ACCEPTABILITY AND COMPARATIVE EVALUATION OF CHEMICAL PROPERTIES OF ENRICHEDWATER YAM BALLS (*OJOJO)* AMONG TOURISTS IN AGODI GARDENS, IBADAN

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ABSTRACT

This study employed the use of three common but underutilized protein supplement seeds (watermelon seeds, soybean and cowpea) in enriching ojojo (fried water yam balls) because of its high carbohydrate content and low protein content. A comparative evaluation of the chemical composition and acceptability level amongst tourists in Agodi Gardens was therefore conducted. Four different samples of ojojo were mechanically prepared. WB served as the control (unfortified ojojo) while WBC, WBS, WBW were enriched with cowpea, soybean and water melon seed flours, respectively. The four samples were subjected to proximate and mineral analysis. The samples were presented to 150 tourists for organoleptic assessment. Results were subjected to descriptive statistics and ANOVA at $\alpha_{0.05}$ using SPSS version 20. The fortified samples were found to be significantly different in their chemical composition from the control sample at $p<0.05$. The enriched ojojo samples had higher protein, ash, crude fibre, fat, moisture, calcium, magnesium, sodium, magnesium and phosphorus than the control. WBC was rated highest for the taste, compared to other samples. WB however had a significantly higher ($p<0.05$) overall acceptability than all enriched samples with respect to colour, flavour, aroma and texture. The study concluded that enrichment of ojojo with protein supplement seeds specifically watermelon seed, soybean and cowpea improved the nutritional quality but not the acceptability. It's therefore recommended that inclusion of the underutilized seed flours should be made to prevent protein energy malnutrition in homes likewise among the indigenous snacks' promoters and producers.

Keywords: proximate analyses, organoleptic assessment, water yam, watermelon seed, soybean

INTRODUCTION

Hospitality is defined as a commercial project of the tourism industry (such as hotels, catering, and tour operation) and in another sense to the social interactions between local people and tourists that is, hosts and guests. Sajna (2005) described hospitality products as tangible and intangible elements of food, drinks, accommodation, and pleasure. Saayman, (2007) refer to hospitality as the provision of meals, beverages and accommodation as well as major components of the tourism industry. Tourism entails the travel for recreation, leisure, religious, family or business purposes for a defined period of time (United Nations World Tourism Organization, 2012). The individual who partakes in the travel is referred to as tourists and are expected to stay in a destination for more than a day. Food has been documented to be a major source of satisfaction to tourists during their day (Boyne & Hall, 2004) and enhances their overall tourist experience (Harrington & Ottenbacher, 2010). According to Richards (2002), tourists' days are organized around food, and that a substantial part of most tourist experiences are spent either consuming food and drink or planning what and where to eat.

Food, especially indigenous cuisines has also become a key element in promoting tourist destinations. Fried water yam ball is traditionally known as *ojojo.* It is an indigenous snack of Southwest Nigeria most especially in Ogun state. The balls are prepared from freshly grated water yam and fried in oil which makes it looks like akara balls (beans cake) (Olopade, 2014). It is mostly eaten with *ogi* (pap), *eko/agidi* (solid pap), or *gari*. It can also be eaten solely as a snack. Water yam is the major ingredient used for preparation of *ojojo* and has been referred as poor source of protein (7.4%) but high in starch content of 75-84% hence, there is need to supplement ojojo especially with underutilized protein seeds (soybean, watermelon seeds and cowpea). Soybeans are important dietary sources of protein, lipids, minerals, vitamins, fiber, and bioactive compounds. The chemical compositions of soybean and most of its derived products

are characterized by high protein content that ranges from 33 to 43% (Grieshop *et al*., 2001; Karr-Lilienthal *et al.,* 2004) while watermelon (*Citrullus lanatus*) is one of sweetly fruit crop that belongs to the family *cucurbitaceae.* It is mainly propagated by seeds and thrives best in warm areas. It is grown in every geopolitical zone in Nigeria (Oyeleke *et al.,* 2012). It is known to be low in calories but highly nutritious and thirst quenching. Watermelon can be used as fresh salad, dessert, snack, and for decorations. Drinks can also be made from the juice (Okonmah *et al.,* 2011). Watermelon seeds are known to be highly nutritional; they are rich sources of protein, vitamins B, minerals (such as magnesium, potassium, phosphorous, sodium, iron, zinc, manganese and copper) and fat among others as well as phytochemicals (Braide *et al.,* 2012).

