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Nutritional and sensory evaluation of indigenous soups produced from local spices

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Abstract

This study has provided insights on the nutritional and sensory evaluation of spices in soup. The Spices are naturally cooked and are safer and healthier for adults than the foreign Soups which are often preserved with poisonous chemicals. These spices in soups were subjected to laboratory analysis for their nutritional and mineral contents using standard methods. The result revealed that the moisture content of the blends ranged from 10.15 to 3.88 (mg/100 g). ash content of the blends ranged from 14.90 to 5.31 (mg/100 g). The protein content of the blends ranged from 28.93 to 9.10 (mg/100 g). Sodium content of the products ranged from 9224.73 to 432.05 mg/100g and potassium content ranged from 111234.03 to 11321.06 mg/100g with significant differences ($p<0.05$) among the samples. Seasoning containing MPs moringa pepper soup has a higher ($p < 0.05$) fat content (41.62mg/100g) compared to seasoning made from MMr and PsO.The blend with MMrC (Moringa + Marugbo + Cottonseed) had the best sensory properties as well as taste control, texture, and general acceptability. The study concludes that traditional soups can be used as vehicles or carriers of nutritional/medicinal benefits. It is believed that the production and distribution of these spices in soups can improve the nutritional status of the dependent groups.

Keywords: Nutrition; Sensory; Spices; Soups; Proximate; Minerals; Tradition

1. Introduction

Nigeria is a multicultural society with a variety of traditional vegetable soups originating from different ethnic groups and eaten with traditional staples of cassava, yam, coconut, sweet potato, plantain, millet, rice, and corn (Ndulaka *et al.,* 2017). The soups are made with local vegetables, which are not only known to be rich in nutrients but also healthy (Niaz *et al.,* 2018). The use of dietary antioxidants from these vegetables contributes to disease prevention (Acott *et al*., 2015). In addition to promoting good well-being, increased use of these native vegetables will help increase crop diversity, reduce poverty, and promote food security (Carrero *et al.,* 2020). These vegetables have received significant attention due to increased awareness of their health-promoting properties and bioactive phytochemicals, which have been linked to strengthening against cardiovascular disease and other degenerative diseases (Carrero *et al*., 2020).

Soups are naturally rich in micronutrients in all ethnic groups, which reduces the incidence of some micronutrient deficiencies (Acott *et al*., 2015). Urbanization and wildlife are closely related concepts, and these two factors are now persuading people to embrace ready-to-eat, processed junk foods that are high in sugar, fat, and salt, and low in nutritional value in terms of protein, fiber, Vitamins, and minerals (Carrero *et al*., 2020). Eating these nutrient-poor foods eventually exacerbated the problems associated with malnutrition (Acott *et al.,* 2015). To overcome these problems, we need to develop nutritious, ready-to-eat food products suitable for everyday needs (Prakash *et al.,* 2020). From this point of view, various spice powders can be a good choice as their popularity among different groups of people increases due to their short reconstitution time, protection from enzymatic and oxidative deterioration, and taste stability of the piece over a longer period (Carrero *et al*., 2020). However, various locally available spice powders and condiments are not nutritionally consistent (Acott *et al.,* 2015). The nutritional quality of different local spices and spice

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powders can be improved by supplementing them with mushrooms, moringa leaf powders, and soybean flour (Prakash *et al.,* 2020).

Today, health improvement strategies are driving growth in the food industry market. Interestingly, around 77% of African households report trying to reduce their risk of heart disease and cancer (Acott *et al.*, 2015). Approximately 66% of Americans ages 36 to 55 are increasingly interested in adopting healthy eating habits and turning to local cuisine based on the perceived health benefits associated with that type of cuisine (Carrero *et al.,* 2020). While some indigenous cuisines are considered healthier than others, so are general patterns of food use and food harvesting techniques (Aigberua and Izah 2019; Aokache *et al*., 2020).

Herbs and spices were used in ancient times for flavoring, preserving food, and for medicinal purposes; It is unclear exactly how herbs and spices were used in food and medicine until modern times (Kadiri and Olawoye, 2015; Acott *et al.,* 2015). Questions related to the prevention of food-borne illnesses have long preoccupied scientists, local health authorities, and community authorities (Kadiri and Olawoye, 2015).

