Nigerian Food Journal
Official Journal of Nigerian Institute of Food Science and Technology www.nifst.org

NIFOJ Vol. 31 No. 1, pages 70 – 76, 2013

Proximate and Cholesterol Composition of Selected Fast Food Sold in Nigeria

*Afolabi, W.A.O.[1]; Oyawoye, O.O.[1], Sanni, S.A.[1] and Onabanjo, O.O.[1]

ABSTRACT

Fast foods consumption has been on the increase in Nigeria raising concerns about the nutritional and health implications. This study was carried out to determine the proximate composition and cholesterol contents of four commonly consumed fast foods (doughnut, chicken pie, roasted chicken, and Jollof rice) sold in Nigeria. Commonly consumed fast foods and most widely patronized fast food outlets were determined by a preliminary survey. There was a wide variation in the proximate composition and cholesterol contents of the food samples. Average dry matter ranged between 68.8 – 84.0g while the range of values for ash, crude fibre, crude fat, crude protein and nitrogen free extract were 0.89 – 2.45%, 0.56 – 7.53%, 10.99 – 18.52%, 1.81 – 9.71% and 43.32 – 66.98% respectively. Energy content of the fast foods ranged between 304.9 and 400.8 Kcal/ 100 g. Cholesterol levels ranged between 10.40 – 117.80 (mg/ 100 g) in the food samples. This study has established the fact that fast foods are concentrated sources of energy, low fibre and high dietary cholesterol and could significantly contribute to dietary cholesterol intake with implications for cardiovascular health.

Keywords: Proximate composition, cholesterol, health, fast food, nutrition.

Introduction

Fast foods comprise a growing portion of foods eaten outside the home (Isganaitis and Lustig, 2005) especially among urban populations both in developing and developed countries including Nigeria. Global diet is going through a remarkable transition with staple foods becoming more refined and processed, fat and meat intake is increasing, processed dairy products and other processed foods are consumed more than before, and larger number of meals is eaten outside the home, making households more reliant on the food industry, food vendors and markets (Uusitalo, 2002). These dietary transitions are associated with the escalating trends of non-communicable diseases, (Uusitalo, 2002). Not only do patterns of food consumption differ markedly among nations and culture (Furtado et al., 2004; O'Niel et al., 2001), what comprise fast foods also vary from one country to the other. 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 a week.

Many urban cities in Nigeria are markedly experiencing nutrition transition which represents a large shift in the composition and structure of diet especially from traditional diets to more westernized diets. The dietary changes in nutrition transition according to Steyn and Damasceno (2006) involve increased consumption of fat (especially saturated fat) and sugar, marked increases in consumption of animal products, sodium, cholesterol and a decline in consumption of unrefined cereal and fibre. Most urban cities and towns in Nigeria have witnessed an

[1] Department of Nutrition and Dietetics, Federal University of Agriculture P.M.B. 2240, Abeokuta, Ogun State, Nigeria.

* corresponding author: afolabiwao@yahoo.com

upsurge in the establishment of fast food outlets in the last decade to cater for the increasing demand for fast foods as more people and families eat more outside the home. These developments according to Mahan and Escott-Stump (2008), relate to major changes in diet, physical activity and socio-economic status as well as increased obesity and other non-communicable diseases like diabetes, hypertension and dislipidemia risk factors which act independently and synergistically (Steyn and Damasceno, 2006).

Although there has not been a nationwide study on the prevalence of non-communicable diseases in Nigeria, available studies have indicated a wide variation and an increasing prevalence among different groups. Obesity prevalence is 3% among urban adolescents in Lagos State (Ben-Bassey et. al. 2007); 3.4% among undergraduates in Ibadan (Ameen et al., 2007); 18% among school age children and 5.2% among preschool children (Sebanjo and Adejuyigbe 2007). Various isolated studies conducted in Nigeria also revealed different but increasing prevalence of hypertension from 7% (Kaufman et al., 1999); to 12.4% (Lawoyin, 2002); 36.6% (Adedoyin et al., 2008) and 39% (Akindele and Uba 2009.) Similarly, Oyati et al., (2005) reported a rising incidence of myocardial infarction which was linked with increasing predisposing factors such as hypertension, diabetes mellitus, hyperlipidemia among other reasons. A Àve years' incidence and pattern of cardiovascular disease study in a Nigerian Teaching Hospital conducted between 1997 and 2001 revealed a prevalence rate of 35% for heart failure and 32% for hypertension among 1104 patients (Adedoyin and Adesoye 2005). In a study of healthy workers in Nigeria, 5% of the study population had hypercholesterolemia, 23% elevated total serum cholesterol, 51% elevated LDL cholesterol and 60% low HDL-cholesterol, with females recording better overall (Akpa et al., 2006). A national prevalence rate of 3.9% for Type II diabetes mellitus have also been reported (International Diabetic Federation Atlas, 2009).

