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ORIGINAL PAPER

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Contribution of bread and biscuits to vitamin A daily requirement of preschool children in Lagos State, Nigeria

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ABSTRACT

Introduction and aim. Vitamin-A-deficiency is a public health problem among preschool children of Nigeria. Study determined the contribution of bread and biscuits to vitamin A-daily-requirement of preschool children in Lagos-State, Nigeria.

Material and methods. A community-based-study using a cross-sectional-design with analytical component was carried out from 2013-2015. Multi-stage-sampling-technique was used to select mothers of preschool-children (n=1599) in 5 Local-Government-Areas of Lagos. Respondents' socio-demographic information and samples consumption-pattern were collected using validated, food-frequency-questionnaire/dietary recall. Retinyl palmitate content of randomly selected commonly-consumed brands of oven-fresh-bread stored for 5-days and biscuits (30- to 60-days) at prevailing outdoor-market-temperatures were analysed using High-Performance-Liquid-Chromatography. Contribution to preschool children's vitamin A-daily-requirements were determined. Data were analysed using Student's t-test and ANOVA at $p<0.05$.

Results. Mean age of preschool children was 31.44±5.28 months. Mean intakes of samples were bread (117.6 ±15.9 g/d) and biscuits (59.8±27.9 g/d). Range of contribution to vitamin-A-daily-requirement of preschool-children was 0-178.4 %. Samples contribution to vitamin A-daily-requirement of pre-school-children were oven-fresh bread (68.3 %); 5 days bread (20.7%); 30-days biscuits (25.0%) and 60-days biscuits (6.8%). Overall contribution to vitamin A-daily-requirement were bread (51.4%) and biscuits (22.4%). Statistically significant difference existed between samples contribution and vitamin-A-daily-requirement of preschool children.

Conclusion. Bread and biscuits samples contributed significantly to the vitamin-A-daily-requirement of preschool children.

Keywords. biscuits, bread, vitamin A daily requirement

Introduction

Vitamin A deficiency (VAD) is a global public health problem. The global prevalence of VAD is 29% and this is similar to that of Nigeria (29.5%).[1-3] In 2013, vitamin A deficiency affected approximately one third of preschool children (24 to 59 months), with the highest rate in Sub-Saharan African countries (48%) and South Asia (44%).[4] The main demographic groups most vulnerable to VAD are preschool children (0-59 months), pregnant and lactating mothers.

Consequences of VAD include preventable childhood night-blindness in children, increased risk of diseases (diarrhoea and measles), stunting, anaemia and premature death from severe infections.[1,4,5] A common cause of vitamin A deficiency might be a shift in the local diet to imported, processed and ready-to-eat foods. The high prevalence of VAD in Nigeria might be as a result of low dietary intake of vitamin A rich foods because Nigerian food staple is dominantly carbohydrate-rich foods which are very low sources of vitamin

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A except the biofortified crops which are rich in beta-carotene.[6] Nigeria is biofortifying cassava and sweet potatoes with beta-carotene (a pre-cursor of vitamin A) but the availability and accessibility of these biofortified crops to consumers in the local markets is limited.

Food fortification is recognised as a long-term strategy, most reliable, safe, and cost-effective means of eradicating and controlling micronutrient deficiencies and delivering nutrients to the population at large.[7,8] While vitamin A supplementation reduces child mortality by 23-35%, vitamin A fortification of commonly consumed processed foods reduces deaths among infants and preschool children by 11-45%.[9] However, an Indonesian study reported that some fortified products do not contribute substantially to the total vitamin A intake of the poorest segments of the society.[10] To make good judgments on the benefits of current fortification practices and the opportunities for fortification in the future, it is important to assess how fortified foods contribute to nutrient intakes across the population.[11] Fortified foods are foods to which important nutrients that are not naturally contained in them are added in order to prevent or eradicate some demonstrated deficiencies of those nutrients in the at-risk groups. These fortified foods thereby serve as food vehicles for delivering the nutrients to the vulnerable groups. Example is vitamin A. Wheat flour has been fortified with vitamin A in Nigeria since 2004 at 30,000IU/Kg as a long-term strategy to eradicate vitamin A deficiency in the country and it is a major raw material for the production of bread and biscuits. This fortification level has been recently reviewed.[12] Low vitamin A stability has been reported in vitamin A fortified wheat flour, bread and biscuits in Nigeria.[13-16]

In Ghana, the average consumption weight of flour products was 56 g/day.[17] Lagos State has the highest consumption of flour products (8.89%) and household expenditure pattern in the consumption of baked/processed products (5.1%) in Nigeria (share in food expenditure).[18,19] However, the contribution of these vitamin A fortified wheat flour products to the daily nutrient requirement of preschool children has not been determined. The vitamin A Recommended Daily Allowance (RDA) for preschool children (1-6 years) has been given as 400 µg retinol/day (1,333 IU/day).[20] Generally, provision of 15-50% of the RDA can meet both nutritional and safety goals of vitamin A.[21-22] Vitamin levels used in food fortification are normally within the safe range of 15-25% of the RDA per serving or at least one-third (10-15%) of the children's vitamin A RDA.[23] Some countries have assessed the RDA contribution of their vitamin A fortified foods in their preschool children and reported thus: 50% South Africa; 35-55% from Chapattis in rural Bangladesh; 15-30% in Brazil and Vietnam and 33% in baked *Pandesal* in Philippines.[9,22-27] Fortified foods contributed one-half of recommendation in vitamin A intake in poor urban Guatemalan Toddlers. [28]

Vitamin A contents and stability in flour, bread and biscuits and their compliance level have been studied in Nigeria.[13-16,29] But the contribution of bread and biscuits to vitamin A daily requirement of preschool children in Nigeria has not been jointly determined. It cannot be assumed that just because bread and biscuits were made with 'vitamin A fortified wheat flour' that they will contribute adequately to the vitamin A daily requirement of preschool children given that low vitamin A stability has also been reported in these products.

Aim

The aim of this study was to determine the contribution of bread and biscuits to vitamin A daily requirement of preschool children in Lagos State, Nigeria.

