

Reframing the Sweet Biscuit Profile in Nigeria: Nutritional Analysis, Dietary Exposure Modeling, and Regulatory Pathways for Front-of-Pack Labeling and Product Reformulation

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Research Article

Keywords: Nutrient Profile Model, Free Sugars, Sweet Biscuits, Product Reformulation, Front-of-Pack Labeling, Dietary Exposure, Nigeria

Posted Date: August 7th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10612186/v1>

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Additional Declarations: The authors declare no competing interests.

Abstract

Background

The escalating burden of diet-related non-communicable diseases (NCDs) in low- and middle-income countries (LMICs) calls for a critical assessment of hidden free sugars in processed foods. In Nigeria, changing dietary habits have turned sweet biscuits into affordable, everyday snacks, yet their cumulative contribution to population-level sugar consumption remains unquantified under current food policy frameworks.

Objective

This study evaluates the total sugar profile of commercially available sweet biscuits in Nigeria against the benchmark established by the World Health Organization (WHO) African Region Nutrient Profile Model (≤ 6.0 g of total sugar per 100 g for sweet biscuits). It additionally utilizes dietary and fiscal predictive modeling to demonstrate that current formulation levels are excessively high, establishing an objective basis for front-of-pack labeling (FOPL) and industry-wide reformulation.

Methodology:

A cross-sectional nutritional audit evaluated 76 major sweet biscuit products sampled randomly from prominent retail open markets and supermarkets across Nigeria. Total sugar densities (g/100 g) were extracted from on-pack nutrient declaration panels and compared directly against the WHO African Region threshold. A deterministic dietary model simulated the impact of a standard snack serving (50 g) on the WHO guideline for free sugar intake ($< 10\%$ of daily caloric intake based on an adult standard of 2,000 kcal baseline). An economic and structural substitution model simulated how a standardized FOPL framework and tiered sugar reductions affect daily per capita sugar exposure.

Results

The mean sugar concentration across the 76 audited brands was **29.68 g per 100 g** (± 8.4 g), ranging from 13.9 g to 46.09 g. **100% of the sampled sweet biscuits failed** to meet the WHO African Region threshold of ≤ 6.0 g/100 g for marketing restriction to children. The lowest sugar profile found was 13.9 g/100 g, which is still more than double the regional benchmark. Dietary modeling shows that a single 50 g serving introduces **14.84 g of free sugar**, instantly consuming **29.68% of an adult's total daily allowable sugar intake**.

Conclusion & Policy Recommendation:

The sugar content of sweet biscuits sold in Nigeria is notably high, highlighting a vital public health focus area. To advance the goals outlined in the National Policy on Food Safety and Quality 2023, relevant regulatory bodies may find value in transitioning toward a standardized Front-of-Pack Labeling (FOPL) framework. This strategy aligns national standards with regional guidelines and establishes a transparent foundation for incremental product reformulation.

Background

The rapid transformation of food environments in sub-Saharan Africa has triggered a double burden of malnutrition, where undernutrition coexists with a sharp rise in overnutrition and diet-related non-communicable diseases (NCDs) [1]. In Nigeria, urban migration, fast-paced lifestyles, and the widespread availability of low-cost, shelf-stable processed goods have structuralized the daily consumption of sweet biscuits and confectionery snacks across all socio-economic strata [2]. While these products are traditionally viewed as minor treats, their high intake—often paired with hot beverages or consumed as meal replacements—substantially increases the baseline consumption of free sugars.

Excessive consumption of free sugars is directly linked to weight gain, metabolic syndrome, type 2 diabetes, and dental caries [3]. Dental disease, in particular, remains a persistent public health problem in Nigeria, where recent systematic data shows a pooled dental caries prevalence of 23% among school-aged cohorts [4]. This creates a long-term economic drain on households due to out-of-pocket dental healthcare expenditures. To mitigate these risks, the WHO guideline on sugars intake strongly recommends that both adults and children restrict their free sugar intake to less than 10% of total daily energy intake, noting that a further reduction below 5% offers additional metabolic benefits [3]. For a standard reference adult requiring 2,000 kcal/day, the 10% ceiling allows for a maximum of 50 grams of free sugar per day.

