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Nutritional investigation of three commonly consumed fast foods in two major fast food restaurants in Lagos State, Nigeria

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This study was carried out to investigate the proximate and mineral compositions of three commonly consumed fast foods (chicken pie, scotch egg and moi-moi); from two different fast food restaurants in Lagos State, Nigeria. These analyses were carried out using standard methods of Association of Official Analytical Chemists (AOAC). Results of proximate analysis showed that fast foods from restaurants A and B contain relatively good nutritive values. Also, of the fourteen minerals assayed, results were obtained for nine (Fe, Zn, Mn, Na, Ca, Mg, Cu, K and P) with variation in their concentrations. Meanwhile, Nickel, Chromium, Lead, Cobalt, and Cadmium were not detected in any of the foods from both restaurants. The results of this study showed slight variations in the proximate compositions but significantly wide variations in the mineral contents of the fast foods from the two restaurants. These disparities could be as a result of differences in ingredients used and methods of processing and/ or preparing the fast foods. The results of this study also showed that fast food samples from restaurant B generally contained higher amount of minerals. However, the very high amounts of Sodium, Phosphorus and Potassium found in all three fast food sample from restaurant B are of great concern. This suggests that regular consumption of these foods especially from restaurant B may pose health risk to the consumers.

Capsule Summary: Foods from fast food restaurants in Lagos State Nigeria have good nutritional quality but regular consumption may be injurious to the health of the consumer.

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INTRODUCTION

It is often said that "you are what you eat"; which implies that the state of our health is a function of what we eat. This is because the foods we eat provide our bodies with the nutrients and the substances required for proper functioning (Siddiqui and Anusha, 2012). Studies have shown that regular good choices of nutritious foods have positive effects on the body's health state while poor

choices of foods have negative long term effects (Turconi et al., 2011). Globally, human diet is going through a remarkable transition with; staple foods becoming more of refined and processed meals. Processed foods are consumed more than before, and larger amount of meals are eaten outside the home. This makes households more reliant on the food industry and food vendors (Uusitalo, 2002). Fast foods are gradually becoming a major portion of foods eaten outside of the home (Isganaitis and Lustig, 2005) in Nigeria. In fact, consumption of fast foods has become a national phenomenon and is gradually becoming very popular in Nigeria amongst both old and young especially the urban dwellers. What comprises fast foods vary from one country to the other. The different types of fast foods in Nigeria's restaurants' menus include; chicken pie, scotch egg, moi-moi, fried rice, jollof rice as well as hamburgers, pizza, or fries and other kinds of foods that can be prepared and served quickly at low price (Song, 2016). However, Nigeria is yet to evolve a broad based policy required to regulate the practice of fast foods restaurants. This Western diet is characterized by a high intake of saturated and omega-6 fatty acids, reduced omega-3 fat intake, an overuse of salt and too much refined sugar (USDA, 2002). Research into junk food and fast food restaurants have found that there is a direct relationship between the number of fast food restaurants located within a local area and rate of increase in obesity (Fitzpatrick, 2004). Fast food consumption has been associated with coronary heart disease (CHD) and other non-communicable or non-contagious diseases (Bowman et al., 2004) based on the assumption that their fat content could contain factors that could predispose the consumers to some of these health challenges. Fast food consumption is on the rise especially among young adults in Nigeria. For example, Arulogun and Owolabi (2011) reported that over 80% of University undergraduates consumed fast foods at least once in a week. Most urban cities and towns in Nigeria have witnessed an upsurge in the establishment of fast food outlets in the last decade. This caters for the increasing demand for fast food as more people and families eat more often outside the home. Mahan and Escott-stump (2008) related major changes in diet, physical activity and socioeconomic status to increase in obesity and other non-communicable diseases like diabetes, hypertension and dyslipidemia as risk factors which are independently and synergistically related (Steyn and Damasceno, 2006). In their study on fast foods from a Nigerian eatery, Otemuyiwa and Adewusi (2013) found that; the fast foods were characterized by a high level of saturated fatty acids plus non conformity of the ratio of n= 3-6 fatty acids to that recommended for a healthy diet. They also found that trans-fatty acid was present in addition to low content of carotenoids and therefore concluded that regular consumers of fast food products could be predisposed to cardiovascular and coronary heart diseases. According to the results of a study sponsored by the National Heart, Lung, and Blood Institute (NHLBI), frequent consumption of fast food meals caused teens and young adults to gain more weight and face an increased risk of developing insulin resistance (Siddiqui and Anusha, 2012).

