

Fatty Acids Constitution of Selected Franchised Snacks in Nigeria

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Abstract. There has been an increase in the frequency of consumption of fast foods in Nigeria. This study aimed to investigate the fatty acid composition of franchised snacks available in south-western Nigeria. Five non-meat-based and five meat-based fast foods were selected from ten fast food outlets from South-west Nigeria using systematic random sampling. The samples were analyzed for fatty acids composition using gas chromatography-mass spectrometry. Saturated fatty acids (SFA) ranged from 0.72 in popcorn to 11.44 g/100g in doughnut, n-3 unsaturated fatty acid [0.30 doughnut to 2.62 g/100g in meat pie], n-6 unsaturated fatty acids [0.55 in doughnut to 2.03 g/100g beef roll], n-9 unsaturated fatty acids [0.21 sausage roll to 6.59 g/100g beef roll] and Trans fatty acids (TFAs) content [0.29 popcorn to 11.78 g/100g sausage roll]. However, elaidic acid was abundant in almost all non-meat-based snacks (406.60 to 1146.33 mg) and vaccenic acid in almost all meat based samples (324.03 to 2307.60 mg) except in meat pie. The study established that snacks consumed in south-western Nigeria are abundant in SFA, TFA and unsaturated fatty acids and this information will aid in making informed choice during selection of snacks by consumers.

Keywords: Fat content, fast foods, lipids, saturated fats, pastries.

1. Introduction

The prevalence of diseases linked to inappropriate dietary pattern has been on the rise and recognition of the involvement of diet in the development of many diseases has been identified in numerous studies (Keys, 1957; Landsberg, 1986; Simopoulos, 1991; Damaso and Ramon, 2000; WHO/FAO, 2003; Hawkes, 2006). Consumption of fast food, especially pastries based, have been associated with a high prevalence of some diet related non-communicable diseases, based on the source of fat used in

production of such snacks could contain fatty acids that predispose the consumers to these diseases (Otemuyiwa and Adewusi, 2013); yet not all fatty acids are harmful because some are actually important constituents of cells in living organisms (Truswell, 1995). Monounsaturated and Polyunsaturated fatty acids have been linked with good heart health and proper cell membrane formation (NCSF, 2011). The most abundant fatty acid is oleic acid, a n-9 monounsaturated fatty acid which are found naturally in animals and plants sources (Annekan et al., 2006); yet operators of fast food chains in Nigeria use both saturated (butter) and trans fatty acids (margarine) which have been linked to incidence of non-communicable diseases, immensely in preparation of snacks because these fats improve sensory and physical characteristics of these snacks making them attractive, enticing and tasty to consumers. Thus, the reason for this study; which aimed to determine the fatty acids contents of franchised fast food snacks eaten in south-western Nigeria so as to help consumers make good and informed choices during selection for consumption.

2. Material and Methods

2.1 Study Area

Nigeria is made up of six [6] geo-political zones with a total of 36 states and the federal capital territory. The south west zone comprises of six states (Lagos, Ekiti, Ondo, Oyo, Ogun and Osun) with an estimated population of 28 million people (NPC, 2009). The study areas were Ikeja Local Government Area in Lagos State, Abeokuta South Local Government Area in Ogun State and Ibadan the capital of Oyo State.

2.2 Study Design

As of the time of this study, there were 34 registered franchised fast food centers in Lagos, 27 in Ibadan

and 13 in Abeokuta. 10 franchised fast food centers were selected in ratio 5:3:2 in the state capital respectively. A snack from each franchised fast food was selected by balloting from each fast food center i.e. Five non-meat based snacks [doughnut01, doughnut02, doughnut03, doughnut04 and popcorn] and five meat based snacks [scotched egg, beef roll, sausage roll, chicken pie and meat pie] (Uthman-Akinhanmi et al., 2020). The fast foods centers were registered with the states ministries of commerce and industries and also the states ministries of tourism.

2.3. Access to food samples

Franchised Fast Foods (FFF) were purchased daily from the selected outlets as consumed and kept in food warmers at 65°C till use which was on or before 9:00 hours daily (Uthman-Akinhanmi et al., 2020).

2.4. Determination of fat content of fast foods

Fat content was determined using Soxhlet method. Fatty acids were analyzed using a Hewlett-Packard 5973 mass selective detector interfaced with a Hewlett-Packard 5890II gas chromatograph. Total fatty acids were calculated as sum of individual fatty acids expressed as triglyceride equivalents. Saturated and Trans fatty acids were calculated as sum of

respective fatty acids. Theoretical correction factors were used to quantitate all saturated and monounsaturated acids.