Cowpea grain contains about 25% protein (Singh & Singh 1992), making it extremely valuable for people who cannot afford animal protein foods such as meat and fish (Bradbury & Holloway 1998). The use of cowpea seed as a vegetable provides an inexpensive source of protein in the diet. The plant can be used at all stages of growth as a vegetable crop. Despite the nutritional values of soya beans, watermelon seed and cowpea seed they remained underutilized plant products though enriching the indigenous snack (*ojojo)* with these seeds could be highly valuable in the treatment of malnutrition and other chronic diseases that are caused by protein deficiency.

Problem statement

Fried water yam ball is traditionally known as *ojojo.* It is an indigenous snack of Southwest Nigeria most especially in Ogun state. The balls are prepared from freshly grated water yam and fried in oil which makes it looks like akara balls (beans cake) (Olopade, 2014). It is mostly eaten with *ogi* (pap), *eko/agidi* (solid pap), or*gari*. It can also be eaten solely as a snack. *Ojojo* is comprised mainly of carbohydrates. Osagie (1992) reported that water yam contains 28 percent starch. The protein content (1.1-2.0%) is however very low. According to World Health

Organization and Food and Agriculture Organization of the United Nations, (2006), enrichment is the practice of deliberately increasing the content of an essential micronutrient in a food, so as to improve the nutritional quality of the food supply and provide public health benefit with minimal risk to health. Watermelon seeds, cotton, groundnut, soybean, cowpea and rape seeds are common protein supplement seeds. They have however received less attention (Mustafa & Alamin, 2012).

Some studies have been carried out on the enrichment of *ojojo*. For example, the study of Okoye (2018) documented the proximate composition, micronutrient contents and acceptability of *ojojo* from the blends of water yam and ricebean flours. Likewise, Olapade and Akinyanju (2014) assessed the chemical and functional properties and performance of blends of water yam and soybean flours for *ojojo* preparation. Also, Shittu and Olaitan (2014) investigated the functional effects of dried okra powder on *ojojo*. While these studies had established the significance of enrichment of the balls to improve the protein content, the use of common protein supplement seeds such as watermelon seeds, soybean and cowpea has been scarcely documented. Moreso, none of these studies were carried out in a tourism destination context.

Objectives of the study

The purpose of the study was to determine the acceptability and comparative evaluation of chemical properties of enriched water yam balls (*ojojo)* among tourists in Agodi gardens, Ibadan and specifically, the study

1. determine demographic characteristics of the tourists
2. estimate chemical composition of the major ingredient
3. compare the chemical composition of the wateryam ball (*ojojo)* samples

4. determine organoleptic characteristic of the tourists in water yam balls (*ojoj*o) acceptability on the samples.

MATERIALS AND METHODS

Study area

Agodi Gardens comprises of both Zoological and Botanical Gardens, a notch recreational centre in the city of Ibadan, Oyo state Nigeria, sharing same fence with Oyo state fire service headquarters in **Oyo State Secretariat complex.** The site is located in a serene environment on about 150 acres of land. It was originally created in 1967 by the then Western region before the infamous Ogunpa flood disaster in Ibadan destroyed the garden in 1980; the flood swept away most of the animals and left the place in a deplorable state. In 2012, the government renovated it and in 2014 the new Agodi Gardens was re-opened (Oyo State Government Ministry Information, Culture and Tourism, 2014). Since 2014, the garden has been serving as a tourist attraction site in Ibadan.

Materials

Ingredients used were purchased from Bodija market, Ibadan Oyo state. Water yam tubers 10kg (*Diosocrea Alata*) were washed, manually peeled with a sharp stainless knife and manually grated to form paste.