This increasing trend in the prevalence of non communicable diseases can be attributed to the impact of urbanization, economic transition with associated nutritional transition currently being experienced in Nigeria.

Nigeria is yet to evolve a broad based policy required to regulate the practice of fast foods, establish standards and protect consumers of fast foods. Similarly, available food composition table in Nigeria does not have data on fast foods and no fast foods operator is yet to provide information to consumers on the nutritive value of menus being served.

This study was carried out to determine the nutrient and cholesterol composition of selected but commonly consumed fast foods sold in Abeokuta, Nigeria with a view to providing data on which reliable inferences can be made and predict potential risks of developing NCDs especially among urban dwellers.

Materials and Methods

Sample collection

A total of four commonly consumed fast foods in Nigeria comprising two pastries (doughnut and chicken pie) and two main meals (Jollof rice and roasted chicken) were purchased at point of sale from three most patronized fast foods outlets in Abeokuta, South West Nigeria. These fast food outlets were coded as CheRe, SweSe and MaCs. The samples and outlets were determined on the basis of the result of a preliminary survey conducted to elicit information from Àfty consumers on the frequency of consumption and preference for fast food in the study location.

Although the researchers made attempt to elicit information on the various ingredients and recipes used by each of the fast food outlets in the preparation of the menus, this was not possible as they all declined to share such information and moreover, each outlet owed their competitive edge to the uniqueness of their recipes and taste of their foods and were not prepared to share them with the public.

Sample preparation and treatment

The samples purchased were dried in an oven (Gallenkamp, London) at 105ºC for 6 h and milled into flour with the aid of a blender (Master Chef model: B919A). The dried samples were then kept in airtight plastic bottles, covered, labelled and kept at frozen temperature until analysis.

Sample analysis

All analyses were carried out at the Food Chemistry and Analytical Laboratory, Department of Food Science and Technology of the Federal University of Agriculture Abeokuta, Ogun State, Nigeria. Each of the samples were analysed in duplicate.

Proximate analysis

Moisture, ash, fibre, crude fat, crude protein (%N x 6.25) were determined by methods of AOAC, 2003. Nitrogen Free Extract (NFE) was obtained by difference (NFE = Dry matter (% protein + fat + ash + fibre)), while energy was calculated using Atwater factor of 4:9:4 for NFE, fat, Protein respectively.

Cholesterol analysis

Cholesterol concentrations in the samples were determined using Liebermann-Burchard Method as described by Syed et al. (2003). This method involved dissolving 1 g of the milled oven dried sample in Chloroform to make 10 ml. Sample was stirred to dissolve completely and diluted 10 times to 100 ml, 3 ml of the diluted sample solution was taken, Lieberman-Burchard reagent was then added to the solution but without the standard solution. Libermann-Burchard reagent reacted with the Sterol to produce a characteristic green colour whose absorbance was determined at 640 nm on spectrophotometer Model T60The cholesterol content of the samples were determined by comparing sample value with that of a standard cholesterol (Cypress Diagnostics, Code HB006, Belgium.) dissolved in 10 ml chloroform.

Preparation of Lieberman-Burchard reagent

0.5 ml of sulfuric acid was dissolved in 10 ml of acetic anhydride it was then covered and kept in ice bucket.