Material and methods

Ethical considerations

The study was approved by the University of Ibadan/University College Hospital (UI/UCH) Health Research Ethics Committee, Institute of Advanced Medical Research and Training (IMRAT) (UI/IRC/07/0095). On-the-spot written voluntary informed consent was obtained from mothers willing to participate in the survey. All the bakers that agreed to participate supplied free bread samples.

Study design/Area

A cross-sectional design with analytical component was used to carry out a study in 5 out of 20 Local Government Areas (LGAs) in Lagos State namely: Agege, Mushin, Oshodi/Isolo, Lagos Island, and Ikorodu LGAs representing the poor-urban communities in the three senatorial districts in the State. The population of the LGAs were Oshodi-Isolo (602,159), Agege (459,939), Mushin (633,009), Lagos Island (317,720) and Ikorodu (535,619).[30]

Study population

The study population comprised of preschool children who were children from the ages of two to less than 6 years (24-59 months) and their mothers. These group of children are just beginning to go to school and those who were enrolled in school earlier than the enrollment age are in nursery and primary one classes. In Nigeria, parents enroll their children in schools earlier than the age of enrollment probably because some of them are working class mothers. These group of children are among the at-risk groups for VAD. The respondent was the mother since preschool children cannot remember their food intake.[31] Until children have reached the developmental stage when they are able to give account of

their food intake and can begin to conceptualize (approximately 7-8 years), the onus for dietary reporting is on the parents.[32] In a dietary recall studies, which compared the results of direct observation of children's food intake with 24-hour recalls by parents, the evidence suggests that parents can be reliable reporters of their children's food intake in the home setting.[32]

Study sample products

The study sample products were breads and biscuits baked with wheat flour fortified with vitamin A (30,000 IU/Kg). After the study population, it became necessary to sample biscuits and breads which were the food products under study from bakeries and shops.

Determination of sample size (n)

The sample size for the study was estimated based on the prevalence of household consumption of flour-based products (5.1%) considering 95% confidence interval, a relative precision of 5% and a design effect of 3.[19,33] This gave a total sample size (n) of 320 preschool children per LGA.

$$n = DEFF * Z^2pq / d^2$$

where:

n = Minimum sample size

DEFF = Design Effect = 3[33]

Z^2 = Standard score corresponding to a given confidence level. Example, at 95% confidence level or 5% level of significance (α=0.05), Z=1.96.

P = 5.1% = prevalence of household consumption of flour-based products (5.1%)[18]

q = (1 – p) or percentage of failure which is 100 – 5.1% = 94.9%

d = Precision limit or proportion of sampling error (standard error) was 5% confidence limit.

$$n = DEFF + Z^2P (1-p) / d^2$$

— $$n = 3 * \frac{(1.96)^2 \times 0.051 \times 0.949}{(0.05)^2} = 222$$

Adjustment of sample size for individual non-response: 10 % non-response (90 % response)

— n = 222/0.9 = 246

Adjustment of sample size for household non-response: 23 % non-response (77 % response)

— n = 246/0.77 = 319 .5 households

The number was rounded up to 320 households/LGA.

Total Sample size for the 5 LGAs = 320 households * 5 LGAs = 1600 households

Sample and sampling technique

Eligibility criteria

Inclusion criteria: Households were included in the study if the households/children (24-59 months) consume bread and biscuits.

Study location was selected based on the State that had the highest consumption of bread and biscuits. Lagos State was chosen for this study because it had the highest consumption of bread and similar foods (8.89 %) in Nigeria.[18]

Exclusion criteria: Households were excluded from the study if the households/children (24-59 months) does not consume bread and biscuits.

A three-stage stratified systematic random sampling technique was used to select LGAs, wards and households using probability proportionate to size technique. Lagos State is made up of 3 Senatorial Zones and 20 LGAs. The state was stratified into three senatorial zones namely Lagos Central, Lagos East and Lagos West Zones. Five (5) LGAs were selected out of the twenty (20 LGAs) as a representative sample. The number of LGAs that was randomly selected from each of the senatorial zones was proportionately calculated to get Lagos Central (1 LGA); Lagos East (1 LGA) and Lagos West (3 LGAs). Probability proportionate to size technique was also used to selected 22 wards out of 107 wards as follows: Oshodi/Isolo LGA (4 wards); Ikorodu LGA (7 wards); Mushin LGA (4 wards); Lagos Island (4 wards) and Agege LGA (3 wards). This technique was also used to select the number of children across the wards to make up the sample size per LGA. A pair of mother and child between 24 -59 months old was selected from the identified households to make up the 320 preschool children selected from each of the five LGAs. All eligible pairs in the selected households were included in the study.

Data collection

Data on socio-demographic information, food consumption pattern and repeated 24-hour dietary recall were collected using a pre-tested, structured and semi-quantitative interviewer-administered food frequency questionnaire (FFQ).[34,35] After the pre-test, leading, ambiguous, repetitive and irrelevant questions were eliminated and double barrel questions were rewritten as separate questions based on literature and expert advice. The FFQ were administered to mothers with the help of 15 trained research assistants. In the 3-days dietary recall including one weekend day 24-hour dietary recall, respondents were asked 'Since this time yesterday, has the child eaten bread/biscuits? If the answer was yes, they were probed more for brand names and quantities in packets, prices (N) and slices within the three days similar to the study done by Brand.[36] Names and quantities in packets, prices and slices enabled the researchers to source and calculate the actual grammes of samples consumed by the preschool children for the estimation of the contribution (vitamin A intake IU/g) of the samples to the daily nutrient requirement of the children. Sample conversion from price to

grammes weight, slice to grammes weight and packet to grammes weight were determined afterwards to get gramme consumptions per child.[37] Children that consumed same grammes of bread/biscuits were grouped together for each LGA and mean number of children calculated. These portion sizes and number of children were then used to calculate the vitamin A (IU) content of samples per gramme, mean, total vitamin A in samples consumed and their contribution to the daily requirement of the children (% RDA). A 'narrow interval' was used for bread consumption (g)/child to enable the researchers to calculate the actual vitamin A intake per child. One 3-day including one weekend day 24-hour recall each was done during school and holiday periods to accommodate the effects of seasonal variation.