Then Soybeans (1kg) were hand picked to remove extraneous materials and rinsed in tap water. This was followed by roasting in a pot. It was then crushed using mortal and pestle for easy chaff removal, after which it was milled. The sample was packaged in polythene nylon and stored at 5^0C in a refergerator and Method of Kiin-Kabari and Akusu (2015) was modified in preparation

of watermelon seed flour. Water melon fruits was washed and longitudinally divided into two so as to extract the seeds. The seeds were washed in tap water and then subjected to boiling at 100^0C for 10 min; oven-dried at 120^0C for 4hrs, dehulled manually; milled into flour; then packaged into polyethylene films; and stored at 5^0Cin a refergerator.

Cowpea (1kg) were hand picked to remove extraneous materials and soaked in tap water for 4minutes. The chaffs were removed manually.This was followed by oven drying at 150^0C for 5hours and was milled into powder form. The sample was packaged in polythene nylon and stored at 5^0Cin a refergerator.

Table I: Method of Preparation of water yam ball (Ojojo)

Ingredients	**Samples**			
	WB	**WBC**	**WBS**	**WBW**
Wateryam paste (g)	200	200	200	200
Watermelon seed flour (g)	--	--	--	20
Soya beans flour(g)	--	--	20	--
cowpea flour(g)	--	20	--	--
Vegetable oil (ml)	500	500	500	500

KEY:
Sample WB = water yam paste + Vegetable oil (control)
Sample WBC = Sample **WB** + cowpea flour at 10% (20g)
Sample WBS = Sample **WB** + Soya bean flour at 10% (20g)
Sample WBW = Sample **WB** + watermelon seed flour at 10% (20g)

Firstly, wateryam paste was prepared using 800g of water yam paste with finely chopped

10g of onions, 2g of salt, 5g of pepper, and8g of magi.200g of prepared paste were then measured and portioned into labeled four soup bowls (WB, WBW, WBS & WBC). Each of the labeled samples carried 20g of watermelon seed flour, soybean flour and cowpea flour respectively except the control that remains plain. Each of the samples was fried in 500ml

groundnut oil at the temperature of 160^0C that was done at 130^0C to 132^0C for 13mins on the regulated burner as represented in Table I.

Preparation of water yam ball (Ojojo)

Fig 1: ***Samples of water yam ball (ojojo) produced***

Chemical analysis of cowpea flour, soya bean flour, watermelon flour and water yam ball

Moisture Content, Ash content, Crude Fat, Protein Fibre, and Carbohydrates also minerals element such as Ca, K, Na, P, Se, Mg, Cu, Mn, Fe, Ni and Zn were determined in triplicate. The method described by AOAC (2005) was used.

Tourists' acceptability

The Samples (WB, WBC, WBS, and WBW) were taken to Agodi gardens and 150 copies of questionnaire (including sensory evaluation) was administered to visitors. The sensory characteristics (colour, taste, texture, flavour, aroma and overall acceptability) were measured on a five-point hedonic scale of dislike extremely (1) to like extremely (5).

Statistical Analysis

Data obtained were subjected to descriptive analysis using SPSS version 20. Analysis of variance (ANOVA) was used in separating the means of the samples.

DISCUSSION OF FINDINGS

Table II: Demographic characteristics of the respondents

Demography	Frequency	Percentage
Gender		
Male	90	60.0
Female	60	40.0
Religion		
Islam	49	32.7
Christianity	92	61.3
Traditional	2	1.3
Others	7	4.7
Age (Years)		
Below 20	9	6.0
21-30	83	55.3
31-40	34	22.7
41-50	20	13.3
51-60	4	2.7
Nationality		
Nigerian	129	86
Other African	15	10.0
American	2	1.3
Asian	4	2.7
Occupation		
Civil Servant	42	28.0
Public Servant	7	4.7
Artisan	21	14.0
Trading	27	18.0
Student	53	35.3
Marital Status		
Single	92	61.3
Married	57	38.0
Divorced	1	.7
Academics Qualification		
Secondary	45	30.0
OND/NCE	56	37.3
HND/B.Sc./B.Ed.	37	24.7
M.Sc/Ma	10	6.7
Phd	2	1.3