Nutrient profiling serves as an objective tool for health authorities to identify products with high concentrations of critical nutrients like sodium, saturated fats, and free sugars [5]. The *WHO African Region Nutrient Profile Model* establishes clear limits tailored to the regional food supply [6]. Crucially, for the category of sweet biscuits, the model applies a strict threshold of **≤ 6.0 grams of total sugar per 100 g of product**.

While Nigeria's *National Policy on Food Safety and Quality and its Implementation Plan 2023* acknowledges the need for national guidelines to reduce sugar in packaged foods, the state has not yet defined clear food category thresholds or actionable structural timelines [7]. This study addresses that policy gap by analyzing the sugar metrics of the Nigerian sweet biscuit market, proving that current formulation levels are excessively high, and outlining how front-of-pack warning labels can drive product reformulation across the country.

Methods

Sample Procurement and Nutritional Mapping

A cross-sectional nutritional audit mapped seventy-six (76) distinct brands of sweet biscuits, cookies, cream sandwiches, and sweet wafers distributed across Nigeria. Samples were gathered using a stratified random collection method from major wholesale hubs (e.g., Balogun and Oke-Arin markets in Lagos) and nationwide supermarket chains to mirror real-world consumer access. Savory biscuits, plain crackers, and cheese-based matrices were excluded from the study. Total sugar counts per 100 g were transcribed directly from the manufacturer on-pack nutrient declaration panels as shown in Table 1.

Table 1
Total Sugars per 100 g Sweet Biscuits

S/N	Brand name	Total sugars (g) per 100 g
1.	Oreo chocolate sandwich cookies	43.00
2.	London triple cookies	38.00
3.	Spur choc chip cookies	36.00
4.	Noel super 2 lemon cookies	36.00
5.	Noel super 2 strawberry cookies	36.00
6.	Maryland cookies choc chip	34.40
7.	Maryland cookies double choc	34.20
8.	Fox's fabulous half-coated milk chocolate cookies	34.00
9.	Fox's fabulous white chocolate cookies	33.70
10.	Maryland cookies choc and hazelnut	33.50
11.	Keebler chips deluxe minis cookies	33.30
12.	Papel coconut chips cookies	33.00
13.	Famous amos chocolate chip cookies	32.10
14.	Noel super 2 vanilla cookies	32.00
15.	Noel super 2 chocolate cookies	32.00
16.	Fox's fabulous triple chocolate cookies	32.00
17.	Fox's fabulous milk chocolate cookies	31.00
18.	London classic milk chocolate chunk cookies	31.00
19.	Maryland cookies choc chip and coconut	30.70
20.	Spur cream cookies	30.00
21.	Eurocake butter cookies	26.50
22.	Britannia good day cashew cookies	23.50
23.	Huamel donut peanut flavor cookies	23.30
24.	Huamel donut cashew flavor cookies	23.30
25.	Parle hide&seek American style butter cookies	22.30
26.	Patanjali Jeera bakery cookies	21.35
27.	Parle hide&seek American cashew cookies	21.20

S/N	Brand name	Total sugars (g) per 100 g
1.	Oreo chocolate sandwich cookies	43.00
28.	Patanjali Nariyal bakery cookies	20.25
29.	Fastizers fun cookies	14.70
30.	Candycake bit bite chocolate coated wafers	46.09
31.	Shirin asa choco jido biscuit set in milk compound	43.80
32.	Oreo cocoa original biscuits with vanilla flavored filling	43.00
33.	Lotus biscoff vanilla biscuit	42.50
34.	Tiffany gotcha milk flavored sandwich biscuit	42.30
35.	Candycake waffle crunchy chocolate wafers	42.00
36.	Lorena biscuit	40.00
37.	Foseh creamzy mango flavored cream biscuit	39.20
38.	Foseh creamzy orange flavored cream biscuit	39.20
39.	Britannia treat kool vanilla biscuit	39.00
40.	Lotus biscoff biscuit	38.10
41.	Deemah dabre bars biscuit	38.00
42.	Mcvities hobnobs biscuits	37.90
43.	Mcvities Dark creams biscuit	37.80
44.	Tiffany delights ginger nut biscuit	37.00
45.	Britannia treat funty choco biscuit	35.00
46.	Toren carre milk waters	34.20
47.	Britannia treat buzzy strawberry biscuit	32.00
48.	Serena milk cream short cake biscuits	30.00
49.	Serena chocolate short cake biscuits	30.00
50.	Britannia nice time sugar-showered coconut biscuit	29.00
51.	Serena milk cream short cake biscuits	30.00
52.	Mcvities ginger nuts	28.90
53.	Tower gate milk chocolate digestive biscuits	28.40
54.	Haansbro noreds sandwich biscuits with vanilla flavored cream	28.40