Samples for vitamin A analysis were sourced from retail outlets (biscuits) and bakeries (bread) rather than directly from factories and milling companies because the study was seen as an evaluation of the levels of vitamin A actually present in samples as finally consumed by the public rather than levels present at the point of manufacture as done by[38,] The most commonly consumed bread samples were collected by researcher from 15 bread hawkers and non-hawkers and 8 brands of biscuit samples were purchased in cartons from major markets in the study LGAs (Ejigbo, Mushin and Oshodi markets). Samples consumed by at least 5% of the total population per LGA were included and regarded as commonly consumed.[35]

Laboratory analysis of vitamin A contents of bread and biscuits

Data on pre-storage (at collection (day 1)) and post-storage (5-days storage (bread) and biscuits (30- and 60-days storage)) vitamin A (retinyl palmitate) contents of samples were obtained by direct laboratory analysis using HPLC as cited in sources.[14,15,16]

Calculation of contribution of samples to the vitamin A daily requirement of U-5

The contribution of bread and biscuits to vitamin A daily nutrient requirement of pre-school children was esti-

Table 1. Socio-demographic characteristics of children and their mothers (N=1599)

	Local Government Areas				
Variables	**Agege**	**Ikorodu**	**Lagos Island**	**Mushin**	**Oshodi/Isolo**
Gender of children					
Male, n (%)	141 (44.1)	146 (45.6)	177 (55.5)	183 (57.2	159 (49.7)
Female, n (%)	179 (55.9)	174 (54.4)	142 (44.5)	137 (42.8)	161 (50.3)
Age of children (months)					
23-35, n (%)	196 (61.3)	160 (50)	274 (85.9)	138 (43.1)	102 (31.9)
35-47, n (%)	74 (23.1)	100 (31.2)	29 (9.1)	81 (25.3)	127 (39.7)
47-59, n (%)	50 (15.6)	60 (18.8)	16 (5)	101 (31.6)	91 (28.4)
Mean age (months)	**31.44±5.28**				
Child's education					
None, n (%)	74 (23.1)	134 (41.9)	39 (12.2)	50 (15.6)	60 (18.8)
Nursery, n (%)	230 (71.9)	150 (46.9)	241 (75.6)	170 (53.1)	246 (76.8)
Primary 1, n (%)	16 (5)	36 (11.2)	39 (12.2)	100 (31.3)	14 (4.4)
Age of mothers (Years)					
18-29, n (%)	62 (19.4)	134 (41.9)	153 (48)	16 (5)	205 (64.1)
30-39, n (%)	206 (64.3)	150 (46.9)	135 (42.3)	228 (71.3)	115 (35.9)
40+, n (%)	52 (16.3)	36 (11.2)	31 (9.7)	76 (23.7)	0 (0)
Mean age (years)	**36.11±4.22**				
Maternal education					
No formal education, n (%)	2 (0.6)	10 (3.1)	21 (6.6)	39 (12.2)	16 (5)
Primary School, n (%)	34 (10.6)	48 (15)	18 (5.6)	34 (10.6)	68 (21.3)
Secondary School, n (%)	121 (37.8)	136 (42.5)	154 (48.3)	58 (18.1)	134 (41.8)
Tertiary Institution, n (%)	142 (44.4)	110 (34.4)	91 (28.5)	189 (59.1)	102 (31.9)
Dropped out, n (%)	21 (6.6)	16 (5)	35 (11)	0 (0)	0 (0)
Maternal occupation					
Full house wife, n (%)	57 (17.8)	50 (15.6)	31 (9.7)	48 (15)	66 (20.6)
Artisan, n (%)	46 (14.4)	40 (12.5)	15 (4.7)	42 (13.1)	57 (17.8)
Skilled worker, n (%)	122 (38.1)	110 (34.4)	73 (22.9)	157 (49.1)	66 (20.6)
Trading, n (%)	95 (29.7)	120 (37.5)	159 (49.8)	73 (22.8)	115 (36)
Unemployed, n (%)	0 (0)	0 (0)	41 (12.9)	0 (0)	16 (5)

mated as a proportion of vitamin A contents of samples and mean consumption grammes of commonly consumed samples per child per sample to the recommended dietary allowance (RDA) using data from the 3-days 24-hour dietary recall. This estimation was based on the vitamin A RDA (400 µg retinol/day (1,333 IU/day)) for pre-school children.[20] Calculation was done based on grammes weight and number of packets eaten by specific number of children. Percentage DNR was calculated for day 1, day 2, one weekend day, and the mean value taken. Samples that had zero vitamin A values in the 2 storage periods were excluded from the study during data calculation and analysis. The percentage contribution of each sample to vitamin A DNR was calculated using the following formulae:

$$\text{Mean vitamin A intake per child per sample} = \frac{\text{Total vitamin A intake per sample (IU)}}{\text{Total number of children}}$$

$$\%\ \text{vitamin A daily requirement/child} = \frac{\text{Sample mean vitamin A intake/child (IU)}}{\text{RDA of age group (1,333 IU/day)}} \times 100$$

Statistical analysis

Data were entered into Excel sheet, cleaned and presented in tables, mean and percentages. Student's t-test and ANOVA were used to analyse the statistically significant differences between samples using the Statistical Package for the Social Sciences (SPSS) 15.0 version 15 at $p<0.05$. Out of the 1,600 questionnaires collected, one was disqualified during data entry because consumption of bread and biscuits by the child were not reported thus bringing the total questionnaires used to n = 1,599. Response rate was 99.94 %.

Results

Table 1 shows the socio-demographic characteristics of the children and their mothers who were the respondents for the study (N=1599). The mean age of children across the LGAs was 31.44±5.28 months.

Table 2 shows that the bread brands most commonly consumed by pre-school children across LGAs were *Agege* bread (70.6 %), Premium HarvestPlus sliced bread (8.9 %) and Queensmeal sliced bread (6.9 %). The unbranded *Agege* bread was the most frequently consumed white bread across the LGAs 1130 (70.6 %).

Table 3 shows the eight (8) commonly consumed biscuit brands: wafers (6.9%), coaster (16.87%), crackers (12.73%), butter bread (15.2%), spicy fish (6.3%), digestive (8.9%), richtea (10.5%) and noreos (15.8%). These were the brands of biscuits normally consumed by the preschool children.