Source: Field survey, 2018

Demographic characteristics of the tourists

Table II shown the results of demographic data of the respondents. Sixty percent of the respondents were male while 40% were female. Majority were Christians with 61.3% while 32.7% were of Islamic faith. Most of the respondents were Nigerians (86%) while 10.0% were from other countries in Africa continent, 1.3% was from America continents and the remaining respondents (2.7%) were from Asian continents. The majority of the respondents were students (35.3%), followed by civil servants (28%), traders (18%) and artisans (14%) while public servants had the lowest percentage (4.7%). The largest numbers of the respondents were single with 61% while 38% were married. On their educational status, the majority of the respondents (37.3%) had either NCE/OND while 30% possessed O level. Moreso, 24.7% possessed HND/BSc/B.Ed. and 1.3% of the respondents possessed PhD degree. Ojo *et al.,* (2017) in their assessment of the socio-demographic characteristics of Agodi Gardens visitors documented similar findings where majority were male, single, students who possessed tertiary education. Apata *et al*. (2019) also documented similar results.

Table IV: Chemical Composition of the raw ingredients

Sample	**Water yam**	**Cowpea flour**	**Soybean flour**	**Water melon seed flour**
Ash %	3.13 ± 0.06	4.34 ± 0.49	4.93 ± 0.03	4.50 ± 0.00
Protein %	8.30 ± 0.52	18.60 ± 0.40	38.30 ± 0.69	22.50 ± 0.10
Fibre %	2.10 ± 0.20	11.15 ± 0.01	5.20 ± 0.20	7.40 ± 0.53
Fat %	1.50 ± 0.10	1.91 ± 0.01	23.10 ± 0.10	30.00 ± 0.01
Moisture %	59.20 ± 0.35	4.80 ± 0.00	7.60 ± 0.35	10.50 ± 0.00
CHO %	25.76 ± 0.85	59.19 ± 0.87	20.87 ± 1.06	25.10 ± 0.52
Calcium	731.70 ± 0.10	173.54 ± 0.01	371.00 ± 1.73	130.00 ± 3.00
Magnesium	486.70 ± 0.20	191.81 ± 0.02	300.00 ± 2.00	153.00 ± 4.36
Potasium	15400.00 ± 0.00	7500.13 ± 0.00	19796.67 ± 7.57	3940.00 ± 2.65
Sodium	122.70 ± 0.17	79.60 ± 0.36	20.00 ± 1.73	80.10 ± 0.17

Manganese	12.00 ± 2.00	15.13 ± 0.00	43.00 ± 5.20	50.00 ± 2.65
Iron	1781.70 ± 0.01	1169.00 ± 1.0	1700.00 ± 0.00	3497.00 ± 1.00
Copper	13.20 ± 0.35	11.02 ± 0.02	15.00 ± 0.00	47.00 ± 2.65
Zinc	11.20 ± 0.30	6.69 ± 0.02	55.00 ± 2.65	17.00 ± 0.00
Phosphorus	1513.00 ± 1.00	1812.00 ± 1.73	1500.00 ± 1.00	1685.00 ± 1.00

Chemical composition of the major ingredients for *ojojo*

Table III shown that chemical composition of the major ingredients for *ojojo*. Water yam had (3.13 ± 0.06) ash content, (8.30 ± 0.52) protein content, (2.10 ± 0.20) fibre content, (1.50 ± 0.10) fat, 59.2% moisture content and (25.76 ± 0.85) CHO. This shows the characteristic high carbohydrate and moisture content as well as the low ash, protein, fibre and fat contents of water yam as documented by Ogidi *et al*. (2017). Also, water yam was found to have significant concentration of minerals such as calcium (731.70 ± 0.10mg/kg), magnesium (486.70 ± 0.20 mg/kg), potassium (15400.00 ± 0.00mg/kg), sodium (122.70 ± 0.17mg/kg), manganese (12.00 ± 2.00mg/kg), iron (1781.70 ± 0.01mg/kg), copper (13.20 ± 0.35mg/kg), zinc (11.20 ± 0.30mg/kg) and phosphorus (1513.00 ± 1.00mg/kg).