Calculation of daily value

Daily values have been established by the Food and Drug Administration as references to help consumers use information on food labels to plan a healthy overall diet. The daily values provide a reliable guide for most people. The daily values for sodium and cholesterol are the same for everyone, regardless of total calories consumed although they are usually based on a 2000 Kcal diet. The percent contribution of the fast foods to the daily value requirements for different nutrients were calculated by dividing the actual quantity of the nutrient with the appropriate daily value for that nutrient in diets and was expressed as a percentage. The daily value of total fat is 65 g, cholesterol (300 mg), dietary fibre (25 g), protein (50 g) and total carbohydrate (300 g) (Gebhart and Thomas 2002).

Data analysis

Data was analyzed by subjecting to both descriptive and inferential statistical analysis using SPSS Version 14.0.

Results and Discussion

The result of the study is presented for each of the constituent proximate composition and cholesterol.

Energy

The energy contents of the fast foods are presented in Table 1. Doughnut (400.84 Kcal/ 100 g) and Chicken pie (383.77 Kcal/ 100 g) which are flour-based products contained the highest amount of energy. Jollof rice contained 304.90 Kcal per 100 g. These values were higher than the energy contents of fast foods reported by Rolls et. al. (1999) (251 – 277.9 Kcal per 100 g), the energy content of fast food samples in this study was also observed to be lower compared to the amount reported by Hassan et. al., (1991) as well as values documented by Abdulraman et. al., (2008) (215.0 – 349.0 Kcal/ 100 g) in fast food samples. The findings of this study also indicate that fast foods are becoming a more concentrated source of energy compared to typical starchy roots and tubers consumed in Nigeria which are known to characteristically have high caloric density (Alade,

1985) and may have severe implications especially on health since reduced physical activity is typical in urban areas. Consuming energy-dense foods drives daily caloric intake upward (Ebbeling, 2004), this implies a higher energy intake for individuals who solely depend on fast foods and if not matched with increased physical activity will increase pre-disposition to chronic diseases.

Carbohydrate

Carbohydrate content of the fast foods varies across the outlets and was highest in doughnut (66.98 g/ 100 g) and lowest in roasted chicken (43.32 g). The presence of carbohydrate particularly in roasted chicken may be due to the coating and dressings used in their preparation which are typically good sources of carbohydrate. This value is higher than the 12.14 – 43.81% (w/ w) reported by Abdulraman et al. (2008) and 28.8 – 54.7 (g/ 100 g) reported by Hassan et al. (1991) in similar fast foods. Thus regular consumption of such fast foods containing high carbohydrate may contribute to the burden of increased glycemic index with implications for rise in the prevalence of non-communicable diseases.

Fat

All the fast foods analyzed contained varying amounts of fat with the least value found in jollof rice (10.99 g) and the highest value found in chicken pie (18.20 g). These values were similar to 8.74 – 17.33% reported by Abdulraman et al., (2008) and 1.2 – 20.7 g/ 100 g reported by Hassan et al., (1991) in similar fast food samples. Consumers who solely depend on fast foods may be at a greater risk of obesity and other non-communicable diseases especially cardiovascular diseases. The high fat concentration of the samples may also have serious implications on children who consume fast foods regularly leading to high incidence of obesity. Some authors have reported high fat concentration in fast foods (Guthrie et al. 2002) and an increasing per capital supply of fat from animal foods in developing countries (Regmi and Dyck, 2002).

Table 1: Average proximate composition of fast food samples per 100 g edible portion

	Dry matter	NFE	Crude Protein	Crude fat	Crude fibre	Ash	Energy (Kcal)
Doughnut	84.03 ± 0.45	66.98 ± 1.98 (22.3%)	2.59 ± 0.0	16.28 ± 2.12 (25.1%)	0.57 ± 0.00 (2.3%)	0.89 ± 0.0	400.84 ± 1.44 (20.0%)
Chicken pie	79.07 ± 0.57	50.79 ± 1.17 (16.9%)	3.50 ± 0.02	18.52 ± 0.70 (28.5%)	5.36 ± 0.04 (2.1%)	0.92 ± 0.01	383.77 ± 0.63 (19.2%)
Jollof rice	69.00 ± 0.92	46.85 ± 0.603 (15.6%)	1.81 ± 0.26	10.99 ± 1.15 (16.9%)	7.53 ± 0.23 (30.1%)	1.99 ± 1.13	304.90 ± 0.67 (15.3%)
Roasted chicken	68.77 ± 1.5	43.32 ± 0.92 (15.6%)	9.71± 0.05	13.16 ± 0.49 (20.3%)	2.45 ± 0.01 (0%)	319.16 ± 0.489	0.00 ± 0.00 (16.0%)