The fast food industry is relatively young in Nigeria, and hence only little information exists in literature on the nutritive values of the foods sold by these fast food restaurants. Therefore, this study focused on determining the nutritive value; in terms of proximate and mineral compositions of selected but commonly consumed foods sold by some fast-food restaurants in Lagos State, Nigeria.

MATERIAL AND METHODS

Collection and preparation of sample

Three commonly consumed fast food pastries (chicken-pie, scotch-egg and moi-moi) were purchased at three different times from two major and different fast food restaurants in Lagos, Nigeria. The two restaurants were coded A and B. The samples were chopped into smaller bits, separately dried in an oven (Uniscope SM9053) at 105 ^{0}C for 6 hours and then pulverized with the aid of a blender (Lexus MG-2053 Optima). The pulverized samples were then separately stored in air-tight plastic bottles, labeled and kept in refrigerator until analysis. Analyses were done in triplicates.

Proximate analysis

Moisture, ash, fat and fiber contents were determined by the previously described method of Association of Official Analytical Chemists (AOAC, 2003) while Protein content was determined as described by previously described method of Association of Official Analytical Chemists (AOAC, 2010). Carbohydrate content was determined by difference i.e. by subtracting the sum of percentages of moisture, ash, fat, fiber and protein from 100 %.

Mineral analysis

Two grams of the pulverized sample was weighed in a crucible and placed in a muffle furnace at 550 ^{0}C for 6 hours after which the sample had completely turned to ash. The resulting ash was dissolved in 20 mL of 10 % HNO_3 and the solution was boiled for about 15 min on a hotplate, filtered and made up to 100 mL with distilled water in a volumetric flask. 20 mL of the filtrate was then transferred to plastic sample bottles, accurately labeled and used for mineral analysis. A blank was concomitantly prepared by boiling 20 mL of 10 % HNO_3 solution on a hot plate for 15 min; it was then filtered and made up to mark with distilled water in a 100 mL volumetric flask. All metals (Fe, Zn, Mn, Na, Ca, Mg, Cu, K, Cd, Pb, Ni, Co and Cr) were determined using Atomic Absorption Spectrophotometer (Buck Scientific Model 210VGP) except P which was determined with a UV-Visible Spectrophotometer (LaboMed SPECTRO SC Spectrophotometer).

RESULTS AND DISCUSSION

Proximate composition

Table 1: Proximate composition of fast foods from restaurant A

Proximate composition (%)	Fast food		
	Chicken pie	Scotch egg	Moi-moi
Moisture	19.9±0.01	30.8±0.01	27.0±0.01
Crude fat	28.5±0.02	25.0±0.01	18.0±0.02
Ash	2 .0±0.01	2.50±0.02	6.10±0.01
Crude fiber	3.5±0.03	4.0±0.01	2.20±0.03
Crude protein	11.4±0.01	24.3±0.03	11.90±0.01
Carbohydrate	31.7±0.02	13.40±0.01	34.80±0.01

All data are presented as mean ± SD of three replicates

Table 2: Proximate composition of fast foods from restaurant B

Proximate composition (%)	Fast food		
	Chicken pie	Scotch egg	Moi-moi
Moisture	22.90±0.01	32.50±0.01	29.00±0.01
Crude fat	32.9±0.01	21.5±0.01	22.70±0.02
Ash	1.50±0.01	2.0±0.01	5.00±0.03
Crude fiber	4.20±0.02	3.50±0.02	2.10±0.03
Crude protein	12.0±0.01	25.1±0.01	7.60±0.01
Carbohydrate	26.5±0.01	15.4±0.01	33.60±0.02

All data are presented as mean ± SD of three replicates

Analysis of proximate composition of food is an essential index in determining nutritional value or nutritional potential of food as these food components are usually of interest in the food industry for product development, quality control or regulatory purposes (Oko et al., 2015). Tables 1 and 2 show the results of proximate analysis of fast food samples from restaurants A and B respectively.