Tables 4 shows that a statistically significant difference existed between commonly consumed brands of bread assessed for vitamin A content and other brands of bread

Table 2. Brands of bread consumed by pre-school children across the LGAs

	Local Government Areas					
	Oshodi/Isolo	**Agege**	**Mushin**	**Lagos Island**	**Ikorodu**	**Total**
Bread Brand	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
None	19 (5.9)	16 (5)	16 (5)	15 (4.7)	10 (3.1)	76 (4.8)
Agege	210 (65.7)	250 (78.1)	236 (73.8)	180 (65.8)	254 (79.4)	1130 (70.6)
HarvestPlus	32 (10)	10 (3.1)	58 (18.1)	11 (3.5)	12 (3.8)	123 (7.7)
Queens meal	27 (8.4)	13 (4.1)	0 (0)	60 (18.8)	10 (3.1)	10 (6.9)
Fresh bake	11 (3.4)	7 (2.2)	0 (0)	0 (0)	10 (3.1)	28 (1.8)
Family bake	5 (1.6)	10 (3.1)	0 (0)	15 (4.7)	4 (3.1)	34 (2.1)
Today's bread	0 (0)	0 (0)	0 (0)	14 (4.4)	7 (2.2)	21 (1.3)
UTC	6 (1.9)	4 (1.3)	0 (0)	5 (1.6)	0 (0)	15 (0.9)
Val-U	5 (1.6)	0 (0)	0 (0)	9 (2.8)	8 (2.5)	22 (1.4)
Ok Special	-	-	2 (0.6)	-	2 (0.6)	4 (0.3)
Butter Field	-	1 (0.3)	-	2 (0.6)	1 (0.3)	4 (0.3)
Tea Mate	-	1 (0.3)	2 (0.6)	1 (0.3)	-	4 (0.3)
Quin Tea	1 (0.3)	-	1 (0.3)	-	-	2 (0.1)
DonitPremium	-	1 (0.3)	-	1 (0.3)		2 (0.1)
Good Luck	-	1 (0.3)	-	1 (0.3)	2 (0.6)	4 (0.3)
Flourish	-	-	1 (0.3)	-	-	1 (0.3)
Premier Special	-	3 (0.9)	-	2 (0.6)	-	5 (0.3)
Malta Chocolate	-	2 (0.6)	-	1 (0.3)	-	3 (0.2)
Nouvelle	-	-	2 (0.6)	1 (0.3)	-	3 (0.2)
Ifelodun	4 (1.3)	1 (0.3)	2(0.6)	1 (0.3)	-	8 (0.5)
Total	**320**	**320**	**320**	**319**	**320**	**1599**

consumed by preschool children (F =107.163, p=<.001). The Post hoc test conducted also shows that the consumption of *Agege* bread brand was significantly higher than the consumption of other bread samples (p<0.05).

Table 5 also shows that there was a statistically significant difference between commonly consumed brands of biscuits used for vitamin A content analysis and other brands of biscuits consumed by preschool children (F=3.605, p<.001).

Table 6 shows the vitamin A contents of bread and biscuit samples according to their storage periods. Mean vitamin A content of oven-fresh bread was 7,571.6 IU/Kg and at the 5th day (1,460.6 IU/Kg). Mean vitamin A content of 1- and 2-months stored biscuits were 5,164.7±4,851.7 IU/Kg and 739.9 ±1361.5 IU/Kg respectively. Mean calculation excluded samples that had zero vitamin A values in the 2 storage periods in order to get the actual vitamin A value in the samples that retained vitamin A to avoid 'watering down effect'. For those samples that had zero vitamin A, it could be that there was zero vitamin A fortification compliance or very poor premix was used in the fortification of their wheat flour

Table 7 presents the mean quantity of bread consumed by the children in the repeated 3-days 24- hour recall including one weekend day 24-hour dietary recall across LGAs. The highest weight (in gramme) of bread and the children (in %) that consumed the biscuits across the LGAs were Oshodi/Isolo LGA 88.3 g (12.6 %), Agege LGA 120.2 g (15.9 %), Mushin LGA 87.7 g (2.8 %), Lagos Island LGA 76.8 g (6.6 %), and Ikorodu LGA 113.9 g (12 %). Mean consumption of bread was 117.6±15.9 gramme per day per child.

Table 8 shows the quantities of biscuits (packets) and number of preschool children that actually con-

Table 3. Brands of biscuits normally consumed by Preschool children in LGAs

	Local Government Areas					
	Oshodi/Isolo	**Agege**	**Mushin**	**Lagos Island**	**Ikorodu**	**Total**
Biscuit Brand	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
None	62 (19.4)	171 (53.4)	205 (64)	167 (52)	170 (53.1)	775 (48.5)
Wafers	22 (6.9)	9 (2.8)	25 (7.8)	16 (5)	10 (3.1)	82 (5.1)
Coaster	43 (13.5)	43 (13.5)	10 (3.1)	65 (20.3)	10 (3.1)	171 (10.7)
Crackers	38 (11.9)	41 (12.9)	10 (3.1)	37 (11.6)	12 (3.8)	138 (8.6)
Butter bread	46 (14.4)	3 (0.9)	4 (1.3)	1 (0.3)	9 (2.8)	63 (3.9)
Spicy fish	19 (5.9)	2 (0.6)	15 (4.7)	4 (1.3)	12 (3.7)	52 (3.3)
Mini cookies	7 (2.2)	3 (0.9)	10 (3.1)	3 (0.9)	6 (1.9)	29 (1.8)
Digestive	27 (8.5)	4 (1.3)	5 (1.6)	2 (0.6)	8 (2.5)	46 (2.9)
Richtea	32 (10)	3 (0.9)	4 (1.3)	1 (0.3)	5 (1.6)	45 (2.8)
Parle-G Glucose	7 (2.2)	1 (0.3)	2 (0.6)	4 (1.3)	10 (3.1)	24 (1.5)
Pepper Snacks	1 (0.3)	2 (0.6)	0 (0)	0 (0)	0 (0)	3 (0.2)
Pearl	1 (0.3)	2 (0.6)	2 (0.6)	2 (0.6)	0 (0)	7 (0.4)
Cabin	2 (0.6)	11 (3.4)	0 (0)	8 (2.5)	0 (0)	21 (1.3)
Football	2 (0.6)	2 (0.6)	14 (4.4)	1 (0.3)	8 (2.5)	27 (1.7)
Twist	2 (0.6)	1 (0.3)	5 (1.6)	2 (0.6)	0 (0)	10 (0.6)
Beloxxi	2 (0.6)	3 (0.9)	1 (0.3)	3 (0.9)	7 (2.2)	16 (1)
Chic-choc	1 (0.3)	7 (2.3)	6 (1.9)	1 (0.3)	5 (1.6)	20 (1.4)
Noreos	3 (0.9)	8 (2.5)	2 (0.6)	2 (0.6)	48 (15)	63 (3.9)
Short cake	3 (0.9)	4 (1.3)	0 (0)	0 (0)	0 (0)	7 (0.4)
Total	**320 (100)**	**320 (100)**	**320 (100)**	**319 (100)**	**320 (100)**	**1599 (100)**

*Numbers in brackets are in percentages; Total of children who did not consume biscuit 775 (48.5%).