Values in bracket indicate percent of daily value supplied by the fast foods

Protein

The protein content in the fast food samples ranged between 1.81 and 9.71 g/ 100 g in jollof rice and roasted chicken respectively. Although the protein content of the fast foods reported in this study is lower than that documented in food composition table by Oguntona and Akinyele, (1997), it agrees with the findings of Abdulrahman et al. (2008) and Hassan et al. (1991). These significant variations however, may be a function of the higher cooking temperatures which fast foods and particularly roasted chicken were processed. Callahan (2011) has reported a 89.7% decrease in soluble protein in raw chicken when exposed to heat treatment of 176°F. This reduction in protein due to heat treatment are usually caused by denaturation as well

as structural changes in the meat such as destruction of cell membrane, shrinkage of meat fibers, aggregation and gel formation of myofibrillar and sarcoplasmic proteins shrinkage and solublisation of the connective tissue. Protein concentration in the fast food samples were generally low with the exception of roasted chicken and thus regular consumption of fast foods may not contribute significant amount of dietary protein especially in developing countries unless rational choices of fast foods are made.

Fibre

The fibre content of the fast foods was generally low with jollof rice having the highest value of 7.53 g% while roasted chicken had no fibre content. The values reported in this study are similar to the value (0.56 – 3.43%w/ w) reported by Abdulrahman et al., (2008), and 0.1 – 1.1 g/ 100 g by Hassan et al. (1991) in fast food samples in Asia. The fibre content in the fast food samples in this study compares favourably with findings of Adeyeye et al., (2012) in similar fast foods in Nigeria which indicated that fast foods are typically low in fibre which may increase the risks of non-communicable diseases including diabetes mellitus and cardio vascular diseases. Supplementing these fast foods with whole foods high in fibre may increase chances of consuming adequate fibre required per day. The result of this study agrees with Isganaitis and Lustig, (2005) who reported that fast foods tend to be poor in fibre and may be one of the characteristics that link low fibre consumption to obesity and insulin resistance.

Cholesterol

The cholesterol concentration (mg/ 100 g) in the fast food samples of the three outlets and the average are shown in Table 2. All the fast food varieties contains dietary cholesterol with, average cholesterol concentration in doughnut being 65.3 mg/ 100 g value compared to other similar fast food samples analysed. This may be a function of the type of fat and oil used in the preparation and frying of the product. Jollof rice had the lowest cholesterol concentration (11.8 mg) corroborating the submission of Mahan and Escott-Stump (2008) that foods of plant sources contain lesser cholesterol compared to those of animal origin and that most fast foods are made from ingredients high in dietary cholesterol such as cooking oils and hydrogenated fats. The average cholesterol concentration in roasted chicken (with skin) from all the fast food outlets was 79.17 mg/ 100 g and ranged between 31.0 mg (SweSe) and 117.8 mg/ 100 g (MaCs). This value is similar to that reported by Joshi, (2002) in roasted chicken (80 mg/ 100 g). The cholesterol concentration of chicken pie is significantly higher than that (with the exception of MaCs outlet which have a significantly higher value) of a typical American meat pie (25 mg/ 106 g) as documented by Krummel (2008). The implication of these high dietary cholesterol values in the fast foods may be an indication that animal fat is majorly used in cooking just as eggs and butter, the major sources of dietary cholesterol form a major ingredient used in the preparation of many fast foods (Antia and Abraham, 2007).