Cowpea flour (CFR)had the lowest ash content (4.34 ± 0.49); water melon seed flour WMSFR had (4.50 ± 0.00) and soybean flour (SOYFR) had the highest with (4.93 ± 0.03). The protein content of the samples in descending order shows that SOYFR had the highest content with (38.30 ± 0.69), to WMSFR with (22.50 ± 0.10) while CFR had (18.60 ± 0.40). The fibre content of CFR was the highest with (11.15 ± 0.01), followed by WMSFR with (7.40 ± 0.53), and SOYFR with (5.20 ± 0.20). For the moisture content, WMSFR had the highest with (10.50 ± 0.00), followed by SOYFR (7.60 ± 0.35) and the least was CFR with (4.80 ± 0.00). CHO of CFR was the highest with (59.19 ± 0.87) followed by WMSFR with (25.10 ± 0.52) while the least was SOYFR with (20.87 ± 1.06). This result shows that soybean flour had higher amounts of ash and

protein; cowpea flour had more fibre and carbohydrate content while water melon seed flour had higher moisture content. These were observed to influence the proximate concentration of the water yam balls produced from them.

SOYFR had the highest Calcium (Ca) content of 371.00 ± 1.73mg/kg followed by CFR with 173.54 ± 0.01mg/kg while sample WMSFR has the lowest 130.00 ± 3.00mg/kg. Magnesium (Mg) content of SOYFR was the highest at 300.00 ± 2.00 mg/kg, followed by CFR with 191.81 ± 0.02mg/kg and the least was WMSFR (153.00 ± 4.36mg/kg). The potassium (K) content of SOYFR had the highest value with 19796.67 ± 7.57mg/kg followed by CFR 7500.13 ± 0.00 mg/kg while the least was WMSFR with 3940.00 ± 2.65 mg/kg. Sample WMSFR contains largest portion of sodium (Na) with 80.10 ± 0.17mg/kg; CFR had 79.60 ± 0.36mg/kg and the least was SOYFR with 20.00 ± 1.73mg/kg. WMSFR had the largest content of manganese (Mn) with 50.00 ± 2.65mg/kg; next to this was SOYFR 43.00 ± 5.20mg/kg; followed by CFR with 15.13 ± 0.00mg/kg. The content of Iron Fe in WMSFR was the highest 3497.00 ± 1.00mg/kg, followed by SOYFR with 1700.00 ± 0.00 mg/kg and least content was in CFR at 1169.00 ± 1.0mg/kg. Sample WMSFR had the largest copper Cu content with 47.00 ± 2.65mg/kg followed by SOYFR at 15.00 ± 0.00mg/kg while CFR had the least with 11.02 ± 0.02mg/kg. The Zinc (Zn) content of CFR was the least with 6.69 ± 0.02mg/kg, this increased to17.00 ± 0.00mg/kg in WMSFR while sample SOYFR had the largest with 55.00 ± 2.65mg/kg. The phosphorus content in CFR was the largest with 1812.00 ± 1.73mg/kg followed by WMSFR with 1685.00 ± 1.00mg/kg while SOYFR had the least1500.00 ± 1.00mg/kg.

Table V: Comparative evaluation of the chemical composition of the water yam balls *(ojojo)* samples

