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Physicochemical Properties of Aqueous Extract from Curry Paste of Selected Local Medicinal Soups in Eastern Nigeria

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Abstract: Aqueous extract from curry paste of some local soups commonly consumed in South East Nigeria were analysed for their physicochemical and antibacterial properties. Ingredients for soups namely 'Kontomire', 'Ofensala' and 'Igbagba' were either blanched in boiling water or un-blanched, blended into paste and the extracts were subjected to various analyses using standard methods. The results revealed that the soup water extracts were in the neutral pH values of 6.62-6.75. Proximate composition determination showed that the curry paste contained very low protein (0.57% to 1.60%). It was observed that all the soup extracts were able to inhibit the growth of *S. aureus* (19.0 mm-25.0 mm). In addition, soup extracts scavenged DPPH radical (2, 2-diphenyl-1-picrylhydrazyl) with values ranging from 41.41%-94.00%. The result from the phytochemical analysis showed that all the soups contained flavonoid (2.82mg/g-3.81mg/g). These findings may explain the medicinal value attributed to the soups by the local consumer.

Keywords: Antibacterial, Aqueous Extract, 'Kontomire' 'Ofensala' 'Igbagba' Soups, Physicochemical Properties

1. Introduction

Plants are rich sources of functional dietary micronutrients, fibres and phytochemicals that may singly or synergistically offer health benefits since they demonstrate antioxidant activity [1]. World Health Organization reported that a healthy diet formulated from plant sources is abundant in bioactive compound [2]. Health benefits of herbs and spices are well documented in the literatures [3, 4, 5, 6]. Many spices have been reported to possess antioxidant, antimicrobial, cholesterol lowering effects, and anti-diabetic properties [7, 8, 9]. The rural population who do not have access to primary health care may depend solely on plant remedies for their health challenges.

Medicinal plants play a significant role in providing nutrient composition that can support health of the consumer [10]. Medicinal soups have substantial antioxidant activity owing primarily to phenolic compounds, especially flavonoids which influence nutrition and the absorption of other nutrients. Antioxidants from plant sources can act as natural preservatives, preventing or slowing the spoilage of food, leading to a higher nutritional content in stored foods [4, 5, 11]. The aqueous extract of palm fruits possess high total antioxidant capacity, ferric reducing power and effectively inhibited lipid peroxidation as shown by low concentration of thiobarbituric acid [12]. The antimicrobial and antioxidant effects of Thai seasoning, Tom-Yum [13], stability of antibacterial property of Thai green curry during chilled storage [14] and the phytochemical and antioxidant properties of instant 'irihibo-toh', 'iribo-erharhe', and 'afia efere' soups have been reported [15].

The medicinal soup curry pastes investigated in this study are 'Ofensala', 'Igbagba' and 'Kontomire' soups commonly consumed in Eastern Nigeria. This present study was carried out to study the physicochemical, antioxidant and antibacterial properties of the local medicinal soup pastes or aqueous extract from the soup pastes.

2. Materials and Methods

2.1. Medicinal Soups and Their Ingredients

2.1.1. Ofensala Soup

"Uziza" (*Piper guineense*), "Eheru" (*Monodora myristica*)

known as African calabash nutmeg, "Uda" (*Xylopia aethiopica*), "Utazi leaf" (*Gongronema latifolium*), "Uchumo" (*Tetrapleura tetraptera*).

2.1.2. Igbagba Soup

Lemon grass (*Cymbopogon citratus*), "Otaiko" (*Aframomum creptum* L.), "Iregeje" (Asy*stasia gangetica* L.) and "Uda" (*Xylopia aethiopica*).

2.1.3. Kontomire Soup

Red cocoyam leaves (*Colocasia esculenta)*, onion (*Allium cepa*) and pepper.

The spices and herbs employed in the production of the medicinal soups were purchased from the local market in Akure, Ondo State, Nigeria. The ingredients were thoroughly washed with portable water to remove dirt and sand particles and then with distilled water and allowed to drain. Ingredient for each soup was prepared according to local method, divided into two and one portion was blanched in boiling water for one min while the other was left unblanched [14]. The blanched ingredients were allowed to cool down at room temperature for 5 min. Both the blanched and unblanched were separately blended into smooth paste using a blender. The blended curry was mixed together, packaged into polyethylene plastic bags, sealed and then stored at 4°C for further analyses.