2.5. Statistical analysis

All laboratory experiments were carried out in triplicates and results presented as mean and standard deviation of replicate analysis (n=3) of samples collected for each food type. ANOVA was used to assess and compare result and calculations made using SPSS 20.0 for windows.

3. Results and Discussion

Table 1 shows the fatty acids composition of pastry-based franchised fast foods from three south-western states of Nigeria. There was variation in the saturated fatty acids content within doughnut samples. Highest value of saturated fatty acids was observed in Doughnut01 and Popcorn the lowest value 11.44 g and 0.72 g/100g of edible portion respectively. Omega 3 unsaturated fatty acids varied within doughnut samples with doughnut02 having the lowest value and doughnut the highest 0.30 g and 0.93 g/100g respectively; highest value was obtained in meat pie 2.62 g/100g.

Table 1: Cholesterol, saturated and unsaturated fatty acid profile of edible portion of snacks (g/100g)

Snack	Cholesterol (g)	Saturated (g)	n-3 unsat (g)	n-6 unsat (g)	n-7 unsat (g)	n-9 unsat (g)	Trans-fats (g)
Doughnut 01	0.43 ^d ±0.04	11.4 ^a ±0.30	0.94 ^d ±0.02	0.55 ^d ±0.01	2.08 ^b ±0.10	0.89 ^e ±0.00	3.14 ^e ±0.03
Doughnut02	0.81 ^e ±0.13	8.50 ^e ±0.638	0.30 ^f ±0.01	0.92 ^d ±0.01	1.39 ^c ±0.23	2.77 ^b ±0.09	4.77 ^b ±0.56
Doughnut03	3.81 ^b ±0.98	8.81 ^e ±0.16	ND	ND	2.12 ^b ±0.55	1.14 ^d ±0.03	2.68 ^d ±0.16
Popcorn	ND	0.72 ^f ±0.06	0.65 ^e ±0.06	1.02 ^e ±0.08	0.52 ^c ±0.42	1.15 ^d ±0.09	0.29 ^g ±0.02
Doughnut04	ND	9.30 ^b ±0.20	ND	0.85 ^e ±0.18	3.54 ^a ±0.75	2.30 ^c ±0.05	3.32 ^c ±0.06
Scotched egg	7.25 ^a ±0.29	9.66 ^b ±0.38	1.32 ^c ±0.52	1.19 ^b ±0.05	0.52 ^c ±0.02	0.22 ^g ±0.01	0.72 ^g ±0.01
Beef roll	1.06 ^d ±0.02	9.74 ^b ±0.13	1.62 ^b ±0.18	2.03 ^a ±0.03	0.69 ^d ±0.01	6.59 ^a ±0.10	1.82 ^{ef} ±0.55
Sausage roll	2.50 ^c ±0.03	7.35 ^d ±0.19	ND	ND	0.35 ^f ±0.00	0.21 ^g ±0.00	11.78 ^a ±0.14
Chicken pie	0.79 ^e ±0.03	6.38 ^e ±0.24	ND	ND	0.54 ^e ±0.02	0.35 ^f ±0.01	2.22 ^e ±0.11
Meat pie	1.15 ^d ±0.04	6.91 ^d ±0.19	2.62 ^a ±0.65	ND	ND	ND	1.79 ^f ±0.11

^{abcdef} Means along the serial column with different superscripts have significant difference (p<0.05) The values represent the means ± S.D of 3 independent experiments. ND: not detected

Tables 2-4 revealed that doughnut03 had the highest composition of 18:2 (n-6) (linoleic acid) and the lowest was observed in scotched egg. 18:2(n-6) was not detected in beef roll and chicken pie. 18:3(n-3) (α-Linolenic acid) was highest in doughnut02 which was the only doughnut sample with this fatty acid and lowest in popcorn. Vaccenic acid [18:1(n-7)] was present in all samples except doughnut01 and meat pie. Nervonic acid [24:1(n-9)] and Angelic acid [4:1] was absent in all samples except doughnut02. Palmitic acid [16:0] was detected in all samples except

doughnut01 and popcorn. 16:0 (Caproic acid) was present in all samples except popcorn and doughnut04. 5:0 (Butyric acid) was absent in all samples except doughnut01. 15:0 (Pentadecylic acid) was absent in all snacks except sausage roll. Elaidic acid was present in all non-meat-based snacks.