Table 4. ANOVA table showing differences in consumption of commonly consumed brands of bread in Lagos State

Brands of bread	**Mean***	**Standard Deviation**	**F-ratio**	**p-value**
Agege	226.0[a]	30.9	107.163	<0.001
HarvestPlus	28.6b	23.6		
Sliced bread A	22.0b	23.3		
Fresh bake	8.6d	5.6		
Family bake	8.8d	5.4		
Today's bread	4.2c	6.2		
UTC	2.0c	2.8		
Val-U	4.4c	4.3		

*Means with the same letters along the same column are not significantly different

sumed biscuits in the repeated 24-hour recall across the LGAs. Most of the children consumed 1 packet of biscuit per day. Mean gramme consumption of biscuits was 59.8±27.9 gramme per day. It was observed that in the 2h-hr dietary recall, the number of children that actually consumed biscuits were lower than that reported by their mothers in Table 3. This might be expected because biscuits were eaten as snacks and the preschool children use them to go to school. So their consumption in the dietary recall might have been affected by family meals and weekend days when mothers were at home to prepare meals for their children who are also at home.

Table 9 shows the mean biscuit consumption by children across the LGAs in the repeated 3-day including one weekend day 24-hr dietary recall. Approximately 59.8 % of the children did not consume biscuits and

Table 5. ANOVA table showing differences in consumption of commonly consumed biscuit brands*

	Mean*	Std. Deviation	F-value	p-value
Wafers	16.4000[a]	7.09225	3.605	<0.001
Coaster	34.2000[b]	23.84743		
Crackers	27.6000[b]	15.24139		
Butter bread	12.6000[c]	18.90238		
Spicy fish	10.4000[c]	7.23187		
Mini cookies	5.8000[d]	2.94958		
Digestive	9.2000[d]	10.18332		
Richtea	9.0000[d]	12.94218		
Parle G	4.8000[e]	3.70135		
Pepper Snacks	1.4000[f]	0.89443		
Pearl	5.4000[d]	5.54977		
Cabin	2.0000[f]	1.87083		
Football	3.2000[f]	2.28035		
Twist	4.0000[d]	2.82843		
Beloxxi	12.6000[c]	19.94492		
Chic-choc	1.4000[f]	1.94936		
Noreos	3.8000[f]	3.03315		
Short cake	3.8000[f]	3.63318		

*Means with the same letters along the same column are not significantly different

Table 6. Vitamin A contents of bread and biscuit samples according to their storage periods

	Bread samplesb	Vitamin A content (IU/Kg)			Vitamin A content (IU/kg)	
S/N[a]	LGAs	Oven-fresh	5 (days)	Biscuit brands	1 month	2 months
	***Agege* bread (A)**					
1	*Agege*	3,434	0	Spicy fish	0	0
2	*Agege*	12,597	0	Coaster	1,847.7	0
3	*Agege*	0	0	Digestive	6,797.6	0
4	*Agege*	18,239	6,344	Richtea	12,873	3,136
5	*Agege*	0	0	Wafers	0	0
6	*Agege*	17,472	0	Cream Cracker	0	0
7	*Agege*	5,615	0	Butter bread	3,361.5	0
8	*Agege*	998.7	678.8	Noreos	943.8	563.6
9	*Agege*	3,438.1	2,221.8	[a]**Mean**	**5,164.7**	**739.9**
10	*Agege*	4,826.8	3,031.2		**±4,851.**7	**±1361.**5
11	Sliced bread B	0	0			
12	Sliced bread B	0	0			
13	Sliced bread C	0	0			
14	Sliced bread C	0	0			
15	Sliced bread C (Mixed flour)	1,524	869.7			
	cMean	**7,571.6**	**1,460.6**			
		±6,730.6	**±2,132.7**			

[a]1-2=Agege LGA; 3-4, 13-15=Mushin; 5-6=Lagos Island, 7-8=Oshodi/Isolo LGA; 9-10= Ikorodu LGA; 11-12 Ojo LGA; bBread samples; cExcluding samples that had zero vitamin A values in the 2 storage periods.

Table 7. Mean bread consumption quantities by preschool children in repeated 24-hour recall across the LGAs

	Local Government Areas (LGAs)				
Bread consumption (g)/child	**Oshodi/Isolo (%)**	**Agege (%)**	**Mushin (%)**	**Lagos Island (%)**	**Ikorodu (%)**
0	213.5±13.4 (65.0)	214±14.1 (66.9)	286±2.8 (89.4)	251.5±6.4 (78.8)	246.5±0.7 (77)
38.4	3.5±2.1 (1.3)	-	-	9±1.4 (2.8)	-
65.1	-	-	-	21±1.4 (6.6)	12.5±3.5 (3.9)
76.8	2 (0.7)	4.5±3.5 (1.4)	4.0±1.4 (1.3)	4.5±3.5 (1.4)	-
80.1	-	16±8.5 (5.0)	8±1.4 (2.5)	1±1.4 (0.3)	-
87.7	-	1±1.4 (0.3)	9±1.4 (2.8)	14±1.4 (4.4)	-
88.3	38.5±4.9 (12.6)	3±1.4 (0.9)	-	-	-
97.7	-	-	-	-	18.5±5.0 (5.8)
113.9	-	-	-	-	38.5±2.1 (12)
115.3	7.0± 0.0 (2.3)	51.0±12.7 (15.9)	3.0±1.4 (0.9)	3.5±4.9 (1.1)	-
120.2	-	0±1.4 (0.9)	6.5±2.1 (2.0)	2. (0.6)	-
130.2	-	-	-	-	4.0±5.7 (1.3)
132.4	28.5±2.1 (9.2)	-	-	-	-
147.8	-	1±1.4 (0.3)	1±1.4 (0.3)	4±1.4 (1.4)	-
153.7	0.5± 0.7 (0.3)	17.5±12 (5.5)	1.0±1.4 (0.3)	4.0±2.8 (1.4)	-
160.2	-	7±4.2 (2.2)	1.5±0.7 (0.5)	3±1.4 (0.9)	-
176.5	26.5±7.8 (8.6)	-	-	-	-
240.3	-	2 (0.6)	-	1±2.1 (0.3)	-
Total	**320(100)**	**320(100)**	**320.0 (100)**	**319.0(100)**	**320(100)**