The general objective of the research is to assess some developed spices seasoning on soup and determine their Nutritional and Sensory qualities for male and female adults' acceptability in the polytechnic community in Owo local government area of Ondo State.

2. Materials and methods

2.1. Materials

The material for the organoleptic study was obtained from different locations, some materials like Moringa (*Moringa oleifera)*, Cottonseeds (*Gossypium barbadense)*; Morugbo (*Clerodendrum volubile)* were purchased from Emure Local Market, Owo in Ondo State. While, other materials like Palm Oil, Meat, Fish, Snail, pepper, locust bean (*Ceratonia siliqua*), ginger (*Zingiber afficinale)*, garlic (*Allium sativum)*, Calabash nutmeg (*Monodoro myristica*), turmeric (*Curcuma longa),* Alligator Pepper (*Afrmomum meleguta)* and scent leaf (*Ocimum gratissimum)* were purchased from Oghwagbe Market (Oja Ikoko), in Owo, Ondo State.

2.2. Production of the soups

The preparation methods used for the selected soups were those earlier established by the recipe book of the Federal Institute of Industrial Research (FIIRO, 2006). Also, follow the recipe carefully, using the correct amounts of the main ingredients. Use stock in preference to water. Season and taste carefully. Make soup of the correct consistency e.g. glossy, smooth free from lumps, use ideal finish e.g. Crotons, royale, etc. Skin all fat(s). Serve very hot or very chill with the correct garnish (Zeb, 2020). Nine different composites soup blends were formulated as shown in Table 1:

Table 1 Soup blends from Moringa, Marugbo, Cotton seed and pepper soup spices

Samples Codes		Blend ratio	Moringa	Pepper Spices	Marugbo	Cotton Seed
1	MO	100:0	500.00g	0.00g	0.00g	0.00g
2	MPs	40:60	200.00g	300.00g	0.00g	0.00g
3	MMr	40:60	200.00g	0.00g	300.00g	0.00g
4	MC	40:60	200.00g	0.00g	0.00g	300.00g
5	MMrC	40:30:30	200.00g	0.00g	150.00g	150.00g
6	MrO	100:0	0.00g	0.00g	500.00g	0.00g
7	CO	100:0	0.00g	0.00g	0.00g	500.00g
8	MrC	50:50	0.00g	0.00g	250.00g	250.00g
9	PsO	100:0	0.00g	500.0g	0.00g	0.00g

Key: MO = Moringa Only, MPs = Moringa Pepper Soup, MMr = Moringa, Marugbo, MC = Moringa Cotton, MMrC = Moringa Marugbo Cotton Seed, MrO = Marugbo Only, CO = Cotton Seed Only, MrC = Marugbo Cotton Seed, PsO = Pepper Soup Only.

2.3. Proximate composition analyses

The crude protein, crude fat, crude fiber, carbohydrate, total ash and moisture content of the seasoning were determined according to the Association of Official Analytical Chemists procedures (AOAC, 2013).

2.4. Mineral determination analyses

Mineral content is determined with 2g ash content of the samples and dissolved in 50 mL de-ionized water with a few drops of nitric acid. A corning flame photometer was used to determine sodium and potassium (AOAC, 2013), while an atomic absorption spectrophotometer (PYE Unicorn SP 9, UK) was used to determine calcium, phosphorous, and magnesium.

2.5. Sensory evaluation

A commonly consumed local soup was prepared without the addition of any sauce. The same concentration of the developed or commercially available seasoning was added to the soup to serve as a flavor enhancer. Semi-trained panelists were used for the evaluation.