The daily value required for dietary cholesterol is 300 mg, this amount represent the tolerable limit for cholesterol in diets per day. This study

Table 2: Cholesterol concentration of fast food samples mg/ 100 g edible portion

Outlet code	Doughnut	Jollof rice	Roasted chicken	Chicken pie
CheRe	32.50 ± 23.19	10.40 ± 0.99	88.60 ± 6.72	29.10 ± 14.21
SweSe	27.40 ± 26.80	7.50 ± 3.04	31.10 ± 3.99	23.80 ± 17.96
MaCs	136.00 ± 50	17.50 ± 4.03	117.80 ± 27.32	94.70 ± 32.17
Average	65.30 ± 33.33	11.8 ± 2.81	79.17 ± 12.68	49.20 ± 21.50
	(21.77%)	(3.93%)	(26.39%)	(16.40%)

Values in bracket indicate per cent daily value supplied by the fast foods and are based on a 2000 Kcal diet.

established that all the fast foods contain varying concentrations of cholesterol and the foods of animal sources and plant based foods supplemented with foods of animal sources (chicken pie) had high concentration of cholesterol. It was also noted that the products from MaCs outlet had significantly higher cholesterol than similar products from the remaining two fast food outlets and especially doughnut (a flour-based product) from this outlet contained the highest (136.49 mg/ 100 g) cholesterol concentration. This may be due to the ingredients (probably animal fat is solely used in meal preparation in this outlet) used in meal and fast food preparation. The continued consumption and over dependence on these foods over a long period of time will inevitably translate to consumption far above the required daily value and thus will have severe implication on the health of consumers and may be attributed to one of the numerous causes of chronic diseases especially atherosclerosis.

Conclusion

In conclusion, this study provides nutrition information on fast foods sold in Abeokuta Nigeria and has established that fast foods are concentrated sources of energy, very high in dietary cholesterol and can be good sources of essential nutrients when taken in the right proportion and may not predispose to any health problems as long as it is not solely depended upon as the major source of meal. Although they serve as a good source of animal protein, however, the high cost of these fast foods will make access to them almost impossible especially for the urban poor. The high calorie, carbohydrate, fat, low ash and fibre and very high dietary cholesterol content in most of the fast foods may also be a risk factor for the increasing high prevalence of non-communicable chronic diseases among Nigerians especially in urban cities and towns.

References

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

Adedoyin, R.A. and Adesoye, A.T. (2005). Incidence and pattern of cardiovascular diseases in a Nigerian hospital. Tropical Doctor 35: 104 – 106.

Adedoyin, R.A., Mbada, C.E., Balogun, M.O., Martins, T. Adebayo R.A., Akintomide, A. and Akinwusi, P.O. (2008). Prevalence and pattern of hypertension in a semiurban community in Nigeria. Eur J. Cardiovasc. Prev. Rehabil. 15(6): 683 – 687.

Adeyeye, E.I., Orisakeye, O.I. and Oyarekua, M.A. (2012). Composition, mineral safety index, calcium, zinc and phytate interelationships in four fast foods consumed in Nigeria. Bull. Journal of Chemical Society, Ethiopia 26(1): 43 – 53.

Akindele, O.M. and Uba, M. (2009). Incidence and pattern of cardiovascular diseases in North Western Nigeria. Niger. Med. J. 50 (3): 55 – 57.

Akpa, M.R., Agomouh, D.I. and Alasia, D.D. (2006). Lipid profile of healthy adult Nigerians in Port Harcourt, Nigeria. Niger J. Med 15(2): 137 – 140.

Alade, I. (1985). Classification of Nigerian foods: A review. Food and Nutrition Bulletin. The United Nations University Press Volume 7, Number 2, June 1985.

Ameen, I.O. and Fawole, O. (2007). Prevalence of risk factors for cardiovascular disease among Nigerian youth. Department of Epidemiology and environmental health, University of Ibadan. Accessed Online http:/ / www.jhsph.edu/ 19th December, 2011.

Antia, F.P. and Abraham, P., (2007). Clinical Dietetics and Nutrition, fourth edition, Oxford University Press, New Delhi, India 4: 380 – 381.

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

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

Ben-Bassey, U.P., Oduwole, A.O. and Ogundipe, O.O. (2007). Prevalence of overweight and obesity in Eti-Osa LGA, Lagos, Nigeria. Obesity Reviews 8: 475 – 479.

Callahan, R. (2011). Does Chicken loose protein if it is boiled? http:/ / www.livestrong.com/ article/ 54796-does-chicken-loose-protein-if-it-is-boiled/ html. Accessed 2nd March 2013.