Table 2: Free fatty acid profile of edible portion of pastry-based franchised fast foods mg/100g

Snack	Linoleic (mg)	Oleic (mg)	Linolenic (mg)	Myristoleic (mg)	Vaccenic (mg)	Sapienic (mg)	Elaidic (mg)	Palmitoleic (mg)	Linoelaidic (mg)	T arachidonic (mg)
Doughnut 01	551.17 ^c ± 9.00	ND	ND	ND	ND	2222.76 ^a ± 47.14	892.66 ^d ± 3.43	2080.70 ^b ± 97.91	1074.20 ^c ± 22.77	ND
Doughnut 02	926.26 ^a ± 12.70	738.97 ^a ± 12.32	ND	1046.07 ^a ± 17.45	512.70 ^{cd} ± 8.53	1333.16 ^b ± 22.24	751.30 ^e ± 66.45	878.93 ^c ± 14.64	1196.10 ^b ± 19.92	ND
Doughnut 03	ND	ND	1973.07 ^a ± 50.44	ND	2129.53 ^b ± 54.49	ND	1146.33 ^c ± 29.32	ND	1685.96 ^a ± 43.24	ND
Popcorn	857.26 ^b ± 17.87	747.77 ^a ± 60.26	ND	ND	82.07 ^f ± 6.62	ND	406.60 ^f ± 32.74	443.46 ^d ± 35.71	ND	172.03 ^c ± 13.82
Doughnut 04	852.00 ^b ± 17.87	ND	ND	ND	2307.60 ^a ± 48.45	ND	1308.63 ^b ± 27.46	1234.50 ^b ± 25.93	ND	ND
Scotched egg	114.10 ^d ± 4.48	224.30 ^c ± 9.00	ND	285.13 ^c ± 11.27	324.03 ^c ± 12.84	ND	ND	202.26 ^e ± 8.01	ND	1083.27 ^b ± 42.81
Beef roll	ND	400.67 ^b ± 5.93	ND	954.70 ^b ± 14.12	490.23 ^d ± 7.09	ND	3948.90 ^a ± 58.47	204.96 ^e ± 3.02	1022.10 ^d ± 15.08	2039.10 ^a ± 30.16
Sausage roll	ND	210.23 ^c ± 2.86	ND	ND	355.03 ^c ± 4.86	340.36 ^c ± 4.66	ND	ND	ND	ND
Chicken pie	ND	ND	ND	ND	543.17 ^c ± 22.29	131.80 ^d ± 5.41	ND	ND	ND	ND
Meat pie	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

abcde : Means along the serial column with different superscripts have significant difference (p<0.05)
The value represents the means ± S.D of 3 independent experiments. N.D: Not Detected

Table 3

Snack	Brassic (mg)	Erucic (mg)	Gondoic (mg)	Nervonic (mg)	Stearidonic (mg)	Angelic (mg)	Palmitelic (mg)	Cholesterol (mg)	Caprylic (mg)	Capric (mg)	Lauric (mg)
Doughnut 01	ND	ND	ND	ND	ND	ND	915.90 ^d ± 40.42	420.70 ^a ± 9.32	1340.00 ^b ± 28.39	323.76 ^{bc} ± 6.84	521.43 ^c ± 11.04
Doughnut02	ND	344.47 ^c ± 5.71	387.70 ^b ± 6.44	547.97 ^a ± 9.10	307.40 ^d ± 5.13	573.3± 9.57	ND	818.13 ^f ± 13.60	706.23 ^c ± 11.77	320.46 ^{bc} ± 55.51	ND
Doughnut03	ND	ND	ND	ND	ND	ND	ND	3815.16 ^b ± 97.63	ND	659.66 ^b ± 57.13	ND
Popcorn	ND	ND	ND	ND	518.87 ^e ± 43.69	ND	ND	ND	ND	ND	ND
Doughnut04	ND	999.10 ^b ± 20.95	ND	ND	ND	ND	2683.20 ^b ± 56.37	ND	ND	ND	657.96 ^b ± 13.79
Scotched	65.03 ^c ± 2.60	ND	ND	ND	310.67 ^d ± 12.30	ND	585.90 ^e ± 23.11	7255.06 ^a ± 286.74	223.93 ^c ± 8.82	ND	191.93 ^c ± 7.61
Beef roll	363.67 ^a ± 5.41	1901.97 ^a ± 28.16	345.10 ^b ± 5.12	ND	1355.6± 18.52	ND	1074.66 ^c ± 15.90	1060.86 ^e ± 15.72	365.07 ^d ± 5.33	265.13 ^{bc} ± 3.93	231.50 ^d ± 3.44
Sausage roll	148.73 ^b ± 1.99	ND	ND	ND	ND	ND	7948.30 ^a ± 108.43	2502.73 ^c ± 34.13	1595.27 ^a ± 21.79	ND	641.86 ^b ± 8.76
Chicken pie	ND	353.90 ^c ± 14.49	ND	ND	ND	ND	293.80 ^f ± 12.06	798.56 ^f ± 34.48	138.93 ^f ± 7.81	1183.93 ^a ± 48.54	160.70 ^f ± 6.56
Meat pie	ND	ND	ND	ND	1474.1± 41.23	ND	ND	1124.63 ^d ± 59.44	ND	ND	1155.33 ^a ± 32.34