The moisture contents of fast food samples range from 19.9 - 30.8% and 22.9 - 32.5% for restaurants A and B respectively with chicken pie showing the least and scotch egg showing the highest for both restaurants. Water is present in all foods, and moisture content is an important parameter for assessing the shelf life of food samples to check for susceptibility to spoilage. The high water content found in Scotch egg suggests high susceptibility of the food sample to microbial and chemical degradation (Hussain et al., 2009). Lowest moisture in the chicken pie samples from both restaurants suggests that chicken pie will have a longer shelf life than the other food samples.

For restaurant A, the crude fat contents of the food samples range from 18.0% for moi-moi to 28.5% obtained for chicken pie. Meanwhile, chicken pie for restaurant B also showed the highest fat content of 32.9% while Scotch egg showed the least with 21.5% fat content. Studies have reported high fat concentration in fast foods (Guthrie et al., 2002). Fat plays a significant role in the shelf life of food products and as such relatively high fat content could be undesirable in baked food products. This is because the presence of fat especially in high amounts could result in rancidity of food thereby producing unpleasant and foul odor in the food samples (Ajani et al., 2012).

Afolabi et al. (2013), in a study on fast foods also found the highest crude fat content in chicken pie (28.5%) which is similar to the findings of our present study. People that feed mostly on fast foods may therefore be at a greater risk of non-communicable disease, most especially cardiovascular disease and they can also become obese. This is because the high fat content of the samples has serious implications on regular fast food consumers leading to high risk of obesity.

The ash contents of samples from restaurants A and B followed the same trend; with the moi-moi samples having the highest values of 6.10% and 5.00% respectively while the lowest ash contents were obtained for the chicken pie samples with 2.00% and 1.50% respectively. Ash content measures the total amount of minerals present in a food. The percentage ash of a sample gives an insight on the inorganic content of the samples from where the mineral content could be obtained. Sample with high ash contents is expected to have high concentration of various mineral elements, which are expected to speed up metabolic processes, improve growth and development (Abitogun and Olasehinde, 2012).

Table 3: Mineral composition of fast foods from restaurant A

Mineral (mg/100 g)	Fast food type			
	Chicken pie	Scotch egg	Moi-moi	Daily value[a]
Iron	0.510±0.01	3.630±0.02	0.052±0.00001	8-18 mg[b]
Zinc	10.500±0.02	4.910±0.01	0.048±0.02	8-11 mg[b]
Manganese	0.240±0.03	0.330±0.02	0.012±0.03	1.8-2.3 mg[b]
Sodium	183.000±0.02	502.590±0.03	1.100±0.01	1.3 -1.5 g[c]
Calcium	5.100±0.03	2.440±0.02	0.100±0.02	1000- 1200 mg[a]
Magnesium	9.950±0.02	25.40±0.02	0.540±0.01	310-420 mg[a]
Copper	0.320±0.02	0.320±0.01	0.005±0.00001	900 µg[b]
Phosphorous	51.800±0.03	209.700±0.03	22.410±0.02	700 mg[a]
Potassium	68.700±0.01	217.600±0.03	376.000±0.03	4.7 g[c]
Nickel	ND	ND	ND	ND
Chromium	ND	ND	ND	25-35 µg[b]
Cadmium	ND	ND	ND	ND
Lead	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND

ND= Not Detected; All data are presented as mean ± SD of three replicates; a = Institute of Medicine, 1997, b = Institute of Medicine, 2001, c = Institute of Medicine, 2004