2.2. Preparation of Curry Extract

The blended curry paste was brought out of the refrigerator and after opening the sealed polythene bags, the curry was placed in a sterile muslin cloth used as sieve. The curry was pressed with the hand (covered with gloves and sterile polythene bag) to remove the water (aqueous curry extract) from the curry [14].

2.3. Determination of pH and Total Titratable Acidity (TTA) of the Curry Extracts

The pH was determined using a pH meter (Mettler 350). Total titratable acidity was determined according to the method of Association of Official Analytical Chemists [16]. About 10 ml of curry aqueous extract was pipette into a test tube and two drops of phenolphthalein indicator was added and thoroughly shaken. The mixture was titrated against 0.1M NaOH till change in colour was observed and acidity calculated.

2.4. Determination of Proximate Composition of Curry Pastes

The proximate compositions of the curry pastes (moisture, ash, fibre, protein and carbohydrate) were determined using the method of Association of Official Analytical Chemists [16].

2.5. Determination of Antibacterial Properties of Curry Paste Aqueous Extracts

The antibacterial analysis was done using the Agar Diffusion Method [17]. Eight bacterial isolates (*Bacillus subtilis, Bacillus cereus, Enterobacter aerogenes, Serratia marcescens, Shigella spp., Staphylococcus aureus*, *Pseudomonas* spp. and *Escherichia coli*) were obtained from the Microbiology Department, Federal University of Technology, Akure. The bacterial isolates were standardized using colony suspension method and matching the culture with 0.5 McFarland standards to give a resultant concentration of 10^8 CFU/ml. The susceptibility test was determined by swabbing the Mueller-Hinton agar (MHA) (Oxoids U. K) plates with the resultant saline suspension of each culture and four wells were made in the agar with the aid of cork-borer of 8mm diameter size. About 0.8 mm of each extracts was dispensed in each well. The control was set up by filling wells with same volume of sterile water. The plates were then incubated at 35°C for 24 h. The experiments were performed in duplicates and the means of the diameter of the zone of inhibition were calculated.

2.6. Determination of Antioxidant Activity of Curry Paste Aqueous Extracts

The free radical scavenging activity of curry paste aqueous extracts against 1, 1-diphenyl-2-picrylhydrazyl (DPPH) was evaluated [18]. Thiobabituric acid reactive substances (TBARs) of curry paste aqueous extracts were evaluated. One gram of sample was mixed with 4ml of a solution containing 0.375% thiobabituric acid, 15% trichloro-acetic acid and 0.25 N HCl and the level of lipid peroxidation was recorded [19]. Vitamin C content of the water extract from the curry paste was determined [20].

2.7. Determination of Phytochemical Constituents of Water Extract from the Medicinal Soup Curry Pastes

Water extract from the curry pastes were tested for saponin, tannin, flavonoid and phenol using solvent extraction method [21].

2.8. Statistical Analysis

All the experiments were carried out in triplicate and data obtained were analyzed using analysis of variance (ANOVA) and Duncan's new multiple range tests using a 5% significance level (SPSS version 19 computer software).

3. Results and Discussion

pH and Total titratable acidity of soup ingredients

Table 1. *Total titratable acidity (TTA) and pH of local soup samples.*

Sample	pH	TTA (%)
OU	6.66±0.08[a]	0.37±0.06[a]
OB	6.70±0.05[a]	0.30±0.01[a]
KU	6.62±0.18[a]	0.27±0.06[a]
IU	6.70±0.15[a]	0.3±0.00[a]
IB	6.62±0.01[a]	0.30±0.01[a]
KB	6.75±0.01[a]	0.30±0.01[a]

Values are means ± SD from triplicate determinations, different superscript in the same column are significantly different.
Note: OU: Ofensala unblanched; IB: Igbagba blanched; OB: Ofensala blanched; KU: Kontomire unblanched; KB: Kontomire blanched; IU: Igbagba unblanched.

Table 1 showed that there was no significant difference in pH and total titratable acidity (TTA) of the soup samples. The pH values of the soups ranged from 6.62 in Kontomire unblanched (KU) and Igbagba blanched (IB) to 6.75 in Kontomire blanched (KB). pH of the local soups were very close to neutral which means that the soups are not acidic in nature. This is also evident in the TTA values of the soups (0.30-0.37). The pH of the local soup ingredients were in the same range with Sa-tay marinade, a popular dish in Thai restaurant [22] but higher than that of Thai green curry [14].

