MARKET HANDLING PRACTICES EFFECT ON THE NUTRITIONAL PROFILES OF HONEY-BEANS AND GROUNDNUTS FROM THREE DIFFERENT MARKETS IN IBADAN, NIGERIA

Abstract

Honey-beans and groundnuts serve as major plant protein sources, market handling practices may affect their nutrient profiles. This study evaluates market-handling practices effects on nutritional profiles of two protein-rich raw-foodstuffs from three markets in Ibadan, Nigeria. Raw honey-beans (*Phaseolus vulgaris*) and groundnut seeds (*Arachis hypogaea*) were purchased from Dugbe, Sango and Oja-Oba markets (chosen based on their differences) in Ibadan. The samples were cleaned and assayed in triplicates for proximate and mineral compositions (Iron, Zinc, Magnesium and Calcium) according to standard procedures using 3 × 2 factorial method in a completely randomized design. Data were subjected to ANOVA using SAS (2002) and means separated with Duncan's Multiple Range Test (at $\alpha_{0.05}$), results of proximate analysis were in percentages while minerals were in mg/Kg. Results showed variations ($p<0.05$) in dry matter based on different markets. Dry matter content was similar ($P>0.05$) in Dugbe (91.37±0.67) and Sango (91.46±0.43) market samples but higher ($P<0.05$) in Oja-Oba (90.64±1.81) samples. Crude protein content of samples from Sango (28.40±11.11) was higher ($p<0.05$) compared with other locations. Crude fat of honey-beans (24.32±0.44) and groundnut (1.97±0.64) were significantly different ($p<0.05$). Similarly, crude fibre content of honey-beans (32.42±2.09) and groundnut (16.46±1.33) were different ($p<0.05$). Results showed similarities in ash content of honey-beans (5.16±0.32) and groundnut (4.85±0.65). Carbohydrate content varied according to sample-type and location; carbohydrate in groundnut (27.88±0.55) was higher ($p<0.05$) than in honey-beans (14.06±1.92) whereas, carbohydrate content of samples from Dugbe (21.75±7.37) and Sango (21.14±8.87) were different ($p<0.05$) from each other but both were similar ($p>0.05$) to samples from Oja-Oba (21.02±7.38). Magnesium content of honey-beans (40.06±9.18) was higher than groundnut (3.11±0.71) while Calcium in honey-beans (5.97±1.25) was also higher ($p<0.05$) compared with groundnut (2.23±0.54). Variations were observed due to interaction effects of sample-type and market handling. Conclusively, market practices affected nutritional content of selected protein-rich raw foodstuffs.

Key words: Honey-beans, groundnuts, proximate parameters, mineral profile

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1. Introduction

Foods from plant or animal sources contain protein, carbohydrate, minerals, moisture, lipid as well as other organic materials [1]. The significance of raw staple foods in the nutrition of an average individual cannot be overlooked. Raw staple foods generally mean dry uncooked agricultural produce. Raw foods have longer life-span compared with vegetables and fruits. Raw food like groundnuts, honey-beans, maize and so on can stay on the shelves for a longer period in as much as preservation methods are adhered to and they are properly handled in the market [2]. Foods experience spoilage as a result of chemical or physical changes and microbial actions [1]. Hence, it is essential to preserve food in order to maintain their quality for an extensive period of time. In view of the rapid development of the global population in relation to the extensive range of products being developed, research must not rely only on crop production improvement but also on physicochemical, functional and nutritional properties of food crops [3]. Cowpea (*Vigna unguiculata*) is a yearly herbaceous legume that belongs to Fabaceae family. It is a major source of protein and suitable replacement in the deficiency of adequate animal protein for the population. It is an important crop and its role cannot be underestimated in the diet of Nigerians [4]. It can be consumed alone or in combination with cereals to enrich the protein value [5]. In Nigeria, cowpea has different names like "ewa" in Yoruba language, "akidi" in Igbo and "wake" in Hausa language. Cowpea is distinct among other legumes because it is a starchy protein source that offers an extensive utilization pattern compared with other legumes like groundnuts and soybeans which are oil-protein seeds [4]. Cowpeas have high nutritional protein content ranging between 20-25%, this amount exceeds the nutritional value of most cereals [6, 4]. Cowpea is rich in tryptophan and lysine but deficient in cysteine and methionine when compared with other animal proteins [7]. Cowpea grains are a rich source of vitamins (pro-vitamin A, ascorbic acid, niacin, riboflavin, pantothenic acid, pyridoxine and thiamine) [7] and minerals (calcium, phosphorus, potassium and magnesium) [8].