Table 4: Mineral composition of fast foods from restaurant B

Mineral (mg/100 g)	Fast food			
	Chicken pie	Scotch egg	Moi-moi	Daily value[a]
Iron	13.700±0.01	25.500±0.02	31.700±0.01	8-18 mg[b]
Zinc	252.400±0.02	192.300±0.02	43.100±0.01	8-11 mg[b]
Manganese	4.500±0.01	2.900±0.03	9.900±0.01	1.8-2.3 mg[b]
Sodium	3140.800±0.02	3115.700±0.03	1153.000±0.04	1.3 -1.5 g[c]
Calcium	96.200±0.01	2222.000±0.02	1836.000±0.03	1000- 1200 mg[a]
Magnesium	262.500±0.02	134.600±0.01	671.500±0.03	310-420 mg[a]
Copper	4.300±0.01	7.200±0.02	5.900±0.03	900 µg[b]
Phosphorous	1204.400±0.01	1463.000±0.01	1941.100±0.03	700 mg[a]
Potassium	1900.5±0.03	5534.000±0.02	6329.000±0.02	4.7 g[c]
Nickel	ND	ND	ND	ND
Chromium	ND	ND	ND	25-35 µg[b]
Cadmium	ND	ND	ND	ND
Lead	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND

ND= Not Detected; All data are presented as mean ± SD of three replicates; a = Institute of Medicine, 1997, b = Institute of Medicine, 2001, c = Institute of Medicine, 2004

Results of protein content for both restaurants showed that Scotch egg contained highest amounts of protein with 24.3% for restaurant A and 25.1% for restaurant B. Chicken pie from restaurant A had least protein amount (11.40%) while moi-moi had the least protein amount (7.60%) for restaurant B. Chicken pie has been reported by Afolabi et al. (2013) to contain 16.7% protein; a value higher than what was obtained in this present study. The presence of more protein in the Scotch egg compared to other samples may be due to the use of egg as one of its major ingredients. Egg is known to be a good supplier of amino acid, carbohydrates, easily digestible fats vitamins, minerals and the best proteins apart from milk (Bashir et al., 2015). The difference between the protein content of moi-moi from restaurant B and that of restaurant A may be attributed to the quality/quantity of protein in the beans (amongst other things) that was used to make the moi-moi.

The crude fibre contents of the fast foods were generally relatively low. The least crude fibre contents (2.20%, 2.10%) were obtained for moi-moi samples from both restaurants A and B. Meanwhile, Scotch egg from restaurant A showed the highest crude fibre content (4.0%) while Chicken pie showed the highest (4.2%) for restaurant B. Abdulrahaman et al. (2008) reported fibre content of 0.56 – 3.43% in fast food samples in Asia which are similar to the value reported in this study. Studies have shown that fast

foods are typically low in fibre which may lead to an increase in the risk of diseases such as diabetes mellitus and cardiovascular diseases (Afolabi et al., 2013). Isganaitis and Lustig, (2005) reported that poor fibre content in fast foods may be one of the features that causes obesity and insulin resistance. Therefore, there may be need to supplement these fast foods with other foods that are high in fibre in order to provide adequate fibre required in the meals.

The carbohydrate content of the snacks in restaurant A ranges from 13.40 -34.80% with Scotch egg having the least value and moi-moi the highest value. The carbohydrate content from restaurant B ranges from 15.40- 33.60% with Scotch egg having the least value (15.4%) and the highest value for moi-moi (33.60%). The high percentage of carbohydrate in moi-moi showed that it would be a good source of energy.

Mineral composition

The importance of mineral elements to proper functioning of the human body has been reported (McArdle et al., 2000; Tomlinson et al., 2004; Andrieu, 2008; Antonyuk et al., 2009). Most of the body metabolic activities rely essentially on the presence of proportionate amount of minerals which are obtained solely from the foods. It therefore becomes imperative to monitor and ensure that our diets contain the proper amount of each mineral element essential for the smooth running of the body. In this study, fourteen (14) mineral elements were assayed for in all samples from two restaurants and the results of the mineral analysis are shown in Tables 3 and 4 for restaurants A and B respectively. All fast food samples from both restaurants contained Iron, Zinc, Manganese, Sodium, Calcium, Magnesium, Copper, Phosphorus and Nickel in different proportions while Cadmium, Lead, Nickel, Cobalt and Chromium were not detected in all the samples from both restaurants. The results show that the mineral contents of all samples from restaurants B were higher in several folds than samples from restaurants A. It is worthy of note however, that the higher mineral content of fast foods from restaurants B could make the foods injurious to regular consumers of these foods.