Proximate composition of soup ingredients

Table 2 revealed that soup ingredients possessed high moisture content (79.79%-83.09) and very low protein (0.57%-1.60%), fibre (1.72%-2.39%), fat (6.65%-9.35%) and carbohydrate (5.76%-1.60%). This result is similar to the report of some soups and stew consumed in Ghana where high moisture and low protein content was observed [23]. The low protein content may be explained that the soup ingredients are made of plant materials that have little or no protein.

Table 2. *Proximate composition (%) of local soups.*

Samples	Fat	Crude Fibre	Moisture Content	Ash	Crude protein	Carbohydrate
OU	6.65±0.0^{f}	2.39±0.0^{a}	83.09±0.01^{c}	0.46±0.0^{a}	0.57±0.01^{f}	6.84±0.01^{d}
OB	9.35±0.0^{a}	2.18±0.0^{b}	81.60±0.01^{a}	0.46±0.0^{a}	0.65±0.0^{e}	5.76±0.01^{e}
KU	8.83±0.0^{c}	1.72±0.0^{e}	79.79±0.01^{e}	0.23±0.0^{d}	0.82±0.0^{d}	8.61±0.01^{b}
IU	8.90±0.0^{b}	1.92±0.0^{c}	80.65±0.01^{d}	0.34±0.0^{b}	0.88±0.0^{b}	7.31±0.01^{c}
IB	7.48±0.0^{e}	1.85±0.0^{d}	83.82±0.01^{b}	0.24±0.0^{d}	1.60±0.0^{a}	5.01±0.01^{f}
KB	8.32±0.0^{d}	1.83±0.0^{d}	78.82±0.01^{f}	0.30±0.0^{c}	0.86±0.01^{c}	9.87±0.01^{a}

Values are means ± SD from triplicate determinations, different superscript in the same column are significantly different.
Note: OU: Ofensala unblanched; IB: Igbagba blanched; OB: Ofensala blanched; KU: Kontomire unblanched; KB: Kontomire blanched; IU: Igbagba unblanched

Antibacterial activities of water extract from the soup ingredients

The ability of the water extracts from the soup pastes to inhibit the growth of test organisms is shown on Table 3. It was observed that all the extracts demonstrated inhibition against *S. aureus* (19.0 mm-25.0 mm), four of the soup extracts were able to inhibit the growth of *E. coli* (18.0 mm-26.0 mm) and three extracts (20. 0 mm-27.0 mm) inhibited the growth of *B. subtilis*. Unblanched 'ofensala' soup extract produced highest antibacterial activity against five bacterial isolates, followed by 'kontomire' and then 'igbagba' soup extract. Several research findings have reported the antimicrobial properties of medicinal plants [4, 5, 6, 24, 25].

Table 3. *Antibacterial properties (mm) of water extract from local soup pastes.*

Microorganisms	KB	KU	OB	OU	IB	IU
Bacillus subtilis	20	24	-	-	27	-
Escherichia coli	-	18	26	16	19	-
Bacillus cereus	20	-	-	23	-	-
Enterobacter aerogenes	-	26	24	-	-	-
Staphylococcus aureus	24	22	25	20	22	19
Serratia marcescens	-	-	-	-	-	26
Pseudomonas spp	-	-	-	23	-	-
Shigella spp.	-	-	-	21	-	-

Note: OU: Ofensala unblanched; IB: Igbagba blanched; OB: Ofensala blanched; KU: Kontomire unblanched; KB: Kontomire blanched; IU: Igbagba unblanched.
-: no inhibition.

