.5% w/v, 0.5 ml). The mixture was heated in a water-bath maintained at 70±20C for 30 minutes with occasional shaking and diluted to the mark with dilute water. The absorbance was measured at 780nm against the reagent blank. To determine carotenoid, a measured weight of each sample wee homogenized in methanol using a laboratory blender. A 1:10 (1%) mixture was used. The homogenate was filtrate to take up the carotenoid mixed well and then treated with 20ml of distilled water in a separating funnel. The other layer was recovered and evaporated to dryness at low temperature (3550^{o}C) in a vacuum dessicator. The dry extract was then saponified with 20ml of ethanoic potassium hydroxide and left-over night in a dark cupboard. The next day, the carotenoid was taken up in 200ml of ether and then washed with two portions 20ml distilled water. The carotenoid extract (ether layer) was dried in a dessicator and then treated with a light petroleum (petroleum spurt) and allowed to stand overnight in a freezer (-10^{o}C). The next day, the precipitate steroid was removed by centrifugation and the carotenoid extract was evaporated to dryness in a weighed evaporation dish, cooled in a dessicator and weighted. The weight of the carotenoid was determined and expressed as a percentage of the sample weight.

Statistical analysis: Data obtained was analyzed statistically using Statistical Package for Service Solution (SPSS), version 22 and presented as Mean ± Standard deviation.

Results

Table 1 shows the qualitative analysis of phytochemicals of the soup samples. Carotenoids were present in appreciable amount (++) while phenol was present in minimal amount (+) in all the soup samples. Glycoside, terpenoid and saponin were not detected (-) in Vegetable and "Uchakiri" soup. All the phytochemicals were found in "Egusi" soup. Alkaloid was present in appreciable amount (+++) in "Egusi" and Vegetable soups.

Table 1: Qualitative analyses of phytochemicals in the traditional soups

Phytochemicals	Soup Sample		
	"Egusi" soup	**Vegetable soup**	**"Uchakiri" soup**
Tannin (%)	++	++	-
Phenol (%)	+	+	+
Flavonoid (%)	+	++	++
Saponin (%)	+	-	-
Alkaloid (%)	+++	+++	+
Carotenoid (mg)	++	++	++
Glycoside (mg)	+	-	-
Terpenoid (%)	+	-	-
Steroid (%)	+	+	-

Keys; +++ = present in appreciable amount; ++ = moderately present; + = minimally present; - = not detected.

Table 2 reveals the quantity of phytochemicals in the traditional soups. The highest tannin, flavonoid and alkaloid content (0.34%), (4.00%) and (3.93%) respectively were found in Vegetable soup while Phytate and caroteniod values ranged from 0.03-0.54 and 2.45-6.82mg respectively. Tannin, flavonoid, terpenoid, steroid, saponin and glycoside were not found in "Uchakiri" soup. The highest amount of the phytochemical saponin (9.57%) was found in "Egusi" soup.

Table 2: Phytochemical composition of traditional soups

Phytochemicals	Soup Sample		
	"Egusi" soup	**Vegetable soup**	**"Uchakiri" soup**
Tannin (%)	0.24+0.01	0.34+0.00	ND
Oxalate (%)	0.64+0.00	0.18+0.00	0.27+0.01
Phenol (%)	0.30+0.00	1.64+0.00	1.99+0.01
Flavonoid (%)	1.93+0.00	4.00+0.00	ND
Phytate (%)	0.03+0.00	0.54+0.00	0.03+0.00
Saponin (%)	9.57+0.02	ND	ND
Alkaloid (%)	3.85+0.01	3.93+0.01	1.86+0.00
Carotenoid (mg)	4.12+0.07	2.45+0.14	6.84+0.02
Glycoside (mg)	2.33+0.00	ND	ND
Terpenoid (%)	2.97+0.01	ND	ND
Steroid (%)	5.38+0.00	2.16+0.07	ND

Key; ND = not detected.

Discussion

The phytochemical screening of the traditional soup samples obtained in this study revealed that the soups contain tannin, saponin, carotenoid, flavonoid, saponin and phenol though there were few exceptions. In "Egusi "soup (melon soup), alkaloid was present in

appreciable amount (+++), tannin and carotenoid were present in moderate amount (++) while phenol, steroid, flavonoid, glycoside, terpenoid and saponin were minimally present (+). This result disagrees with the findings of Ebana et al. (2014) which showed that alkaloid, glycoside, saponnin, flavonoid and phenol were minimally present (+) while tannin was not detected in cooked melon seeds. The presence of tannin in "Egusi" soup could be due to the fact that the soup contained other ingredients like vegetables. According to Ghosh (2015), tannins are group of phytochemicals found to be present in various concentrations in many fruits and vegetables consumed by human. The reduction in the number of phytochemicals like phenol, glycoside, phytate would have been caused by high heat used in preparing the soup. High heat especially when boiling can lead to a reduction in the amount of phytochemical (Atli, 2017; Shunmugariya & Kalasielvan, 2017; Hotz & Gibson, 2017).