Ebbeling, C.B., Sinclair, K.B., Pereira, M.A., Garcia-Lago, E., Feldman, H.A. and Ludwig, D.S. (2004) Compensation for energy intake from fast food among overweight and lean adolescents. JAMA 291: 2828 – 2833.

Furtado, J., Siles, X., Campos, H. (2004). Carotenoid concentrations in vegetables and fruits common to the Costa Rican diet. International Journal of Food Sciences and Nutrition. 55 (2): 101 – 113.

Gebhardt, Susan, E. and Robin, G. Thomas (2002). Nutritive Value of Foods. U.S. Department of Agriculture, Agricultural Research Service, Home and Garden Bulletin 72.

Guthrie, J.F., Lin, B.H. and 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.

Hassan, A.S., Nizar, B.K., Al-mousa, Z.A., Shubber, K.M., Srivstava, V.P, Nawaz, S.P. and Mohana, N.A. (1991) Proximate and mineral compositions of local Kuwaiti fast foods. Ecology of Food and Nutrition, pages 37 – 45 Volume 26, Issue 1, http:// dx.doi.org/ 10.1080/ 03670244.1991.9991187. Accessed 18th December 2011.

International Diabetes Federation: Diabetes Atlas 2009 (fourth edition). Brussels, International Diabetes Federation, 2009.

Isganaitis, E, Robert, H. Lustig (2005). Fast Food, Central Nervous System Insulin Resistance, and Obesity. Lancet 357: 505 – 508.

Joshi, S., (2002). Nutrition and Dietetics 2nd edition. Tata-Mc-Graw Hill, New Delhi, India.

Kaufman, J.S., Owoaje, E.E., Rotimi, C.N. and Cooper, R.S. (1999). Blood pressure change in Africa: Case study from Nigeria. Hum. Biol. 71(4): 641 – 657.

Krummel, D.A. (2008). Medical nutrition therapy for cardiovascular diseases. In Mahan K., Escott-stump, S. Food and Nutrition Therapy 12th Edition, Mc-Graw Hill USA, pp. 833 – 861.

Lawoyin, T.O. (2002) Prevalence of cardiovascular risk factors in an African, urban inner city community. West African Journal of Medicine 21(3): 208 – 211.

Mahan, K. and Escott-Stump, S. (2008) Food and Nutrition Therapy 12th Edition, Mc-Graw Hill USA, pp. 854 – 862.

O'Niel, M.E., Carroll, Y. et al. (2001). A European carotenoid database to assess carotenoid intakes in its use in a Àve country comparative study. Br. J. Nutr.76: 1-2.

Oguntona, E.B. and Akinyele, I.O. (1997). Nutrient Composition of Commonly Eaten Foods in Nigeria – Raw, Processed and Prepared. Food Basket International Foundation Publication, Ibadan.

Oyati, A.I., Danbauchi, S.S., Alhassan, M.A. and Isa, M.S. (2005) Is the incidence of acute myocardial infarction in Nigerians increasing? Annals of African Medicine 4 (3): pp. 132 – 135.

Regmi, A. and Dyck (2002). Effects of urbanization on Global food demand Economic Research Service/ USDA' Changing Structure of Global Food Consumption and Trade.

Rolls, B.J., Bell, E.A., Castellanos, V.H., Chow, M., Pelkman, C.L. and Thorwart, M.L. (1999). Energy density but not fat content of foods affected energy intake in lean and obese women. Am. J. Clin. Nutr. 69: 863 – 871.

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

Syed, M.S., Imran, H. and Syed, D.A.G. (2003). Estimation of sterols in edible fats and oils. Pakistan Journal of Nutrition 2 (3): 178 – 181.

SPSS for Windows, Statistical Package for Social Sciences, version 16.0. Lead Technologies Inc.

Senbanjo, I.O. and Adejuyigbe, E.A. (2007). Prevalence of overweight and obesity in Nigerian preschool children. Nutr Health. 18(4): 391 – 399.

Uusitalo, U., Pietinen, P. and 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 ClassiÀcation: QT 235 pp. 6 – 23.