Groundnut (*Arachis hypogea*) is a legume crop which belongs to the Fabaceae family. It is popularly referred to as peanuts worldwide [9, 4]. Globally, groundnut is one of the prominent agricultural crops to produce palatable protein and plant oil [10]. Groundnut seeds are rich nutritionally as a result of oil presence, niacin, magnesium, protein, phosphorus, manganese and vitamins [11]. Nuts generally are high in protein (25%) and edible oil content (40-50%), they are also good sources of varieties of essential minerals and vitamins [4, 11].

Cowpea and groundnut are vital food stuff because they offer viable dietary options for large population of people due to their nutrient content. Market handling and storage practices of raw food materials vary across different types of markets, especially since there is paucity of information on regulation of market handling practices in Nigeria. Therefore, need for better understanding of market handling effects on the nutritional profile of these raw food stuffs are

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vital. The objectives of this study were to determine the proximate composition and selected mineral profiles of honey-beans and groundnut and to evaluate the interaction effects of market location and sample types on the nutrient contents of the food stuff.

2. Materials and Method

2.1 Collection and preparation of samples

Raw honey-beans (*Phaseolus vulgaris*) and groundnut (*Arachis hypogaea*) were purchased from three different markets namely: Dugbe, Sango and Oja-Oba in Ibadan, Oyo State, Nigeria. These three (3) markets were selected based on their sizes. Dugbe is the biggest market, Sango market is a small market while Oja Oba market is the largest and oldest market in Ibadan. All the raw seeds were identified as same varieties before winnowing and removing the stones. The first set of honey-beans and groundnut were purchased from Oja-Oba market. The second set of groundnut and honey-beans were purchased from Dugbe market and the last two samples were obtained from Sango market respectively. Clean samples were stored in a sterile airtight container and transported to the Nutrition laboratory of Lead City University, Ibadan. Experimental design for the study was a 3 × 2 factorial method in a completely randomized design.

2.2 Equipment used for the analysis

The equipment/instrument used for the various laboratory analyses and test include blender, titration apparatus, fan assisted oven (Model DHG), 250ml round bottom flask, measuring cylinder, dessicator, fume cupboard, uniscope muffle furnace (SM 9080), funnels, soxhlet extraction unit, Kjeldahl apparatus, weighing balance, heating mantle, petri-dish, water bath (HH-S), crucible and tongs were all obtained from the Nutrition Laboratory, Lead City University, Ibadan.

2.3 Proximate analysis

For the proximate composition (Moisture, Ash, Crude protein, Crude fat, Crude fibre and Nitrogen-free extracts), all samples were assayed in triplicates according to standard techniques [12].

Moisture content (%) = Loss in weight due to drying / Weight of sample before drying
Moisture content (%) = $(W2-W3/W2-W1) * 100$
Where,
W_1 = Weight of empty Crucible
W_2 = Weight of empty crucible + sample before drying

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W_3 = Weight of crucible+ sample after drying (constant weight).
Ash content (%) = {Weight of ash /Weight of sample (after drying)} $*$ 100
Ash content (%) = $(W3-W1/W2-W1)$ * 100
Crude fat (%) = (Weight of Flask + oil – Weight of empty flask/ initial weight of sample) * 100
Crude fat (%) = $(W4-W3/W2-W1)$*100
Crude fibre (%) = (Weight of oven dried sample – weight of ash)/ Initial weight of sample * 100
Crude fibre (%) = $(W2-W3/W1)$*100
Nitrogen was determined by micro-Kjeldahl technique and crude protein content was calculated as N% × 6.25. Carbohydrate was determined by difference [12].

2.4 Statistical analysis of data

Data were subjected to analysis of variance (ANOVA) using SAS (2002) package and means were separated with Duncan's Multiple Range Test (at $\alpha_{0.05}$).