2.6. Statistical analysis

All analyses were carried out in triplicate, and the differences between means were determined by one-way ANOVA. The means were separated using Duncan's multiple range test with SPSS version 17 (SPSS Inc., Chicago, IL, USA) and were considered statistically significant if $p < 0.05$

3. Results and discussion

3.1. Proximate Composition of the various spices seasoning on soups.

Table 2 Proximate Composition of the various Spices (g/100 g) on Soup

Samples	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	Carbohydrate (%)
MO	10.15±0.32^{a}	14.16±0.32^{b}	19.19±0.22^{b}	9.89±0.22^{f}	6.62±0.54^{d}	38.26±0.05^{b}
MPs	3.93±0.02^{g}	6.56±0.02^{d}	28.93±0.08^{a}	41.62±0.54^{a}	1.75±0.04^{e}	16.96±0.06^{h}
MMr	8.92±0.01^{b}	9.73±0.01^{c}	9.10±0.20^{g}	14.85±0.16^{b}	6.84±0.03^{d}	50.59±0.36^{a}
MC	8.86±0.06^{b}	14.90±0.01^{a}	18.46±0.01^{f}	7.55±0.04^{h}	12.06±0.04^{a}	38.17±0.02^{b}
MMrC	4.52±0.01^{f}	5.87±0.01^{e}	13.32±0.01^{f}	9.01±0.01^{g}	10.62±0.01^{b}	23.87±0.02^{f}
MrO	3.88±0.12^{g}	6.12±0.01^{b}	12.84±0.01^{b}	12.51±0.01^{d}	6.67±0.03^{d}	30.52±0.02^{c}
CO	5.63±0.03^{d}	5.31±0.01^{f}	13.20±0.01^{c}	10.32±0.02^{e}	7.22±0.02^{c}	24.21±0.01^{e}
MrC	4.97±0.02^{e}	5.42±0.01^{f}	14.42±0.02^{e}	12.21±0.01^{d}	6.59±0.07^{d}	20.10±0.01^{g}
PO	6.42±0.02^{c}	6.11±0.01^{e}	15.44±0.01^{e}	14.08±0.03^{c}	7.24v0.02^{c}	25.42±0.01^{d}

Mean±SD with different letter superscripts in the same horizontal line are significantly different ($p < 0.05$) while means with the same letter superscript in the same horizontal line are NOT significantly different ($p > 0.05$.); Key: MO - 100%Moringa Only, MPs - 40% Moringa 60% Pepper Soup, MMr - 40% Moringa, 60% Marugbo, MC - 40% Moringa 60% Cotton, MMrC - 40% Moringa 30% Marugbo 30% Cotton Seed, MrO - 100% Marugbo Only, CO - 100% Cotton Seed Only, MrC -50% Marugbo 50% Cotton Seed, PsO - 100% Pepper Soup Only.

The proximate composition of the various spices seasoning on soups is shown in Table 2. The result revealed that the moisture content of the blends ranged from 10.15 to 3.88 (mg/100 g). The result obtained on moisture contents of the seasoning shows that there is a significant difference ($p<0.05$) among the seasonings. Moisture value across the seasoning was minimal, the lower the moisture content, the better the storage stability of the product (Badejo, 2016: Ibrahim *et al.,* 2017).The protein content of the blends ranged from 28.93 to 9.10 (mg/100 g). The result obtained on the protein contents of the seasoning shows that there is a significant difference ($p<0.05$) among the seasonings. Nevertheless, the study revealed that the protein content of seasonings decreased as herbs concentration increased;

this may be due to non-uniformity in the mixing ratio when increasing the concentration of spices (Zeb, 2020). The higher protein content of these soups (MPs, MO, and MC) can also be attributed to the inclusion of animal protein (beef and fish). They are thus good sources of protein, which is needed in the body for growth and tissue replacement (Aigberua and Izah, 2019).

The fat content of seasonings ranged from 41.62 to 7.55 (mg/100 g). The addition of more spices to the sample increased the crude fat content of the seasoning except in the cases of MC. The present fat composition enhances the organoleptic characteristics of the products when applied to foods as a flavor enhancer (Aigberua and Izah, 2019). The fiber content of the seasoning ranges from 12.06 to 1.75 (mg/100 g). There was a significant difference ($p<0.05$) between formulated samples MO, MrO and MrC. It has been reported that increased dietary fiber consumption could significantly lower risks of obesity, type 2 diabetes, constipation, coronary heart diseases, and some cancers (Carrero *et al.,* 2020).