The vegetable soup was prepared using fluted pumpkin leaves (ugu), garden egg leaves (anara), "akparata" (Afezelia Africana) as the main ingredients. This study revealed that alkaloid was present in appreciable amount (+++), tannin, carotenoid and flavonoid were present in moderate amount (++), phenol and steroid were minimally present (+), while glycoside and terpenoid were not detected. Fakoya et al. (2019) recorded that fluted pumpkin leaf (ugu) extract, had saponin, tannin and glycoside were present in moderate amount (++), while alkaloid, flavonoid and glycoside were not detected. Saponin and tannin were present in moderate amount (++), alkaloid, terpenoid and phenol were minimally present (+), while steroid was not detected in garden egg (anara) leaf (Ibrahim et al., 2019). Friday et al., (2018), also reported that tannin, phenol, steroid, flavonoid, terpenoid and saponin were minimally present in "akaprata" (Afezelia Africana). The above ingredient contributed to the phytochemicals in the soup. Although some of the findings from the above mentioned researchers of the single ingredient used to prepare the soups correspond with the findings of this work, the increase in the detected phytochemicals in vegetable soup could have resulted from the combination of the different vegetables used in preparing the soup. According to Group, (2014), Phytochemicals are chemical compounds produced by plants that are commonly found in fruits, vegetables, nuts, legumes and grains. The reduction of phytochemical detected of the vegetable soup compare to the phytochemicals detected in the simple soup ingredients could be attributed to the effect of high heat used in preparation of the soup. According to Nandya, et al., (2020), phytochemicals in vegetables are reduced by the application of high heat such as boiling, drying etcetera. The phytochemical screening of the traditional soup samples obtained in this study revealed that the soups contain tannin, saponin, carotenoid, flavonoid, saponin and phenol though there were few exceptions.

"Uchakiri" leaf which is one of the major ingredients for "Uchakiri" soup contains great amount of phytochemicals as observed by Otitoju et al. (2014). However, the result from the phytochemical screening of "Uchakiri"

soup revealed that compared to "Egusi" and vegetable soups, "Uchakiri" soup contained the least of phytochemicals. Carotenoid and flavonoid were present in moderate amount (++), phenol and alkaloid were minimally present (+), while tannin, steroid, glycoside, terpenoid and steroid were not detected. This finding disagrees with the findings of Dawang, (2015), who reported that alkaloid, flavonoid, glycoside, steroid and terpenoid were minimally present (+), while tannin, saponin and phenol were not detected in "uchakiri" leaves. Phytochemicals such as glycoside and flavonoid are reduced my heat during cooking (Parlermo et al., 2014; Islamiyat et al., 2016). This could be the reason why the phytochemicals were not detected in the soup sample but were present in raw "uchakiri" leaves. Ware (2017) also recorded that polyphenols in foods vary depending on where the food is grown, how it is farmed and transported, how ripe it is, and how it is cooked or prepared. All traditional soup samples contained alkaloid which plays an important role in the defense systems against pathogens and animals and possesses antimicrobial and anti-parasitic activities (Bouayad et al., 2011).

In this study, the phytochemical content of "Egusi" (melon) soup varied from what was observed by Okorie (2018) in Abakaliki-indigenous Nigerian melon (isekele) seed flour. This study observed saponin (9.57%) flavonoid (1.93%), carotenoid (4.12mg) and alkaloid (3.85%). while Okorie (2018) detected saponin (6.10%), carotenoid (0.85%), flavonoid (2.90%) and alkaloid (2.90%). This variance could be due to the location the "egusi" is gotten from, the process and preparation method of the samples. Agronomic practices and climatic factors affect the content and profile of phytochemicals. The effect of the environment such as salinity, climate and other abiotic factors, promotes biochemical responses, including changes in quality and quantity of phytochemicals (Borges et al., 2018 & Okunlola et al., 2017).

Vegetable soup in this work contains tannin (0.034), phenol (1.64%), flavonoid (4.00%) and alkaloid (3.39). The findings by Umeoka (2018) revealed that fluted pumpkin leaf (ugu) extract contains tannin (0.437%), phenol (12.2%), flavonoid (1.50%) and alkaloid (1.35%). While the findings by Ndulaka, et al., (2017), revealed that "akparata" (Afezelia Africana) contains tannin (3.55%), phenol (0.78%), flavonoid (1.13%) and alkaloid (1.35%). Also, Eze & Kanu (2014) reported that garden egg (anara) leaf contains tannin (0.14%), phenol (0.24%), flavonoid (0.45%) and alkaloid (0.77%). The reduction in the phytochemical content could be attributed to food preparation or processing method. Certain phytochemicals such as phenol is affected by heat during food preparation/cooking method, fermentation, soaking, roasting, washing, rubbing and other food processing methods reduces flavonoid in food (Nicoletta *et al*., 2010; Elket & Zannini, 2013; Kumar & Panday, 2013; Scalzo, 2016).

This study revealed that "Uchakiri" soup contained oxalate (0.27%), alkaloid (1.86) and carotenoid (6.8mg). The research by Otutoju et al., (2014), revealed that cooked "Uchakiri" leaf contains oxalate (1.95%), alkaloid (1.23%) and carotenoid (0.11%). The above report disagreed with the result obtained in this work. The disparity

could be due to the cooking method used, the storage and processing method used. Certain process such as conventional cooking methods, storage and processing affects the quantity of phytochemicals present in food (Elkek & Zannini, 2013; Nicoletta et al., 2010; Sabrina & Nissreen, 2011).

Conclusion

The selected traditional soups contain a substantial amount of phytochemicals which are helpful in the prevention of some deadly diseases and these phytochemicals varies between the soups. "Egusi" soup showed the higher presence of all the phytochemicals than vegetable and "Uchakiri" soups. Most of the quantified phytochemicals were seen to be within their tolerable limit except for saponin in "Egusi" soup. Although, the reduction of some phytochemicals might have been caused by heat, the traditional soups have shown to be a good source of phytochemicals. Therefore, their consumption should be encouraged.

Recommendation

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

- Further studies should be conducted on traditional soups consumed in different region and its nutrition data made available.
- Due to the health benefits of phytochemicals, consumption of traditional soups (particularly those that had tolerable limits of phytochemicals) should be encouraged.
- The traditional soups should be made popular across the country; this will help in enriching the Nigerian traditional food habits and improving the health status of the population.

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