3.0 Results and Discussion

3.1 Effect of market location on proximate composition of selected foodstuffs

The results of the proximate analysis of honey-beans and groundnut purchased from three different markets within Ibadan city are presented in Table 1. Moisture content plays a significant role in ensuring that the quality of food is well kept. High moisture content in food can result to contrary effect on their storage strength [13]. From the result, it was observed that dry matter content differed significantly (p<0.05) based on different markets. However, dry matter of samples from Dugbe market (91.37±0.66) and Sango market (91.462±0.43) were similar (P>0.05) as well as significantly (p<0.05) greater than the dry matter from Oja-Oba market (90.64±1.81). Nutrients are components of food that provide nourishment for human survival. Results also showed that the crude protein content of Sango market samples (28.40±11.11) was higher (p<0.05) compared with samples from other market locations. Furthermore, results revealed that the crude fat content of Oja-Oba market (13.16±12.22), Dugbe market (12.94±12.07) and Sango market (13.34±12.46) samples were all similar (p>0.05). Likewise, the crude fibre content of samples from Oja-Oba (24.36±7.38), Dugbe (24.36±8.91) and Sango (24.61±10.26) markets were all similar (p>005). Equally, results showed that the ash content of samples from Oja-Oba (4.94±0.32), Dugbe (5.09±0.65) and Sango (4.99±0.20) markets were all the similar (p>0.05). The carbohydrate content of samples from Oja-Oba market (21.02±7.38) shared similarities with samples from Dugbe (21.75±6.61) and Sango (21.135±8.87) markets which were both similar (P>0.05). This indicated that market handling at different market location has effect on the proximate composition of food samples**.** This report

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corroborates the findings of [14] who reported changes in nutrient content of raw food stuff during storage as storage varies from one market location to another. The markets in this study were selected according to the differences in their set up. Some with locked up stores and others with only open counters with make shift umbrellas. This factor dictates different market practices and procedure.

Table 1. Effect of market location on proximate composition of selected foodstuffs

Location	Dry Matter (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)
Oja-Oba	90.64±1.81[b]	27.17±10.37[b]	13.16±12.22[a]	24.36±7.38[a]	4.94±0.32[a]	21.02±7.38[ab]
Dugbe	91.37±0.64[a]	27.21±10.02[b]	12.94±12.07[a]	24.36±8.91[a]	5.09±0.65[a]	21.75±6.61[a]
Sango	91.46±0.43[a]	28.40±11.11[a]	13.34±12.46[a]	24.61±10.26[a]	4.99±0.20[a]	21.14±8.87[b]

Note: Means with different superscripts are not the same
Source: Own data, 2021

3.2 Effect of sample type on proximate composition of selected foodstuffs

Table 2 shows the effect of sample types on proximate composition of selected foodstuffs. Result of dry matter content showed that groundnut was significantly (91.54±0.62) higher when compared to honey-beans (90.76±1.41). Protein is a foremost nutrient components of various groundnuts varieties. In groundnut, protein content is genetically manipulated; likewise, it is influenced by agronomic practices and application of nitrogen fertilizer [15]. The crude protein of honey-beans (37.15±1.37) was significantly ($p<0.05$) greater than groundnut (18.04±0.74). The findings in this study differs from the study of [16] who reported that crude protein content of brown variety of honey-beans was 23.48%. The values were found to be higher than [17] who reported value range between 15.62 and 17.91%. Another study [4] stated that the protein content of groundnut samples analyzed ranged between 22.93% and 29.73%. Similarly, study by [18] revealed that percentage crude protein in varieties of groundnut ranged between 19.7 and 31.3%. This implies that groundnut is a very good source of protein [19]. The crude protein of honey-beans (37.146%) in this study was at variance with the outcome observed by [17] who reported that crude protein content of cowpea falls within the range of 15.62 and 17.91% this may be due to soil conditions at the production site of the crops.

Based on the findings of this study, honey-beans and groundnut could provide good source of protein among low income earners where affordability of animal protein becomes a challenge.

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The crude fat of honey-beans (1.98±0.64) and groundnut (24.32±0.44) in this study, differed significantly ($p<0.05$) this is as expected because groundnut though a protein source is also an oil seed and viable source of dietary fat [15], fat content in groundnut seeds is vital for human consumption as it offers high nutrient energy values and expedites fat soluble vitamin absorption [9, 18]. Likewise, the crude fibre content of honey-beans (32.42±2.09) and groundnut (16.46±1.33) in this study were different ($p<0.05$). Any diets low in crude fibre are undesirable as they may result in constipation hemorrhoids and cancer [20]. Dietary fibre reduces glucose release into the body system and may reduce the risk of colon cancer [21].