S/N	Brand name	Total sugars (g) per 100 g
1.	Oreo chocolate sandwich cookies	43.00
55.	Hill vanilla flavor sandwich biscuit	28.00
56.	Mcvities digestives dark chocolate biscuit	26.60
57.	Mcvities digestives biscuit	26.20
58.	Roshen extra crunch cocoa sandwich wafers	25.00
59.	Binto biscuit	25.00
60.	Binto coated with chocolate flavored cream biscuits	25.00
61.	Hill fig rolls biscuits	24.20
62.	Mcvities chocolate shortbread	24.00
63.	Mcvities chocolate shortbread	24.00
64.	OGL coconut shortbread	21.90
65.	OGL butter shortbread	21.90
66.	Belmont biscuits crumby oaties	21.30
67.	OGL malted milk biscuit	21.20
68.	CBL munchee digestive whole grain biscuit	20.07
69.	Spar digestive biscuits	19.00
70.	Mcvities butter shortbread	18.80
71.	Mcvities rich tea	18.50
72.	Mcvities rich tea biscuit	18.50
73.	Walker's short bread	17.90
74.	Tower gate short cake biscuits	15.60
75.	Mcvities digestives the original biscuit	15.10
76.	Tiffany delights shortbreads	13.90

Regional Benchmark Comparison

The independent variable—total sugar concentration per 100 g—was evaluated against the revised statutory threshold of the *WHO African Region Nutrient Profile Model*. For sweet biscuits, the strict regional target is set at **6.0 g of total sugar per 100 g**. The degree of variation and market-wide failure rates were calculated using descriptive statistical distribution modeling.

Deterministic Dietary Exposure Framework

To quantify consumer sugar exposure from these products, a deterministic simulation model used the following parameters:

- **Standard Snack Unit Serving (SS):** Formulated at 50 grams, representing the typical single-use commercial pouch size in Nigeria.
- **Daily Reference Energy Baseline (E_{base}):** Fixed at 2,000 kcal/day for an average adult.
- **WHO Daily Free Sugar Upper Limit (S_{max}):** Computed as:

$$\text{Sugar Target (kcal)} = 2,000 \text{ kcal} \times 0.10 = 200 \text{ kcal}$$

$$S_{\text{max}} \text{ (grams)} = 200 \text{ kcal} \div 4 \text{ kcal/g} = 50 \text{ g}$$

The individual contribution percentage (PC) of a single snack serving to the total daily sugar allowance was calculated using the empirical sample mean (μ_{sugar}):

$$\text{PC} = ((\mu_{\text{sugar}} \times (\text{SS} \div 100)) \div S_{\text{max}}) \times 100$$

To quantify consumer sugar exposure from these products, a deterministic simulation model was constructed. The mathematical baseline of a 2,000 kcal/day reference energy intake and the subsequent 10% ceiling (50 g) calculations strictly adhere to the standard criteria outlined in the World Health Organization Nutritional Guidelines [4]. The implementation of fixed, deterministic screening scenarios based on a standard point-estimate pouch weight (50 g) to evaluate the percentage contribution (PC) of single-use processed foods follows established food safety risk assessment and dietary exposure protocols [8–9].

Predictive Labeling and Reformulation Modeling

An optimization model was designed to project the impact of two policy interventions over a five-year timeline:

1. **Mandatory Front-of-Pack Labeling (FOPL):** Applying a high-visibility warning stamp ("HIGH IN SUGAR") on all products exceeding the 6.0 g/100 g baseline, assuming a consumer behavioral shift that reduces demand for labeled snacks by 18% [10].
2. **Gradual Reformulation Pathways:** Simulating a phased reduction scheme requiring manufacturers to lower sugar levels toward the WHO African Region standard by 10% in Phase 1, 25% in Phase 2, and 50% in Phase 3.