abcdefg: Means along the serial column with different superscripts have significant difference (p<0.05)
The value represent the means ± S.D of 3 independent experiments ND: Not Detected

Table 4

Snack	Myristic (mg)	Palmitic (mg)	Stearic (mg)	Arachidic (mg)	Behenic (mg)	Cerotic (mg)	Caproic (mg)	Valeric (mg)	Enanthoic (mg)	Pelargonic (mg)	Propionic (mg)
Doughnut01	ND	ND	ND	ND	995.83 ^b ± 7.22	ND	1619.70 ^b ± 49.81	ND	365.96 ^c ± 7.73	414.06 ^b ± 8.77	ND
Doughnut02	ND	504.27 ^b ± 8.41	1004.13 ^a ± 14.25	422.80 ^b ± 7.045	ND	ND	769.16 ^d ± 12.84	ND	ND	352.26 ^b ± 5.89	579.73 ^c ± 9.68

Doughnut03	ND	2549.60 ^b ± 65.19	726.83 ^b ± 18.58	ND	ND	ND	3643.06 ^a ± 93.17	ND	933.53 ^a ± 23.85	ND	ND
Popcorn	86.03 ^e ± 6.93	ND	ND	ND	ND	ND	ND	413.33 ^b ± 33.25	ND	ND	ND
Doughnut04	625.90 ^a ± 13.19	1010.10 ^d ± 21.21	ND	ND	4713.80 ^a ± 99.00	ND	ND	697.10 ^a ± 14.67	ND	ND	786.13 ^b ± 16.49
Scotched egg	168.40 ^d ± 6.68	114.10 ^e ± 4.48	143.50 ^d ± 5.66	1237.33 ^a ± 48.98	ND	324.83 ^c ± 12.81	135.76 ^f ± 5.36	ND	ND	153.23 ^c ± 6.07	1456.13 ^a ± 57.49
Beef roll	85.43 ^e ± 1.55	3230.87 ^a ± 47.83	101.07 ^e ± 1.53	ND	473.96 ^c ± 15.50	228.47 ^d ± 3.38	553.73 ^c ± 8.09	ND	ND	148.26 ^c ± 2.23	516.60 ^d ± 7.67
Sausage roll	184.50 ^c ± 2.54	204.70 ^f ± 2.80	ND	439.60 ^b ± 6.022	ND	355.93 ^b ± 4.86	1207.63 ^c ± 16.49	157.23 ^c ± 2.16	245.56 ^d ± 3.35	ND	245.33 ^c ± 3.39
Chicken pie	ND	71.27 ^e ± 0.99	163.67 ^c ± 6.71	ND	455.83 ^c ± 18.67	ND	110.10 ^f ± 4.49	ND	ND	218.46 ^d ± 8.97	243.47 ^e ± 9.96
Meat pie	542.40 ^b ± 15.16	2435.87 ^c ± 68.14	ND	ND	ND	399.30 ^a ± 11.17	1260.06 ^c ± 35.22	ND	639.53 ^b ± 17.87	244.53 ^c ± 6.87	ND

abcdefg: Means along the serial column with different superscripts have significant difference (p<0.05)
The value represents the means ± S.D of 3 independent experiments.ND: Not Detected

Omega-3 (n-3) fatty acids are important for normal metabolism (USNIH, 2005); as a little as 1% of total calories of n-3 in the diet enable normal growth, and increasing the amount has little additional significance on growth (Lands, 1992).Cholesterol was highest in scotched egg and lowest in doughnut01; 7.25 and 0.43g/100g respectively. High consumption of cholesterol in diet has been associated with increased serum cholesterol which is a risk factor of coronary heart disease and other chronic degenerative diseases (NAS, 1992).