On the other hand, honey-beans (5.16±0.32) and groundnut (4.85±0.65) had similar ash content ($p>0.05$); these findings are in accordance with [4] who reported that ash contents of the groundnut samples analyzed ranged between 3.90% and 5.14%. Presence of high ash content in food stuff suggests that mineral elements are contained in them [9]. The finding in this study corroborates the report of [22] that honey-beans contained 4.28±0.05g/100g of ash. Results further showed that groundnut (27.88±0.55) had a higher carbohydrate content compared with honey-beans (14.06±1.92). The findings of this study differed from [23] who reported a range of 45.66 to 55.74% carbohydrate in various cowpea varieties; this study however corroborates the findings of [9] who stated a range of 25.30% to 26.50% carbohydrate in beans.

Table 2: Effect of sample types on proximate composition of selected food stuffs

Samples	**Dry Matter (%)**	**Crude protein (%)**	**Crude fat (%)**	**Crude fibre (%)**	**Ash (%)**	**Carbohydrate (%)**
Honey-beans	90.76±1.41^{b}	37.15±1.37^{a}	1.98±0.64^{b}	32.42±2.09^{a}	5.16±0.32^{a}	14.06±1.92^{b}
Groundnut	91.54±0.62^{a}	18.04±0.74^{b}	24.32±0.44a	16.46±1.33^{b}	4.85±0.65^{b}	27.88±0.55^{a}

Note: Means with different superscripts are not the same

Source: Own Data, 2021

3.3 Interaction effects of market location and sample types on proximate composition of selected food stuffs

The interaction effect of market location and sample types on proximate composition of selected foodstuffs is shown in Table 3. There were significant variations observed in proximate parameters of the food stuffs. It was observed that honey-beans from Oja-Oba market (92.19±0.89) had the highest ($p<0.05$) dry matter content. However, honey-beans from Dugbe market (91.50±0.70), Sango market (91.77±0.52) and groundnut from Sango market

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(91.43±0.44) had similar ($p>0.05$) dry matter content. Groundnut purchased from Dugbe market (89.09±0.06) had the lowest ($p<0.05$) dry matter content when compared with other samples from different market locations. Results revealed that protein content of honey-beans from Sango market (36.29±0.70) and groundnut from Dugbe market (36.62±1.23) were similar ($p>0.05$) whereas honey-beans from Oja-Oba (17.71±0.54) Dugbe markets (18.27±1.54) with groundnut from Oja-Oba market (18.14±0.43) were similar in protein composition ($p>0.05$). The groundnut from Sango market had the highest (38.53±0.47) crude protein content compared with food samples from other locations. Result further indicated that the crude fat content of honey-beans from Oja-Oba market (24.30±0.16), honey-beans from Dugbe market (24.70±0.11) and groundnut from Oja-Oba market (23.96±0.84) were all similar ($p>0.05$). Likewise, groundnut from Dugbe (20.22±0.47) and Sango markets (19.75±0.53) had similar ($p>0.05$) crude fat content.

Furthermore, similar ($p>0.05$) crude fibre contents found in groundnut samples from Dugbe (31.03±0.06) and Sango (33.77±0.44) were higher ($p<0.05$) than in honey-beans from Oja-Oba (17.68±0.27) and Dugbe (15.45±0.90) markets as well as groundnut from Oja-Oba market (16.25±1.50) which were all similar ($p>0.05$). The ash content of the food samples showed no differences ($p>0.05$) across all the locations this may be alluded to the stability of minerals in storage as minerals are more stable when compared with other micronutrients [24]. The interaction effects of sample type and market location on carbohydrate content of samples showed that honey-beans from Oja-Oba (27.73±0.57) and Dugbe (28.13±0.50) markets as well as groundnut from Oja-Oba market (27.77±0.63) were similar ($p>0.05$) and higher than other samples. Groundnut samples from Sango market (12.14±0.80) had the least ($p<0.05$) carbohydrate content.

Variations in interaction effects may be as a result of differences in market handling practices across the three market locations. The extended period of storage by marketers predisposes the food stuffs to pest and diseases attacks; the different market systems adopted by food sellers also brings variations into handling and storage of food stuffs. Certain types of markets have locked up stalls while others often make do with empty spaces where they place tables to display their foodstuffs, such foodstuffs are often wrapped up with cellophane materials at closing time making the foodstuffs on such stalls liable to attack by pathogenic bacteria and fungi. The report of [25] on food safety regulations shows that the duplicity of regulatory bodies provides

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loopholes in enforcement of standards although the Nigerian government has multiple agencies charged with the oversight of food safety especially in food manufacturing and preservation. Thus, leaving the handling of raw food in markets open to the decision of traders. All these factors translate to different food stuff procurement standards and market handling practices which may impact nutrient content of raw food stuffs.