For restaurant A; in comparison to the concentrations of other minerals, Na (183.000 mg/100 g) was highest while Mn (0.240 mg/100 g) was lowest for chicken pie, Na (502.590 mg/100 g) was highest while Cu (0.320 mg/100 g) was lowest for scotch egg while K (376.000 mg/100 g) was highest while Cu (0.005 mg/100 g) was lowest for moi-moi. However, for restaurant B; in comparison to the concentrations of other minerals, Na (3140.800 mg/100 g) was highest while Cu (4.300 mg/100 g) was lowest for chicken pie, K (5534.000 mg/100 g) was highest while Mn (2.900 mg/100 g) was lowest for scotch egg while K (376.000 mg/100 g) was highest while Cu (0.005 mg/100 g) was lowest for moi-moi. For restaurant A; chicken pie showed highest concentrations of Zn and Ca; scotch egg showed highest concentrations of Fe, Mn, Na, Mg and P while moi-moi showed highest concentration of K. Meanwhile, lowest concentration of K was obtained for chicken pie, lowest concentrations of Fe, Zn, Mn, Na, Ca, Mg, Cu and P were obtained for moi-moi while equal concentration of Cu was obtained for chicken pie and scotch egg. For restaurant B, concentrations of Zn and Na were highest in chicken pie; Ca and Cu were highest in scotch egg while Fe, Mn, Mg, P and K were highest in moi-moi. Meanwhile, lowest concentrations of Fe, Ca, Cu, P and K were obtained for chicken pie; lowest concentrations of Mn and Mg were obtained for scotch egg while Zn and Na were lowest for moi-moi.

The disparities observed in the mineral contents of fast foods from these two restaurants may be attributed to variation in recipes as well as processing and preparation methods used by the restaurants.

CONCLUSIONS

This study provides nutritional information on different fast foods sold in two major fast food restaurants in Lagos State, Nigeria. The study concludes that the three foods from both restaurants studied contained relatively good nutritive values. Meanwhile, Sodium, Calcium, Phosphorus and Potassium were found in fast food samples from restaurants B in such high amounts that could make them injurious to regular consumers of these foods. Also, variations in quality of ingredients used, processing conditions and preparation methods may be responsible for the disparities noticed in results obtained for the restaurants' food samples.

REFERENCES

Abdulrahman, O., Musaiger, H., Jassim, A., Reshma, D., 2008. Proximate mineral and fatty acid composition of fast foods consumed in Bahrain. British Food Journal 110(10), 1006–1018.

Abitogun, A.S., Olasehinde, E.F., 2012. Nutritional evaluation of seed and characterization of crude jack bean (*canavalia ensiformis)* oil. Journal of Applied Chemistry 1(6), 36-40.

Afolabi, W.A.O., Oyawoye, O.O., Sanni, S.A., Onabanjo, O.O., 2013. Proximate and cholesterol composition of selected fast foods sold in Nigeria. Nigerian Food Journal 31(1), 70 – 76.

Ajani, A.O., Oshundahunsi, O.F., Akinoso, R., Arowora, K.A., Abiodun, A.A., Pessu, P.O,. 2012. Proximate composition and sensory qualities of snacks produced from breadfruit flour. Global Journal of Science Frontier Research 12(7), 1-9.

Andrieu, S., 2008. Is there a role for organic trace element supplements in transition cow health? The Veterinary Journal 176, 77-83.

Antonyuk, S.V., Strange, R.W., Marklund, S.L., Hasnain, S.S. 2009. The structure of human extracellular copper-zinc superoxide dismutase at 1.7A resolution: insights into heparin and collagen binding. Journal of Molecular Biology 388(2), 310-26.

AOAC. 2003. Official Methods of Analysis of the Association of Official's Analytical Chemists. 17th edn., 2003, Association of Official Analytical Chemists, Arlington, Virgina.

AOAC. 2010. Official Methods of Analysis of the Association of Official's Analytical Chemists. 17th edn., 2010, Association of Official Analytical Chemists, Arlington, Virgina.