SAMPLE	WB	WBC	WBS	WBW
Ash (%)	3.57 ± 0.058^{c}	6.1667 ± 0.21^{b}	5.70 ± 0.10^{ab}	5.87 ± 0.23^{a}
Protein (%)	3.15 ± 0.01^{d}	8.96 ± 0.01^{c}	12.96 ± 0.01^{a}	9.10 ± 0.01^{b}
Fibre (%)	2.20 ± 0.10^{b}	2.43 ± 0.06^{ab}	2.50 ± 0.10^{a}	2.67 ± 0.12^{a}
Fat (%)	2.73 ± 0.15^{c}	3.80 ± 0.10^{b}	4.80 ± 0.00^{b}	4.23 ± 0.32^{b}
Moisture (%)	36.13 ± 3.27^{c}	41.23 ± 0.56^{b}	47.90 ± 0.89^{a}	47.14 ± 0.22^{a}
Carbohydrate (%)	52.22 ± 3.26^{a}	37.26 ± 0.54^{b}	26.14 ± 0.99^{c}	30.99 ± 0.69^{d}
Ca (mg/kg)	625.00 ± 4.36^{c}	690.00 ± 5.00^{b}	820.00 ± 2.00^{a}	680.00 ± 4.00^{b}
Mg (mg/kg)	347.00 ± 1.00^{c}	345.00 ± 0.00^{c}	667.00 ± 2.00^{a}	510.00 ± 5.00^{b}
K (mg/kg)	7250.00 ± 5.00^{a}	6750.00 ± 10.00^{a}	6750.00 ± 0.00^{a}	5750.33 ± 1.01^{b}
Na (mg/kg)	3650.00 ± 5.00^{c}	4300.00 ± 50.00^{a}	3950.00 ± 0.00^{b}	3700.00 ± 100.00^{c}
Mn (mg/kg)	6.50 ± 0.100^{b}	7.50 ± 0.10^{b}	5.00 ± 1.00^{b}	26.00 ± 2.00^{a}
Fe (mg/kg)	263.00 ± 2.65^{a}	214.00 ± 1.00^{a}	235.50 ± 1223.69^{a}	104.00 ± 1.00^{a}
Cu (mg/kg)	22.80 ± 0.100^{a}	18.95 ± 0.04^{a}	4.40 ± 0.10^{a}	22.25 ± 53.93^{a}
Zn (mg/kg)	15.60 ± 0.100^{a}	14.25 ± 0.03^{c}	12.15 ± 0.05^{d}	15.15 ± 0.02^{b}
P (mg/kg)	1853.50 ± 0.100^{c}	1756.33 ± 2.31^{d}	2662.35 ± 3.21^{b}	3909.00 ± 0.00^{a}

(Means in a row with different superscript are statistically different)

Comparative evaluation of the chemical composition of the water yam balls

The chemical composition (proximate and mineral) of the water yam balls is presented on Table V.

WBC had the highest ash content of (6.1667 ± 0.21). This was followed by WBW (5.87 ± 0.23) and WBS (5.70 ± 0.10). WB had the least with (3.57 ± 0.058). The protein content of WBS was highest at (12.96 ± 0.01). This was followed by WBW and WBC with (9.10 ± 0.01) and (8.96 ± 0.01) respectively, while WB had the lowest (3.15 ± 0.01). WBW had the highest fibre content (2.67 ± 0.12). Other samples WBS, WBC and WB had 2.50 ± 0.10, 2.43 ± 0.06and2.20 ±

0.10respectively. Also, WBS had the highest fat content at 4.80 ± 0.00. This was followed by WBW and WBC at 4.23 ± 0.32and 3.80 ± 0.10respectively, while WB had the least (2.73 ± 0.15). The highest moisture content was recorded in WBS (47.90 ± 0.89). This was closely followed by WBW with (47.14 ± 0.22), and then by WBC (41.23 ± 0.56). The lowest moisture content recorded was in WB (36.13 ± 3.27). Furthermore, highest carbohydrate concentration was found in WB (52.22 ± 3.26). WBC and WBW had 37.26 ± 0.54 and 30.99 ± 0.69respectively, while the least was 26.14 ± 0.99 in WBS. These results are indications that fortification of the *ojojo* with cowpea, soybean and water melon seeds brought about an increase in the ash, protein, fat, fibre and moisture contents. Soybean was found to contribute to the highest protein, fat and moisture contents. Olapade and Akinyanju (2014) who researched on the inclusion of soybean also found an improvement of the protein, fat, ash and crude fibre contents of water yam. Increase in fat content was also reported by Okoye *et al.,* (2018) and Ayo *et al.* (2013). Cowpea increased the ash content more than the other samples while water melon seed brought about more fibre content.