Highest value of trans fatty acids was observed in Sausage rolls and lowest in popcornwith 11.78 g and 0.29 g/100g respectively. Trans fatty acids was highest in a meat based snack in this study which is supported by past research which confirms that milk and meat from cows and other ruminants contain naturally occurring trans fats in small quantities, a type of trans fat that occurs naturally in the milk and body fat of ruminants (such as cattle and sheep) at a level of 2–5% of total fat (TFTF, 2006) coupled with the form of fats (either margarine or butter) used in the crust/dough during preparation. Bassett et al., 2010; RedOrbit, 2011 have shown that natural trans-fat trans vaccenic acid (t 18:1n-7), found in beef and dairy products, could actually be beneficial compared to hydrogenated vegetable shortening, or a mixture of pork lard and soy fat (Bassett et al., 2010), by lowering Total cholesterol and LDL and triglyceride levels (Wang and Proctor, 2008; Basset et al., 2010; Wang et al., 2010). “The predominant trans fatty acid present in all the food items in a study assessing trans fatty acid content in widely consumed snacks in developing countries was elaidic acid (18:1 η 9) acid” (Karn et al., 2013), which is also present in all non-meat-based snacks in this study. The major contributors to TFA in the diets of people in 14 countries were edible fats and ruminant fat with

bakery products and French fries being additional contributing foods in some countries (FSAI, 2009).

Omega 6 unsaturated fatty acid was not detected in most meat-based snacks but highest value was observed in beef roll [a meat-based snack]and lowest in doughnut01; 2.03 and 0.55 g/100g respectively. Lack of dietary n-6 or n-3 polyunsaturated fatty acids in diet can result in poor skin health and growth (O'Neill et al., 1977; Goodgame et al., 1978; Holman et al., 1982; Mascioli et al., 1996; Jeppersen et al., 2000). These fatty acids [n-3 and n-6 PUFA] are essential in diet and regular intake may reduce the risk of secondary and primary heart attack (Bucher et al., 2002). Though, some older clinical studies (Lands, 1992; Okuyama, 2001) indicate that the ingested ratio of n-6 to n-3 (especially linoleic/alpha-linolenic) fatty acids is important in maintaining cardiovascular health. However, some studies found that omega-3 polyunsaturated fatty acids are important in diets to prevent both primary and secondary heart disease in humans without reference to the quantity consumed (Mozaffarian et al., 2005; Willett, 2007; Griffin, 2008). The absence of PUFA in some snacks in this study; may be as a consequence of source and types of fats sources used in the preparation of the snacks which varies from one fast food outlet to the other within the three states under study. Omega 9 unsaturated fatty acid was highest in sausage roll and lowest in beef roll;6.59 and 0.21 g/100g respectively. “Omega-9 fatty acids offer many health benefits. They are important for [heart health](#) and [blood sugar control](#) and can be obtained in the [diet through foods](#) such as canola oil, nuts and avocados and foods manufactured with this type of oil” (Wikipedia, 2014). A study indicates that omega-9 fatty acids may play a role in increasing metabolism and improving mood (Kien et al., 2013). Omega 9 is mainly used when the absence of either n-3, n-6 or both. When the body does not have

enough n-3 or n-6, it tries to compensate by producing n-9 fatty acids to take their place (Kien et al., 2013).

Some meat-based snacks in this study were presented with an imbalanced ratio of omega 3 and omega 6. The healthy ratio of n-3 to n-6 is from 1:4 - 1:1 to (Lands, 2005) and high proportion of n-6 to n-3 fat in the diet may shift the physiological state in the tissues toward the pathogenesis of many diseases (Simopoulos, 2003) where value of total cholesterol and LDL-C are risk factors. High intakes of n-6 polyunsaturated fats have been associated with blood lipid profiles, associated with a lower risk of coronary heart disease, decreased total cholesterol and LDL cholesterol, increased HDL cholesterol and reduced triacylglycerol (Becker et al., 1983; Arntzenius et al., 1985; Sonnenberg et al., 1996).

4. Conclusion

This study revealed that daily contribution of trans fats from these snacks in a 2000kcal diet range from 0.13 to 5.30% per serving of total energy intake and has been able to identify the different fatty acids present in franchised fast foods snacks eaten in southwestern Nigeria so as to assist consumers in proper selection by making informed choices and also assist franchised fast foods outlets managers in production of healthy and heart friendly snacks.

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