[a]Figures in parenthesis are in percentages; Mean total zero (0.0) consumption was 1211.5 (75.76 %)

Table 8. Mean number of children and quantity of biscuit brands commonly consumed in packets in 24-hr dietary recall

	Number of biscuit packets per child/LGA																			
Biscuit brands	**Oshodi/Isolo LGA**				**Agege LGA**				**Lagos Island LGA**				**Mushin LGA**				**Ikorodu LGA**			
	1 pkt	**2 pkts**	**3 pkts**	**4 pkts**	**1 pkt**	**2 pkts**	**3 pkts**	**4 pkts**	**1 pkt**	**2 pkts**	**3 pkts**	**4 pkts**	**1 pkt**	**2 pkts**	**3 pkts**	**4 pkts**	**1 pkt**	**2 pkts**	**3 pkts**	**4 pkts**
Wafers	10	14	7	7	5	4	0	0	3	0	0	0	8	2	0	0	7	3	0	0
Coaster	19	13	10	1	24	16	2	1	47	20	1	0	20	5	0	0	8	2	0	0
Crackers	16	14	8	0	22	18	1	0	17	13	7	0	10	0	0	0	10	2	0	0
Butter bread	25	14	11	2	2	1	0	0	0	0	0	0	4	0	0	0	8	1	0	0
Spicy fish	8	7	3	1	0	0	0	0	0	0	0	0	13	2	0	0	12	0	0	0
Digestive	12	10	4	1	0	0	0	0	2	0	0	0	5	0	0	0	5	0	0	0
Richtea	17	10	2	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Neroes	0	0	0	0	8	0	0	0	2	0	0	0	2	0	0	0	40	6	0	0
Total	**107**	**82**	**45**	**13**	**61**	**39**	**3**	**1**	**71**	**33**	**8**	**0**	**62**	**9**	**0**	**0**	**95**	**14**	**0**	**0**

Pkts = packets

Table 9. Mean biscuit consumption in 3-days including one weekend day 24-hr dietary recall by children across the LGAs

Biscuit consumption (Packets)	Oshodi/Isolo	Agege	Lagos Island	Mushin	Ikorodu	Mean Total
0	73 (22.8)	216 (67.5)	207 (64.9)	249 (77.8)	211 (65.9)	956 (59.7)
1	107 (33.4)	61 (19.1)	71 (22.3)	62 (19.4)	95 (29.7)	396 (24.8)
2	82 (25.6)	39 (12.2)	33 (10.3)	9 (2.8)	14 (4.4)	177 (11.1)
3	45 (14.1)	3 (0.9)	8 (2.5)	0 (0)	0 (0)	56 (3.5)
4	13 (14.1)	1 (0.3)	0 (0)	0 (0)	0 (0)	14 (0.9)
Total	**320 (100)**	**320 (100)**	**319 (100)**	**320 (100)**	**320 (100)**	**1599 (100)**

Table 10. Contribution of bread to vitamin A daily requirement of preschool children

Bread Sample[a]	Vitamin A content IU/g (µgRE/g)	Portion size (g)	Total vitamin A IU (µgRE) /day	% Contribution to RDAb
1 *Agege bread*		128.2±11.5		
Oven-fresh	3.4 (1.0)		447.5±44.5 (134.4±13.4)	33.6±3.3
2 *Agege bread*		128.2±11.5		
Oven-fresh	12.6 (3.8)		1614.7±145.2 (484.9±43.6)	121.1±10.89
3 *Agege bread*		100.0±0.3		
Oven-fresh	18.2 (5.5)		1821.4±2.4 (547±0.7)	136.6±0.2
5 days	6.3 (1.9)		635.0±1.2 (190.7±0.4)	47.6±0.1
4 *Agege bread*		131.7±27.9		
Oven-fresh	17.5 (5.3)		2377.6±377.6 (714±113.4)	178.4±28.4
5 *Agege bread*		131.7±27.9		
Oven-fresh	5.6 (1.7)		764.08±121.37 (229.45±36.45)	57.3±9.1
6 *Agege bread*		126.5±2.3		
Oven-fresh	1.0 (0.3)		126.4±2.3 (38±0.7)	9.5±0.1
5 days	0.7 (0.2)		85.9±1.6 (25.8±0.5)	6.45±0.1
7 *Agege bread*		126.5±2.3		
Oven-fresh	3.4 (1.0)		435.7 ±7.8 (130.8±2.3)	32.7±.6
5 days	2.2 (0.7)		281.2±5.0 (84.4±1.5)	21.1±.4
8 *Agege bread*		102.4±4.6		
Oven-fresh	4.8		494.7±22.2 (148.4±6.7)	37.1±1.7
5 days	3.0		296.8±5.2 (89.1±26.7)	22.3±0.4
9 Sliced bread (C)		93.9±1.4		
Oven-fresh	1.5 (0.5)		138.8±18.3 (41.68±5.5)	10.5±1.3
5 days	0.9 (0.3)		79.2±10.4 (23.78±3.1)	6.0±0.8
Total	**5.8±6.0**	**117.6±15.9**	**685.5±725.1 (205.7)**	**51.4±54.4**

RDA= Recommended Dietary Allowance; [a] Samples with zero vitamin A contents were excluded; bRDA = 1333 IU/ 400 µgRE/ day for 24-59 months old children[19]; 1 RE = 3.33 IU for fortified foods or vitamin A activity from retinol; 1 I.U = 0.3 µgRE

this was considered high even though not unexpected since biscuits are snacks and not the main meals eaten by the preschool children. The number of children that actually consumed biscuits were 643 (40.2 %). Approximately 25% consumed 1 packet of biscuit.