Result and Discussion

Analysis of Market Sugar Content

The empirical evidence indicates that the sugar content of sweet biscuits sold in Nigeria is exceptionally high when contrasted with the regional standard. The statistical distribution of the 76 audited brands highlights this variance in Table 2:

Table 2
Statistical Distribution of the 76 Audited Brands

Statistical Metric	Sugar Density Value (g per 100 g)	WHO AFRO Regional Limit (g/100 g)	Percent Variance From Limit
Sample Mean (μ)	29.68 g ($\pm$ 8.4 g)	6.0 g	+ 394.67% Excess
Sample Median (M)	30.00 g	6.0 g	+ 400.00% Excess
Minimum Value (Min)	13.90 g (<i>Tiffany Delights Shortbreads</i>)	6.0 g	+ 131.67% Excess
Maximum Value (Max)	46.09 g (<i>Candycake Bit Bite Wafers</i>)	6.0 g	+ 668.17% Excess

The data reveals a **100% market failure rate** relative to the optimal profile. Out of the 76 prominent brands analyzed, **not a single sweet biscuit product met the WHO African Region threshold of ≤ 6.0 g/100 g.**

Even the most low-sugar option available in the market (*Tiffany Delights Shortbreads* at 13.9 g) contains more than double the regional sugar recommendation. The upper tier of the market consists largely of ultra-processed products like *Oreo Chocolate Sandwich Cookies* (43.0 g), *Lotus Biscoff Vanilla Biscuits* (42.5 g), and *Shirin Asa Choco Jido Biscuits* (43.8 g), which are nearly half pure sugar by weight (see Table 1). This demonstrates that high sugar content is a systemic characteristic of the sweet biscuit category in Nigeria, rather than an issue limited to isolated brands. This market-wide formulation trend echoes broader global data on ultra-processed bakery products, where hyper-palatability is systematically achieved through excessive sugar and fat density [2, 5].

Dietary Exposure Impact

When these sugar densities are evaluated through a deterministic dietary exposure model, the physiological impact becomes clear. A consumer eating a single 50 g packet of an average biscuit brand ($\mu = 29.68$ g/100 g) ingests **14.84 grams of free sugar** in a short duration.

For an average adult on a reference 2,000 kcal/day diet, this single snack item accounts for **29.68% of the daily free sugar limit**. For younger individuals or individuals with lower energy requirements, such as 1,500 kcal/day (where the 10% threshold equals 37.5 g of sugar), this single snack supplies **39.57%** of their total daily allowance.

Because these products are affordable, highly promoted, and often eaten in multiples throughout the day, consumers frequently exceed their daily free sugar allowance from snacks alone [11]. This high consumption pattern contributes directly to the rising trends of pediatric weight gain and dental caries observed in urban areas like Lagos [3–4].

The Scientific Basis for Front-of-Pack Labeling (FOPL)

Current nutrition disclosures in Nigeria leave an informational gap for the everyday consumer. They are typically printed on the back of packaging in small text, use complex metrics and require a baseline level of nutritional literacy to understand.

The data suggest that transitioning from back-of-pack nutritional disclosures toward a standardized Front-of-Pack Labeling (FOPL) framework could significantly enhance consumer clarity and support national food safety objectives. Establishing clear nutrient targets would provide a structured framework to guide industry-wide product reformulation. Figure 1 shows the proposed warning matrix.

Predictive behavioral modeling indicates that implementing high-visibility warnings reduces consumer demand for high-sugar snacks by approximately 18% through clear risk communication [10]. More importantly, FOPL creates a strong commercial incentive for manufacturers to reformulate their recipes. To avoid a negative warning label on their packaging, companies are driven to lower their sugar levels below the 6.0 g threshold.