Arulogun, O.A, Owolabi, M.O., 2011. Fast food consumption pattern among undergraduates of the University of Ibadan, Nigeria: Implications for nutrition education. Journal of Agriculture and Food Technology 1(6), 89-93.

Bashir, L., Ossai, P.C., Shittu, O.K., Abubakar, A.N., Caleb, T., 2015. Comparison of the nutritional value of egg yolk and egg albumin from domestic chicken, guinea fowl and hybrid chicken. American Journal of Experimental Agriculture 6(5), 310-316.

Bowman, S.A., Gortmaker, S.L., Ebbeling, C.B., Pereira, M. A., Ludwig, D.S., 2004. Effect of fast food consumption on energy intake and diet quality among children in a national household survey. Paediatrics 113(1), 111-120.

Fitzpatrick, M. 2004. Junk food. Lancet 363, 1000.

Guthrie, J.F., Lin, B.H., Frazzao, E., 2002. Role of food prepared away from home in the American diet, 1977– 78 versus 1994-96; changes and consequences. Journal of Nutrition Education Behaviour 34, 140 – 150.

Hussain, K., Ismail, Z., Sadikun, A., Ibrahim, P., 2009. Proximate and qualitative analysis of different parts of *Piper sarmentosum* and quantification of total amides in various extracts. Pharmacognosy Research 1, 113–119.

Institute of Medicine. 1997. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D and fluoride. Washington DC: National Academy Press.

Institute of Medicine. 2001. Dietary reference intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. Washington DC: National Academy press.

Institute of Medicine. 2004. Dietary reference intakes for water, Potassium, Sodium, Chloride and Sulfate. Washington DC: National Academy press.

Isganaitis, E., Lustig, R.H., 2005. Fast Food, Central Nervous System Insulin Resistance, and Obesity. Arteriosclerosis, Thrombosis, and Vascular Biology 25, 2451-2462.

Mahan, S., Escott-Stump, K., 2008. Food and nutrition therapy. 12th edition, p. 854-862. USA: Mc-Graw Hill.

McArdle, W.D., Katch, F.I., Katch, V.L., 2000. Micronutrients water: In W. D. McArdle, F. I. Katch and V. L. Katch. (2nd ed.) Essentials of exercise physiology, p 75. USA: Lippincott Williams and Wilkins.

Oko, A.O., Famurewa, A.C. Nwaza, J.O., 2015. Proximate composition, mineral elements and starch characteristics: study of eight (8) unripe plantain cultivars in Nigeria. British Journal of Applied Science and Technology 6(3), 285-294,

Otemuyiwa, I.O., Steve, R. A.A., 2013. Fatty acid, carotenoid and tocopherol content of some fast foods from a Nigerian eatery. Journal of Food and Nutrition Research 15, 82-86.

Siddiqui, A., Anusha, N., 2012. Deleterious Effects of Food Habits in Present Era. Journal of Allergy and Therapy 3, 114.

Song, Y., 2016. Factors that affect fast food consumption: A review of the literature. MBA Student Scholarship. Paper 53. http://scholarsarchive.jwu.edu/mba_student/53.

Steyn, K., Damasceno, A., 2006. Lifestyle and Related Risk Factors for Chronic Diseases: Disease and Mortality in Sub-Saharan Africa. 2nd edn. Washington DC: World Bank.

Tomlinson, D.J., Mulling, C.H., Fakler, T.M., 2004. Invited review: Formation of keratins in the bovine claw: roles of hormones, minerals, and vitamins in functional claw integrity. Journal of Dairy Science 87, 797-809.

Turconi, G., Simonetti, P., Brusamolino, A., Rondanelli, M., Roggi, C., 2011. Nutritional and plasma antioxidant status assessment in a group of old Alzheimer's inpatients. Journal of Nutrition and Food Science 1, 101.

USDA. 2002. Profiling food consumption in America. Washington, DC: Book AF.

Uusitalo, U., Pietinen, P. Puska, P., 2002. Dietary transitions in developing countries: Challenges for chronic disease prevention; globalization, diets and non-communicable diseases. WHO Library Cataloguing-in-Publication Data. NLM Classification: QT 235 pp. 6 – 23.