Table 10 shows the vitamin A contribution of oven-fresh and 5-days bread to vitamin A daily requirement of preschool children. Mean daily consumption of bread was 117.6±15.9 g. The contribution of bread to preschool children's vitamin A nutriture ranged from 6 to 178 % excluding six (6) samples that had zero vitamin A content. Mean vitamin A contribution was 51.4 %±54.4.

Table 11 presents mean contribution of commonly consumed biscuit brands to vitamin A daily requirement of preschool children. The mean grammes intake of biscuits per day was 59.8±27.9g while the mean total vitamin A intake of biscuits per day was 298.8±354.1 IU/day (98.3 µgRE/day) and this contributed 22.6±26.5 percent to vitamin A daily requirement of the children.

Figure 1 shows the vitamin A contents of bread and biscuits derived after vitamin A analysis at different storage periods. These values were used to estimate the contribution of the samples to the vitamin A daily requirement of the preschool children in IU per day and RDA percentages.

Table 11. Mean contribution of biscuits to vitamin A daily requirement of U-5 children

Biscuit	N	Vitamin A content	Portion size	Total vitamin A	% Contribution
		IU/g	(g)	IU/g	to RDA
Coaster					
Oshodi/Isolo	43	1.9	49.9	92.3	6.9
Agege	43		41.7	77.1	5.8
Lagos Island	68		36.0	66.5	5.0
Mushin	25		32.6	60.3	4.5
Mean	**45**		**40.1±7.6**	**74.0±14.0**	**5.6±1.1**
Digestive					
Oshodi/Isolo	32	6.8	142.0	965.5	72.4
Lagos Island	2		85.8	582.9	43.7
Mushin	4		85.8	582.9	43.8
Mean	**13**		**104.5±32.5**	**710.4±220.9**	**53.3±16.6**
Richtea					
1 (day)*	30	12.9	82.6	1063.1	79.8
30 (days)*	30	3.1	51.7	162.1	12.2
Mean			**67.1±21.9**	**612.6±637.1**	**46.0±47.8**
Butter bread					
Oshodi/Isolo	52	3.4	73.5	224.4	16.8
Agege	3	3.4	47.7	160.3	12.0
Mushin	4	3.4	35.8	120.2	9.0
Mean			**52.31±19.29**	**175.6±65**	**13.2±4.9**
Nereos					
Ikorodu					
1 (day)*	46	1.0	34.5	32.5	2.4
30 (days)*	46	0.6	35.3	19.4	1.5
Mean			**34.9±0.6**	**26.0±9.3**	**2.0±0.7**
Total	**31±21**	**4.0±3.3**	**59.8±27.9**	**300.7±352.7**	**22.6±26.5**

RE=Retinol equivalent; 1 µgRE = 3.33 IU for fortified foods or vitamin A activity from retinol; RDA, Recommended Daily Allowance; RDA = 1333 I.U or 400 µgRE/day[19]; 1 I.U = 0.3 µgRE; N = Number; *storage period

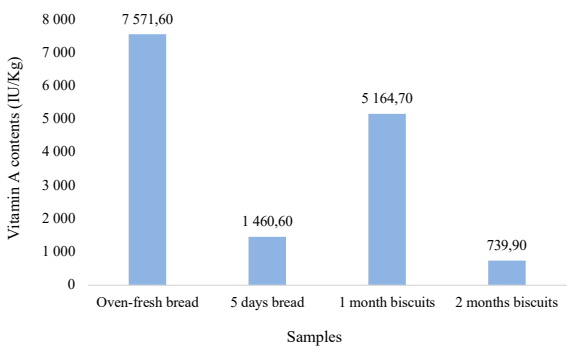

Fig. 1. Vitamin A contents of bread and biscuit samples at different storage periods

Figure 2 shows the mean contribution of bread and biscuits to the vitamin A daily requirement in International Units per day (IU/day) of preschool children across the 5 LGAs in Lagos State. The mean vitamin A intake (IU/day) for bread and biscuits were 685.5±725.1 IU/day and 300.7±352.7 IU/day respectively.

Figure 3 shows the mean percentage contribution of bread and biscuits to the vitamin A daily requirement of pre-school children across the 5 LGAs in Lagos State. The mean vitamin A contribution of bread was 51.4±54.4% per day while that of biscuits were 22.6±26.5% per day.

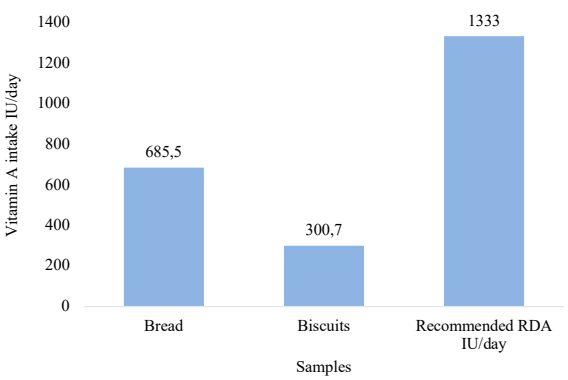

Fig. 2. Mean contributions of bread and biscuits to the vitamin A daily requirements of preschool children in International Units per day (IU/day).