Table 3. Interaction effect of market location and sample types on proximate composition of selected foodstuffs

Samples	Location	Dry Matter (%)	Crude Protein (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)
Honey-beans	Oja-Oba	92.19±0.89^{a}	17.71±0.54^{c}	24.30±0.16^{a}	17.68±0.27^{b}	4.77±0.11^{a}	27.73±0.57^{a}
	Dugbe	91.50±0.70^{ab}	18.27±1.54^{c}	24.70±0.11^{a}	15.45±0.90^{b}	4.95±0.47^{a}	28.13±0.50^{a}
	Sango	91.77±0.52^{ab}	36.29±0.70^{b}	19.75±0.87^{b}	32.46±3.03^{a}	5.36±0.30^{a}	15.73±2.09^{b}
Groundnut	Oja-Oba	90.94±0.42^{b}	18.14±0.43^{c}	23.96±0.84^{a}	16.25±1.50^{b}	4.82±0.39^{a}	27.77±0.63^{a}
	Dugbe	89.09±0.06^{c}	36.62±1.23^{b}	20.22±0.47^{b}	31.03±0.06^{a}	5.11±0.78^{a}	14.30±0.18^{b}
	Sango	91.43±0.44^{ab}	38.53±0.47^{a}	19.75±0.53^{b}	33.77±0.44^{a}	5.02±0.07^{a}	12.14±0.90^{c}

Note: Means with different superscripts are not the same
Source: Own Data, 2021

3.4 Pearson's Correlation coefficient of proximate composition of food stuffs from different locations

Table 4 shows the correlation coefficient values of proximate composition of samples from different location. Results revealed that the correlation analysis of proximate composition of food samples from different market locations were mostly significant. Positive and negative correlation coefficients were observed; dry matter showed negative, non-significant relationship with other proximate parameters except crude fat and carbohydrate with a positive non-significant 0.39 correlation values in both cases. The negative correlation between dry matter and crude protein crude fibre and crude ash were -0.38, -0.30 and -0.18 respectively. Similarly, negative but significant relationship between crude fat and the following: crude protein (-0.99), crude fibre (-0.99) and crude ash (-0.80). Results showed a positive significant relationship between carbohydrate and crude fat (0.99). Likewise, results indicated that there existed positive, significant correlation between crude fibre (0.99), crude ash (0.78) and crude protein. Crude ash had positive correlation (0.77) with crude fibre. In addition, negative but significant correlation existed between carbohydrate and crude fibre (-0.99), as well as carbohydrate and crude ash (-0.72).

Table 4. Correlation coefficient of proximate composition of sample type from different market locations

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	Dry Matter (%)	**Crude fat (%)**	**Crude protein (%)**	**Crude fibre (%)**	**Crude Ash (%)**	**Carbohydrate (%)**
Dry Matter (%)	1.00					
Crude fat (%)	0.39^{ns}	1.00				
Crude protein (%)	-0.38^{ns}	-0.99**	1.00			
Crude fibre (%)	-0.30^{ns}	-0.99**	0.99**	1.00		
Crude Ash (%)	-0.18^{ns}	-0.80**	0.78**	0.77**	1.00	
Carbohydrate (%)	0.39^{ns}	0.99**	-0.99 **	-0.99 **	-0.72**	1.00