Furthermore, there was a decrease in the carbohydrate contents of all the fortified samples. This is an expected decrease given the supplementation of the water yam with the three protein sources used. Similar decrease in water yam balls was reported by Oyeleke *et al*. (2012) and Okoye *et al*. (2018) who fortified with bambara groundnut and ricebean flour respectively. The lowest moisture content in the control sample (WB) is an indication that that fortification with soybean, water melon seeds and cowpea may predispose the samples to a lower shelf life when compared to the usual *ojojo.* As noted by Temple (1996), high moisture content shows a liability to microbial spoilage, hence short shelf life.

WBS was found to have the highest calcium content of 820.00 ± 2.00 mg/kg. This was followed by samples WBC (690.00 ± 5.00mg/kg) and WBW (680.00 ± 4.00mg/kg), while WB had the least (625.00 ± 4.36mg/kg). Similarly, the magnesium content in WBS was the highest (667.00 ± 2.00[a]mg/kg). This was followed by WBW with 510.00 ± 5.00mg/kg. The least concentrations were in WB and WBC with 347.00 ± 1.00 mg/kg and 345.00 ± 0.00mg/kg respectively. The potassium content in WB was the highest at 7250.00 ± 5.00mg/kg. This was followed by that of WBC and WBS at 6750.00 ± 10.00mg/kg each, while WBW had 5750.33 ± 1.01mg/kg. WBC had the highest sodium content with 4300.00 ± 50.00mg/kg. This was followed by WBS (3950.00 ± 0.00mg/kg) and WBW (3700.00 ± 100.00), while WB had the least with 3650.00 ± 5.00mg/kg. The manganese concentration in WBW was the highest at 26.00 ± 2.00mg/kg. Other samples; WBC, WB and WBS had 7.50 ± 0.10mg/kg, 6.50 ± 0.100mg/kg and 5.00 ± 1.00mg/kg respectively. The iron content in WB (263.00 ± 2.65mg/kg) was higher than the rest; 235.50 ± 1223.69mg/kg, 214.00 ± 1.00mg/kg and 104.00 ± 1.00mg/kg in WBS, WBC and WBW respectively. Also, WB had the highest copper content with 22.80 ± 0.100mg/kg. This was closely followed by WBW with 22.25 ± 53.93mg/kg, and then WBC (18.95 ± 0.04mg/kg) while the least was found in WBS (4.40 ± 0.10mg/kg). Zinc concentration was found to be highest in WB (15.60 ± 0.100mg/kg), followed by WBW (15.15 ± 0.02mg/kg) and WBC (14.25 ± 0.03mg/kg) while WBS had least 12.15 ± 0.05mg/kg. WBW had the highest concentration of phosphorous with 3909.00 ± 0.00 mg/kg. This was followed by WBS, WB and WBC at 2662.35 ± 3.21mg/kg, 1853.50 ± 0.100mg/kg and 1756.33 ± 2.31 mg/kg respectively.

It can be said that with respect to the mineral composition of the samples, soybean flour inclusion brought about the highest concentration of calcium and magnesium; cowpea flour inclusion increased the sodium content while water melon seed brought about magnesium and

phosphorous increase. The inclusion of defatted watermelon seed flour in bread as assessed by Anang *et al*., (2018) resulted in a significant increase in phosphorous. Interestingly, the control sample had highest content of potassium, iron, copper and zinc. Observations from the mineral composition of the natural ingredient shows that water yam had very high concentration of these elements than the others.

Table VI: Organoleptic characteristics of the wateryam balls

	WB	WBC	WBS	WBW
Colour	3.83±1.09[a]	3.67±1.15[a]	3.76±1.21[a]	3.52±1.21[a]
Taste	3.51±1.28[a]	3.61±1.10[a]	3.47±1.29[a]	3.39±1.37[a]
Flavour	3.77±0.95[a]	3.65±1.12[a]	3.75±1.05[a]	3.59±1.25[a]
Aroma	3.95±0.96[a]	3.66±1.00[a]	3.53±1.13[a]	3.66±1.13[a]
Texture	3.87±0.99[a]	3.80±0.85[a]	3.48±1.20[ab]	3.49±1.35[b]
Overall acceptability	4.17±0.93[a]	3.75±0.98[b]	3.80±1.07[b]	3.71±1.34[b]

(Means in a row with different superscript are statistically different)