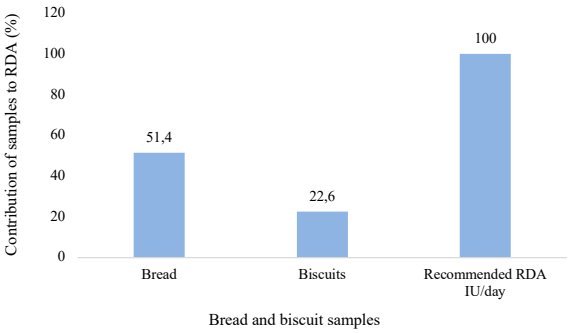

Fig. 3. Mean percentage contributions of bread and biscuits to the vitamin A daily requirement of preschool children

Discussion

The mean consumption gramme of bread by the preschool children was approximately 118 g per day while the mean total vitamin A intake was approximately 686 IU (206 µg RE). This vitamin A intake was more than half of the level recommended by the Indian Council of Medical Research (ICMR) (1333 IU/day) for preschool children.[20] Oven-fresh bread contributed significantly to the vitamin A daily requirement (68.3%) of preschool children than the five days bread (20.7%) ($p<.05$). This contribution of bread ranged from 0 -178 % inclusive of samples that had zero vitamin A contents. The mean total contribution of bread to vitamin A requirement of the children was 51%. Bread therefore contributed one-half of recommended vitamin A daily requirement in poor-urban Lagosian pre-school children. This result indicated that bread made from vitamin A fortified wheat flour can make an important contribution to the vitamin A daily requirement of preschool children if adequately fortified and consumed. This contradicts the concern that some fortified products do not contribute substantially to the total vitamin A intake of the poorest segments of the society.[10] The contribution of bread to vitamin A requirement of the children in this study was similar to and even higher than the values obtained in Bangladesh chapattis, 35-55% and Philippine pandesal, 33%.[21,24] Preschool children are one of the at-risk groups for VAD. The aim of vitamin A fortification of wheat flour is to use it as one of the long-term sustainable strategies to eradicate VAD among vulnerable groups.

Nevertheless, a closer look at those three bread samples that contributed above 100 % vitamin A to this study group might spark a little worry for consumers from affluent homes who have access to animal sources of vitamin A and also consume bread regularly. They might stand a risk of over-consumption of vitamin A. This is due to the unusually high level of vitamin A fortification of wheat flour in Nigeria. Nigeria started fortifying wheat flour with vitamin A with 30,000 IU/kg (9 mg/kg) in 2004. Even though, most of the bread samples did not have vitamin A content, some of those that had, had excess and contributed as high as 178%. A study suggested that there may be no risk of pre-disposition of consumers to hyper-vitaminosis as previously speculated.[28] But the result of this study has confirmed that the possibility of hyper-vitaminosis is a fact not speculation. This result helps to justify the revised Nigerian vitamin A fortification level which is now less than 30,000 IU/kg.[12] Fortification programs that add preformed vitamin A to foods should carefully adjust the fortification levels to benefit consumers whose diets are most deficient without exposing wealthier segments of society, whose diets might be richer in preformed vitamin A, from consuming excessive amounts. This is because vitamin A if consumed in excess, is hypertoxic. However, vitamin A zero bread samples contributed zero vitamin A to the dietary intake of children that consumed them. To ensure that all the groups of consumers benefit from vitamin A fortification, proper choice of vehicles should be made, use of good premix or vitamin A matrices, lower fortification levels and enforcement of compliance will bridge all these risks.

The average weight consumption of biscuits (59.8 g) was similar to that reported in Ghana (56 g/day of flour products).[17] Biscuits stored for one month contributed a higher vitamin A value (25%) than that stored for 2 months (6.8 %). Biscuits contributed one-fifth (22.4±26.6%) of the vitamin A daily requirement of the children. This result was within the range obtained in Phillipine for 4-6 years old children (10-46% for vitamin A); lower than that obtained in Vietnam (30%) and South Africa (50%).[9,23,25] Conclusively, the result obtained in this study is within the recommendation that wheat flour products fortified at 2.1 µgRAE/g or 7 IU/g at <75 g/day flour intake will contribute approximately 22% of RDA for preschool-aged children vitamin A daily requirement.[21] The Researchers recommend that Nigeria should fortify wheat flour at 7,000 IU/kg using a good vitamin A matrix for the premix. Consequently, Nigerian vitamin A fortification of wheat flour has been revised to 6,000 IU/kg.[12]

While fortified foods contribute one-half of recommendation in vitamin A intake in poor urban Guatemalan Toddlers, bread alone contributed the same amount (one-half) of vitamin A requirement of pre-school-aged children in Lagos state and biscuits contributed one-fifth of the DNR.[27] The classification of fortified foods is the responsibility of the authorities of each country.[26] Vitamin levels used in food fortification are normally within the safe range of 15-25% of the RDA per serving or at least one-third (10-15%) of the children's vitamin A RDA.[23] Nigerian bread and biscuits therefore qualify to be called fortified foods. The mean vitamin A contribution of bread and biscuit samples fell within this safe range 15-25%. According to Food and Drug

Administration (FDA), terms to define a serving of food that has 20% or more of the RDA include: "high", "rich in", or "excellent source of" vitamin A.[26] In Nigeria, a fortified product is declared an excellent source of vitamin A if it contributes at least 30% of Nutrient Reasonable Value (NRV) and a good source if it contributes at least 15% of NRV per 100g.[12] Using the FDA classification, fresh bread and biscuits are excellent sources of vitamin A in poor-urban preschool children in Lagos metropolis. Based on Nigerian standards, bread is an excellent source while biscuits are good sources of vitamin A in the daily nutrient requirements of preschool children in this study.

Conclusion

Fresh samples of bread and biscuits contributed adequately to the daily nutrient requirement of the children even though some of the samples had zero and over contribution. There is a need to encourage retention of vitamin A in flour-products and avoid overdose of the vitamin if the aim and objectives of vitamin A fortification of wheat flour in Nigeria will be met.

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Declarations

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Author contributions

Conceptualization, F.N. and O.O.; Methodology, F.N. and O.O..; Software, F.N..; Validation, F.N. and O.O..; Formal Analysis, F.N.; Investigation, F.N.; Resources, F.N.; Data Curation, F.N. and O.O.; Writing – Original Draft Preparation, F.N.; Writing – Review & Editing, F.N. and O.O..; Visualization, F.N..; Supervision, O.O.; Project Administration, F.N.; Funding Acquisition, F.N.

Conflicts of interest

The authors declare no conflict of interest.

Data availability

Data is available as presented.

Ethics approval

The study was approved by the University of Ibadan/ University College Hospital (UI/UCH) Health Research Ethics Committee, Institute of Advanced Medical Research and Training (IMRAT) (UI/IRC/07/0095). On-the-spot written voluntary informed consent was obtained from mothers willing to participate in the survey. All the bakers that agreed to participate supplied free bread samples.

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