** Represents significance at 1% probability level, ^{ns} represents non-significant correlation
Source: Own Data, 2021

3.5 Effect of market location on mineral profile of food samples (honey-beans and groundnut)

The effect of location on mineral profile of food samples (honey-beans and groundnut) are shown in Table 5. The iron content of samples from Sango market (3.06±0.78mg/kg) was significantly higher ($p<0.05$) than in samples from the other two market locations, Oja-Oba (2.59±0.38mg/kg) and Dugbe (2.29±0.50mg/kg) markets which were both similar ($p>0.05$). Results further showed that samples from Oja-Oba market (3.45±0.33mg/kg) had the highest level of zinc. Whereas, Samples from sango (2.62±0.22mg/kg) contained higher ($p<0.05$) zinc than samples from Dugbe market (1.91±0.38mg/kg) which had the lowest zinc content. Furthermore, it was discovered that samples from Oja-Oba market (28.00±26.59mg/kg) contained the highest ($p>0.05$) magnesium while samples from Dugbe (18.17±17.47mg/kg) and Sango markets (18.59±16.69mg/kg) were similar (p.0.05). The calcium content of samples from Oja-Oba market (5.23±2.61) was higher ($p<0.05$) than (3.70±1.64) calcium content in samples from Dugbe market. The least calcium was found in samples from Sango market (3.37±1.91mg/kg).

Table 5. Effect of location on mineral profile of food samples (honey-beans and groundnut)

Location	Iron (mg/kg)	Zinc (mg/kg)	Magnesium (mg/kg)	Calcium (mg/kg)
Oja-Oba	2.59 ± 0.38^{b}	3.45 ± 0.33^{a}	28.00 ± 26.59^{a}	5.23 ± 2.61^{a}
Dugbe	2.29 ± 0.50^{b}	1.91 ± 0.38^{c}	18.17 ± 17.47^{b}	3.70 ± 1.64^{b}
Sango	3.06 ± 0.78^{a}	2.62 ± 0.22^{b}	18.59 ± 16.69^{b}	3.37 ± 1.91^{c}

Note: Means with different superscripts are not the same
Source: Own Data, 2021

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3.6 Effects of sample type on Mineral profile of food samples from different market location

Table 6 shows the effect of sample type on mineral composition of food samples from different location. Groundnuts contained 3.08±0.50 mg/kg of iron and was higher ($p>0.05$) than iron content of honey-beans (2.22±0.43). Although, both honey-beans (2.67±0.90) and groundnut (2.65±0.53) had similar ($p>0.05$) zinc content, the magnesium content of honey-beans (40.06±9.18) was significantly higher ($p<0.05$) than that of groundnut (3.11±0.71). Likewise, calcium content of honey-beans (5.97±1.25) was higher ($p>0.05$) than the calcium content of groundnut (2.24±0.54).

Table 6. Mineral profile of food samples from different location

Sample	Iron (mg/kg)	Zinc (mg/kg)	Magnesium (mg/kg)	Calcium (mg/kg)
Honey-beans	2.22 ± 0.43^{b}	2.67 ± 0.90^{a}	40.06 ± 9.18^{a}	5.97 ± 1.25^{a}
Groundnut	3.08 ± 0.50^{a}	2.65 ± 0.53^{a}	3.11 ± 0.71^{b}	2.24 ± 0.54^{b}

Note: Means with different superscripts are not the same

Source: Own Data, 2021

3.7 Interaction effect of sample type and market locations on mineral profile of foodstuffs from different markets

Table 7 illustrates the interaction effect of sample type and market locations on mineral profile of the food stuffs. There were variations in mineral profile of samples as a result of interaction effects. Honey-beans from Dugbe market (3.72±0.10 mg/kg) had the highest ($p>0.05$) iron content compared with other food samples across other market locations. On the other hand, groundnut from Oja-Oba (2.73±0.14 mg/kg), Dugbe (2.40±0.46 mg/kg) and Sango markets (2.39±0.45 mg/kg) had similar ($p<0.05$) iron contents. The honey-beans from Sango market (1.86±0.17 mg/kg) had the least iron content. The Zinc content of honey-beans (3.27±0.34 mg/kg) and groundnut (3.63±0.24 mg/kg) were the similar ($p>0.05$) and higher ($p<0.05$) than in other food samples across other locations. Results further revealed that the level of zinc in honey-beans from Dugbe market (2.51±0.19 mg/kg) had similarities ($p>0.05$) with those of groundnut from Oja-Oba (2.18±0.17 mg/kg) and Sango markets (2.74±0.22 mg/kg). It was also observed that groundnut from Dugbe market containing 52.26±1.42 mg/kg magnesium had the highest ($p<0.05$) level of magnesium content compared with honey-beans across other locations. However, honey-beans (34.12±0.15 mg/kg) and groundnut (33.82±0.74 mg/kg) from Sango market had similar ($p>0.05$) magnesium content. The findings of [16] reported that white beans had the highest values of magnesium concentration which was between 189.91 and 195.33 mg/100g. According to [26], cowpeas are a good source of magnesium. Magnesium is a component of teeth and bones and also forms a portion of enzyme activator [27]. It also contributes to growth absorption of lipid, nucleic acid, protein and carbohydrate [27]. Among the minerals, calcium was the most abundant as well as considerably higher than other elements analyzed. Results revealed that groundnut from Dugbe market (7.60±0.36mg/kg) had the highest