Organoleptic characteristics of tourists on water yam balls

WB (the control sample representing the usual *ojojo* without fortification) had the highest rating for colour (3.89±1.09), followed by WBS (3.76±1.21), WBC (3.67±1.15) and WBW (3.52±1.21). There was no significant difference in the colour, at $p>0.05$. This may be because the colour of all the samples was golden brown, which could explain the lack of significant differences in the rating. This golden brown *ojojo* colour was also reported by Olopade and Akinyanju (2014) and Okoye *et al.* (2018). With respect to taste, WBC, the sample containing cowpea was rated highest (3.61±1.10), followed by WB (3.51±1.28), WBS (3.47±1.29) and WBW (3.39±1.37). No statistically significant difference however exists among the samples. On flavour, sample WB, the control was rated highest (3.77±0.95) above all the fortified samples {WBS (3.75±1.05), WBC (3.65±1.12) and WBW (3.59±1.25)}. Similarly, the samples were not statistically different from each other. In the same vein, the control sample, WB had the strongest aroma (3.95±0.96). This was followed by WBC and WBW at 3.66±1.00 and 3.66±1.13

respectively. The rating for WBS aroma was the least (3.53±1.13). These samples on account of aroma did not statistically differ.

The texture of the control sample WB was found to be the most acceptable by the respondents given the high rating of 3.87±0.99. This was followed by WBC (3.80±0.85), WBW (3.49±1.35) and WBS (3.48±1.20). The texture rating of WB and WBC was statistically the same ($p>0.05$), but statistically different from WBW ($p<0.05$). Also, WBS and WBW were statistically the same. In terms of the overall acceptability of the samples by the respondents, WB had the highest rating (4.17±0.93) and statistically differed ($p<0.05$) from the remaining samples. This was followed by WBS (3.80±1.07) and WBC (3.75±0.98) while the least was WBW (3.71±1.34). This is an outright indication of the preference of the usual *ojojo* to the fortified samples. This is not in line with the findings of Okoye *et al*. (2018) in their study of the acceptability of *ojojo* from the blends of wateryam and ricebean flours, who found out that the control sample (100% wateryam) was the least accepted. Also, Alakali *et al.* (2016) who supplemented *ojojo* at varying inclusion levels with bambara groundnut reported that the control sample without any fortification was the least acceptable. It is however important to note that the fortifying ingredients for the two studies vary, which may explain the dissimilarity. Overall acceptability of the fortified samples was in the order WBS>WBC>WBW. In other words, the sample with soybean was the most acceptable of all the fortified samples, followed by that with cowpea while that of water melon seed was the least.

CONCLUSION

The improvement in the chemical properties of water yam balls using the flours produced from cowpea, soybean and water melon seed brought about increase in the protein, crude fibre, ash and fat content. Soybean was found to contribute to the highest protein, fat and moisture contents. Cowpea increased the ash content more than the other samples while water melon seed brought about more fibre content. With respect to the mineral composition of the samples, soybean flour inclusion brought about the highest concentration of calcium and magnesium; cowpea flour inclusion increased the sodium content; while water melon seed brought about magnesium and phosphorous increase. The most acceptable fortified sample among visitors to Agodi Gardens was WBS (water yam ball made from the blend of water yam and soybean flour), followed by WBC (water yam ball made from the blend of water yam and cowpea flour) while the least was WBW (water yam ball made from the blend of water yam and water melon seed flour). The visitors however still preferred the traditional water yam ball (WB) above all the fortified samples, based on the colour, aroma and texture.

RECOMENDATIONS

1. Since the inclusion of soya beans, watermelon seeds and cowpeas seeds increase the protein content of the water yam balls, this will prevent protein energy malnutrition (PEM) among the masses.
2. Water yam balls enriched with plant proteins should be encouraged among tourist either as snacks or part of main menu to promote indigenous food.
3. This water yam balls enriched with soya beans, watermelon seeds and cowpea seeds can be made into pudding for the benefit of those with health challenges such as cardiovascular diseases and diabetics to benefit from it.

4. Further research is recommended on the microbial load of the water yam cuisine enriched with plant-based protein.

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