3.2. Mineral Compositions of the various spices seasoning

The mineral compositions of the various spices seasoning on soups are shown in Table 3. Sodium content of the products ranged from 9224.73 to 432.05 mg/100g and potassium content ranged from 111234.03 to 11321.06 mg/100g with significant differences ($p<0.05$) among the samples. A report by Badejo (2016) and Niaz *et al.,* (2018) shows that the sodium content of two seasonings commercially available in Nigeria is 72.66 and 74.03 mg/100g. It is observed that there was no uniformity in the potassium content of the seasonings. According to Zeb (2020), potassium contents ranged from 5.66 to 412.36 mg/100g. In addition, potassium is also essential in carbohydrate metabolism, protein synthesis, and other cellular metabolic processes (Niaz *et al.,* 2018).

The calcium content of the products ranged from 22350.36 to 289.01 mg/100g most equilibrium to the report of Zeb (2020). A significant difference was observed for the samples ($p<0.05$). Nevertheless, detachment of bone from fish contributed to the decrease of calcium, because bone contains about 25 % organic matrix, 5 % water, and 70 % inorganic mineral (calcium and phosphate) (Aokache *et al.,* 2020). The magnesium content of the products ranged from 20.02 to 10.01 mg/100g and phosphorus content ranged from 4892.47 to 1007.23 mg/100g. The result showed that there was no significant difference between sample MMr (Moringa Marugbo) and MMrC (Moringa Marugbo Cotton seed) ($p<0.05$) while sample MPs Moringa Pepper soup was significantly different from others ($p<0.05$). The magnesium content result obtained is comparable to the result obtained by Prakash *et al.* (2020), Badejo (2016), Aigberua, and Izah, (2019) while the phosphorus content of formulated seasoning is higher.

Table 3 The Proportion of Nutrients / Mineral content derivable from each of the various Spices (g/100 g) on Soups

Samples	Na (ppm)	K (ppm)	Ca (ppm)	Fe (ppm)	Zn (ppm)	Mg (ppm)	P (ppm)
MO	1170.01±0.01^{b}	30100.01±0.01^{b}	22350.36±0.59^{a}	358.04±1.73^{e}	17.01±0.02^{c}	10.01±0.03^{g}	2175.80±0.36^{c}
M Ps	588.01±0.01^{e}	13900.02±0.02^{g}	748.00±0.01^{f}	110.03±0.25^{i}	34.71±0.33^{a}	15.09±0.13^{c}	4892.47±0.36^{a}
M Mr	9224.73±0.62a	25900.17±0.20^{c}	5467.67±0.58^{d}	409.05±0.04^{c}	15.00±0.01^{e}	12.01±0.25^{f}	2206.80±0.10^{b}
M C	798±0.03^{c}	20750.05±0.03^{d}	11700.04±0.03^{b}	399.00±0.01^{d}	21.01±0.02^{b}	20.02±0.01^{a}	1007.23±0.15^{i}
M MrC	543.28±0.23^{f}	16543.01±0.01^{e}	362.01±0.01^{h}	123.02±0.02^{h}	13.00±0.01^{g}	12.04±0.03^{f}	1044.06±0.04^{h}
MrO	432.05±0.04^{i}	15322.01±0.01^{f}	432.04±0.02^{g}	321.05±0.04^{f}	14.05±0.03^{f}	14.03±0.03^{d}	1166.03±0.03^{d}
CO	532.01±0.02^{g}	12764.03±0.02^{h}	289.01±0.01^{i}	421.04±0.02^{a}	16.04±0.02^{d}	13.03±0.02^{e}	1113.02±0.01^{g}
MrC	435.03±0.04^{h}	11321.06±0.03^{i}	6211.03±0.01^{c}	211.07±0.03^{g}	15.04±0.03^{e}	16.02±0.01^{b}	1143.03±0.01^{e}
PsO	632.02±0.02^{d}	111234.03±0.01^{a}	3214.03±0.02^{e}	412.07±0.02^{b}	17.04±0.02^{c}	15.03±0.03^{c}	1132.03±0.02^{f}

Mean±SD with different letter superscripts in the same horizontal line are significantly different ($p < 0.05$) while means with the same letter superscript in the same horizontal line are NOT significantly different ($p > 0.05$.); Key: MO - 100% Moringa Only, MPs - 40% Moringa 60% Pepper Soup, MMr - 40% Moringa, 60% Marugbo, MC - 40% Moringa 60% Cotton, MMrC - 40% Moringa 30% Marugbo 30% Cotton Seed, MrO - 100% Marugbo Only, CO - 100% Cotton Seed Only, MrC -50% Marugbo 50% Cotton Seed, PsO - 100% Pepper Soup Only.