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($p<0.05$) level of calcium content. Nonetheless, honey-beans from Sango market (5.20±0.20mg/kg) and groundnut from Sango market (5.11±0.18mg/kg) had similar ($p>0.05$) calcium content whereas honey-beans from Oja-Oba (2.86±0.17mg/kg) had the lowest calcium content. Study by [17] stated that brown beans had higher calcium values of 160.40 to 182.0mg per 100g. Calcium is implicated in many of the biochemical processed in the body such as blood coagulation, neuromuscular excitability, bone mineralization and maintenance of healthy teeth [17, 23]. According to [17] brown cowpeas contain more protein which is essential for development and growth.

Table 7. Interaction effect of market locations and food samples on mineral profile

Samples	Location	Iron (mg/kg)	Zinc (mg/kg)	Mg (mg/kg)	Ca (mg/kg)
Honey-beans	Oja-Oba	2.78±0.22^{b}	3.27±0.34^{a}	3.745±0.23^{c}	2.859±0.17^{c}
	Dugbe	3.72±0.10^{a}	2.51±0.19^{bc}	3.36±0.23^{c,d}	1.64±0.04^{e}
	Sango	1.86±0.17^{c}	1.64±0.33^{d}	34.12±0.15^{b}	5.20±0.20^{b}
Groundnut	Oja-Oba	2.73±0.14^{b}	2.18±0.17^{c}	2.22±0.16^{d}	2.21±0.02^{d}
	Dugbe	2.40±0.46^{b}	3.63±0.24^{a}	52.26±1.42^{a}	7.60±0.36^{a}
	Sango	2.39±0.45^{b}	2.74±0.22^{b}	33.82±0.74^{b}	5.11±0.18^{b}

Note: Means with different superscripts are not the same

Source: Own Data, 2021

3.8 Correlation coefficient of mineral profile of food samples from different market locations

The correlation coefficient of mineral profile of food samples from different market locations is presented in Table 8. Results revealed that zinc had a positive relationship (0.20) with iron. However, magnesium had a negative non-significant relationship with iron (-0.67) and zinc (-0.25). Likewise, calcium had a negative non-significant relationship with iron (-0.70) and zinc (-0.35); whereas there was a positively significant relationship between calcium and magnesium (0.98).

Table 8. Correlation coefficient of mineral profile of food samples from different market locations

	Iron (mg/kg)	Zinc (mg/kg)	Magnesium (mg/kg)	Calcium (mg/kg)
Iron (%)	1.000			
Zinc (%)	0.20^{ns}	1.000		
Magnesium (%)	-0.67^{ns}	0.25^{ns}	1.000	

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Calcium (%)	-0.70^{ns}	-0.35^{ns}	0.98**	1.000

** Represents significance at 1% probability level, ^{ns} represents non-significant correlation
Source: Own Data, 2021

4. CONCLUSION

The findings of this study showed the significant differences and similarities of proximate (dry matter content, crude protein, crude fat, crude fiber, ash content and carbohydrate) and mineral compositions (Zinc, Iron, Calcium and Magnesium) of honey-beans and groundnut from Dugbe, Sango and Oja Oba markets in Ibadan, Oyo State, Nigeria. Findings revealed that sample types and market locations had effect on the proximate and mineral compositions of honey-beans and groundnut samples. Out of the four parameters of mineral composition, iron content was high in both honey-beans and groundnuts. Moreover, significant association existed between the sample type and market location which influenced the proximate and mineral compositions of the selected samples. Also, this study showed that proximate composition and mineral profiles of selected foodstuffs were affected by market handling practices.

RECOMMENDATION

Based on the findings of this study, it can be recommended that people who are prone to anemia, for instance, lactating mothers, pregnant women, menstruating ladies and children that are under five should consume more of honey-beans and groundnuts due to presence of high level of iron in the food samples which could help to prevent anemia. It is recommended that food stuff handling practices be regulated across markets in Nigeria.

ETHICAL APPROVAL

"All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down by AOAC1980."

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