Antioxidant property of aqueous extract from soup pastes

Table 4 shows the result of the free radical scavenging (DPPH), TBARs and Vitamin C content of the soup extracts. It was revealed that DPPH values of the soups ranged from 41.41% from 'ofensala' blanched to 94.0% in 'kontomire' blanched. Result obtained from TBARs (0.041 mg MDA/g-0.08 mg MDA/g) may explain the ability of the extract to delay lipid oxidation. Antioxidant activities exhibited by extract from soup pastes may be attributed to bioactive compounds present in the ingredients. Polyphenolic compounds are found to be responsible for the antioxidant activity of natural extract due to their chemical structures and redox properties [26]. Antioxidant properties of hydrophilic and lipophilic extract constituents of *Corchorus olitorius* vegetable has been assessed [27]. Antioxidant property demonstrated by plant extracts revealed the potentials of herbs and spices to serve as alternate food preservatives which may also be employed as ingredients in functional foods. The reduction in vitamin C content when the unblanched sample (2.57 mg/mL-4.04 mg/mL) is compared with blanched (0.67 mg/mL-2.16 mg/mL) in this work may be attributed to processing methods. However, blanching has been reported to reduce the number of microorganisms present on the surface of spices [14].

Table 4. *Antioxidant properties of the local soups.*

Soup samples	DPPH (%)	TBA (mgMDA/g)	VIT. C (mg/mL)
KU	52.97±0.27^{e}	0.08±0.00^{a}	4.04±0.01^{a}
OB	41.41±0.00^{f}	0.07±0.00^{c}	0.67±0.01^{f}
IU	70.87±0.00^{c}	0.061±0.00^{d}	2.76±0.00^{b}
KB	94.00±0.30^{a}	0.05±0.00^{e}	1.58±0.01^{e}
OU	73.14±0.50^{b}	0.04±0.00^{f}	2.57±0.01^{c}
IB	61.57±0.06^{d}	0.08±0.00^{b}	2.16±0.01^{d}

Values are means ± SD from triplicate determinations, different superscript in the same column are significantly different.
Note: OU: Ofensala unblanched; IB: Igbagba blanched; OB: Ofensala blanched; KU: Kontomire unblanched; KB: Kontomire blanched; IU: Igbagba unblanched.

Phytochemical constituents of soup pastes water extracts

Result on Table 5 shows that the ingredients used in soups contained higher concentration of saponin (2.72 mg/g-23.27 mg/g) compared to flavonoids (2.82 mg/g-3.81 mg/g), tannin (0.03mg/g-0.04 mg/g) and phenol (0.33 mg/g-0.47 mg/g). Saponin has been reported as an anti-nutritional agent. However, it is associated with the beneficial effect of lowering cholesterol and perhaps glucose [28]. This result may be linked to local beliefs that consumption of 'ofensala' soup may reduce hypertension and diabetes mellitus. Antibacterial and antioxidant properties demonstrated by the soup aqueous extracts may be attributed to the phytochemicals present in them. Phytochemicals in fruits, vegetable, spices and medicinal plants have been reported to inhibit lipid peroxidation and demonstrated radical scavenging activity [29].

Table 5. *Phytochemical properties (mg/g) of local soups.*

Samples	Flavonoids	Tannin	Phenol	Saponin
KU	3.81 ± 0.01^{a}	0.03 ± 0.00^{d}	0.47 ± 0.00^{a}	2.72 ± 0.89^{f}
OB	2.83 ± 0.58^{d}	0.03 ± 0.01^{d}	0.33 ± 0.09^{d}	23.27 ± 0.65^{a}
IU	3.41 ± 0.00^{c}	0.03 ± 0.00^{c}	0.39 ± 0.01^{c}	15.27 ± 0.95^{c}
KB	3.61 ± 0.00^{b}	0.04 ± 0.00^{b}	0.44 ± 0.00^{b}	11.09 ± 0.02^{d}
OU	2.96 ± 0.30^{d}	0.04 ± 0.01^{b}	0.35 ± 0.00^{d}	20.18 ± 0.91^{b}
IB	2.98 ± 0.26^{d}	0.04 ± 0.00^{a}	0.36 ± 0.00^{d}	7.46 ± 0.18^{e}

Values are means ±SD from triplicate determination; different superscript in the same column are significantly different ($P<0.05$).
Note: OU: Ofensala unblanched; IB: Igbagba blanched; OB: Ofensala blanched; KU: Kontomire unblanched; KB: Kontomire blanched; IU: Igbagba unblanched.

4. Conclusion

This study has provided information on the physicochemical properties of the selected local soups. Owing to good antioxidant and antibacterial activities recorded from the water extract of 'ofensala', 'kontomire' and 'igbagba' soup pastes, further studies should be carried out to investigate the application of the herbs and spices used in preparing the soups in food and pharmaceutical industries.

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