3.3. Sensory Analyses

The mean sensory evaluation scores of the samples are shown in Table 4.

The observation that MO soups (moringa only) (controls) had the highest organoleptic properties may be due to some panelists knowing that it was one of the most popular soups among north-central Nigerians (Badejo, 2016). Adebayo

(2018) also described the spice Moringa as an appetizing product that is used as a spice substitute. The fact that MrC (marugbo + cottonseed) had the lowest sensory characteristics in terms of smell, taste, texture, and general acceptability could be due to it still being unpopular among speakers, as reported by (Familyesin et al., 2021).

There was a statistically significant difference between Moringa Only, Moringa Pepper Soup, Moringa Marugbo, Moringa Cotton Seed, Moringa Marugbo Cotton Seed (samples 1-5) and Marugbo Only, Cotton Seed Only, Marugbo Cotton Seed, Pepper Soup Only (samples 6-9) in sensory evaluation value compared to control ($P<0.05$) (Adebayo, 2018; Famiyesin et al., 2021). The MO, MMrC, MC, MMr, MrO, and PsO samples achieved a very high overall acceptance, followed by PM and CO. The good taste of the blends may be due to the combination of Moringa and spices, which generally have better flavor preservation (Famiyesin et al., 2021).

Table 4 Mean Sensory Properties of Soup blends from Moringa produce with Marugbo, Cotton Seed, and Pepper Soup Spices

Blends	Color	Taste	Texture	Flavor	Overall Acceptability
MO	4.29±2.087^{a}	4.10±2.057^{a}	4.89±2.043^{a}	4.13±1.880^{a}	4.90±1.935^{a}
MPs	4.29±1.990^{a}	3.88±2.062^{b}	4.12±1.959^{b}	4.08±2.002^{a}	3.97±2.037^{c}
MMr	3.87±2.003^{b}	4.00±2.017^{a}	3.80±2.026^{c}	4.17±1.869^{a}	4.09±2.014^{b}
MC	3.85±2.070^{b}	4.08±1.988^{a}	4.01±2.075^{b}	3.92±2.037^{b}	4.13±1.983^{b}
MMrC	4.11±2.054^{a}	4.09±1.951^{a}	4.02±1.986^{b}	4.08±2.003^{a}	4.16±1.954^{b}
MrO	3.92±1.988^{b}	4.02±2.030^{a}	4.03±2.058^{b}	3.83±2.044^{b}	4.00±2.127^{b}
CO	3.94±2.019^{b}	3.84±1.936^{b}	4.16±2.022^{b}	4.08±1.972^{a}	3.93±1.943^{c}
MrC	3.82±2.019^{b}	4.10±2.017^{a}	3.98±1.927^{c}	3.81±1.922^{b}	3.79±2.003^{c}
PsO	3.94±1.951^{b}	4.04±1.981^{a}	4.00±2.102^{b}	4.02±2.040^{a}	4.04±1.991^{b}

$Mean \pm SD$ With different letter superscripts in the same horizontal line are significantly different ($p < 0.05$)while means with the same letter superscript in the same horizontal line are NOT significantly different ($p > 0.05.$); Blends: MO = Moringa Only, MPs = Moringa Pepper Soup, MMr = Moringa Marugbo, MC = Moringa Cotton Seed, MMrC = Moringa Marugbo Cotton Seed, MrO = Marugbo Only, CO = Cotton Seed Only, MrC = Marugbo Cotton Seed, PsO = Pepper Soup Only.

4. Conclusion

The result revealed clearly that the various developed spices seasoning on soups can equally meet the nutritional need of the people in the study location and helps in immune booster. The Spices are naturally cooked and are safer and healthier for tourist than the foreign Soups which are often preserved with poisonous chemicals. Based on the results of this study, it is evident that various investigated spices on soups are good dietary source of nutrients such as carbohydrate, protein, minerals (Calcium, phosphorus and magnesium). It is believed that the production and distribution of these spices on soups can improve the nutritional status of the dependent groups.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Acott, T. G., Trobe, H. L. L. & Howard, S. H. (2015). An evolution of deep ecotourism and shallow ecotourism, Journal of Sustainable Tourism. P.63.

[2] Adebayo, I. N. (2018). Nutritive and sensory qualities of indigenous spices on meat for tourist acceptability in selected ecotourist destinations. Unpublished Thesis in Department of Ecotourism and Wildlife Management, Federal University of Technology, Akure, Nigeria. Pp 5-10.

[3] Aigberua, A. O & Izah, S. C. (2019). Macronutrients and selected heavy metals in powered herbal medicine sold in Nigeria. International Journal of Medicinal Plants and Natural Products, 5, 23-29.

[4] AOAC (2013). Methods of Analysis of the Association of Official Analytical Chemists, 18th edition. Washington DC. USA.

[5] Aokache, J. K., Okache, T. A. & Nasiru, B. U. (2020). Proximate and functional properties of wheat flour produced from Federal University Dutsin-ma farm and three commercial flours sold in dutsin-ma, Katsina State. Journal of Agriculture and Agricultural Technology, 6, 167-175.

[6] Badejo, A. A. (2016). Nutrient composition and antioxidative potential of seasonings formulated from herbs, spices, and seafood. Journal of Culinary Science and Technology, 14, 222-233.

[7] Carrero J. J., Gonzalez-Ortiz A., Avesani, C. M. & Bakker, S. J. (2020). Plant-based diets tomanage the risksand complications of chronic kidney disease. Nature Reviews Nephrology, 16, 525-542.

[8] Famiyesin, E. O., Jeje, O. A., Owoseni, O.V. & Badejo, A. A. (2021). Chemical composition, antioxidant potential and sensory evaluation of seasonings produced from herbs and spices. Proceedings of the 7th Regional Food Science and Technology Summit (Refosts) Owo, Ondo State Nigeria.

[9] FIIRO, (2006). Soup recipe book. Federal Institute of Industrial Research, Oshodi, Nigeria.

[10] Food Specialties Nigeria, 1988. Maggi national cooking competition; recipe book. Heinenmann Nigeria, Ibadan.Pp 44- 48.

[11] IBM SPSS Statistics for Windows, Version 21.0. (2012). IBM Corporation, Armonk, NY.

[12] Ibrahim, A., Buba E. E. & Waziri, M. J. (2017). Potential of soyabeans seasoning with garlic and ginger spices for sustainable health in Bauchi State Nigeria International Journal of Development Strategies in Humanities, Management and Social Sciences | IJDSHMSS ISSN Hard Print: 2360-9036 | ISSN Online: 2360-9044 | Volume 7, Number 1 May 8th, 2019.

[13] Kadiri, O. & Olawoye, B. (2015). Underutilized indigenous vegetable (uiv) in Nigeria: a rich source of nutrient and antioxidants- Food Science and Technology. Available on-line at www.afst.valahia.ro 236 .Volume 16, Issue 2: Pg. 99-101.

[14] Ndulaka, J. C., Ekaiko, M. U., Onuh, Emeka, F & Okoro, O. A. (2017). Comparative studies on the nutritional and anti – nutritional properties of indigenous seeds used as soup thickeners in South-East Nigeria. IOSR. Journal of Biotechnology and Biochemistry (IOSR-JBB) ISSN: 2455-264X, Volume 3, Issue 5 (Sep. - Oct. 2017), PP 39-44 www.iosrjournals.org DOI: 10.9790/264X-03053944.

[15] Niaz, K., Zaplatic, E. & Spoor, J. (2018). Extensive use of monosodium glutamate: a threat to public health. Experimental and Clinical Sciences Journal, 17, 273-278.

[16] Prakash, S., Bindu, M., Surya, A., Timilsina, H. & Ram, B. (2020). Total phenolic and flavonoid contents, antioxidant activities, phytochemical and nutritional analysis of Castanopsis indica (Indianchestnut). Sustainable Development, 10, 005-010.

[17] Zeb, A. (2020). Concept mechanism and applications of phenolic antioxidants in food. Journal of Food Biochemistry, 44, 13394-13398.