Reformulation Modeling and International Comparison

Predictive modeling shows that a phased, state-supported reformulation policy can systematically lower population-level sugar exposure as shown in Fig. 2:

- **Phase 1 (10% Reduction):** Shifting the market mean down to 26.71 g/100 g reduces daily sugar exposure per serving from 14.84 g to 13.36 g.
- **Phase 2 (25% Reduction):** Lowering the market mean to 22.26 g/100 g prevents substantial cumulative sugar intake across the population over a calendar year.
- **Phase 3 (50% Reduction Target):** Bringing the market mean down to 14.84 g/100 g approaches the upper boundaries of international standards.

Other low- and middle-income countries (LMICs) have successfully used these types of frameworks to improve the nutritional quality of their food supplies. For example, after Chile implemented its *Food Labeling and Advertising Law*, corporate food manufacturers reformulated over 65% of products in targeted categories to lower sugar levels and avoid mandatory warning stamps [5].

Similarly, after South Africa introduced its *Health Promotion Levy*, sweet snack and beverage manufacturers reduced total sugar concentrations across their product lines to lower their tax liabilities

[12]. These examples show that clear, nutrient-profile-based regulations can successfully guide food industries toward healthier product formulations.

Conclusion and Policy Recommendation

The sugar content of sweet biscuits currently sold in Nigeria is notably high. With an empirical mean of 29.68 g/100 g, every single brand evaluated fell short of the ideal WHO African Region nutrient profile target of ≤ 6.0 g/100 g for marketing restriction to children. A single standard serving supplies nearly 30% of an adult's daily sugar allowance, contributing directly to the rise of diet-related chronic conditions and dental caries across the country.

To advance the goals outlined in the National Policy on Food Safety and Quality 2023, relevant regulatory bodies may find value in instituting mandatory, high-visibility Front-of-Pack Labeling (FOPL). This approach aligns national standards with the WHO African Region guidelines and establishes a transparent foundation for incremental product reformulation. Furthermore, utilizing tiered fiscal frameworks based on sugar density would create a supportive market mechanism to incentivize the food industry toward healthier standards.

Declarations

Clinical Application Number, Ethics Approval and Consent to Participate

Not applicable. This policy perspective analyzed public, commercially accessible nutritional data from pre-packaged product labels and did not involve human subjects or animal testing.

Consent for Publication

Not applicable.

Availability of Data and Materials

The complete cross-sectional data set mapping the total sugar concentrations of all 76 sweet biscuit brands is fully detailed within this text.

Competing Interests

The authors declare that they have no competing financial, corporate, or institutional interests that could have biased the presentation of this research.

Funding

This analysis was conducted independently without financial grants or support from commercial, public, or non-profit entities.

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Figures

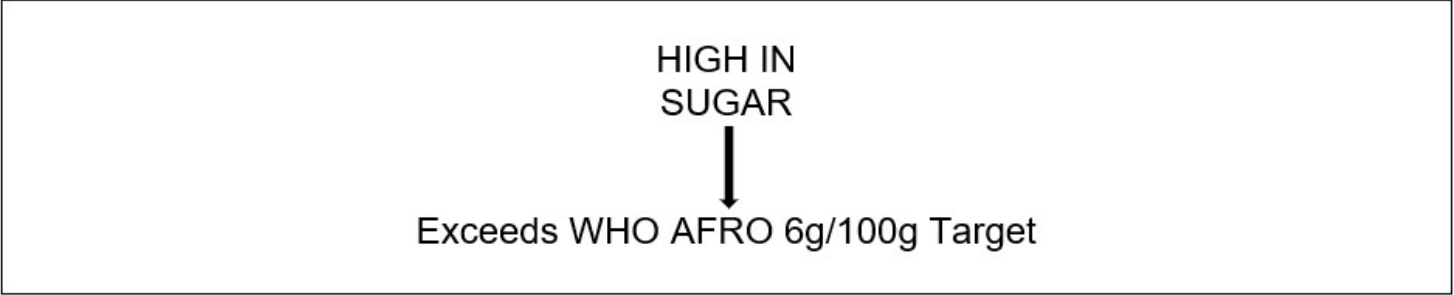


Figure 1

The Proposed Warning Matrix.

PHASED REFORMULATION IMPACT MODEL		
Phase 1: -10% Market Mean: 26.71 g/100g	Phase 2: -25% Market Mean: 22.26 g/100g	Phase 3: -50% Market Mean: 14.84 g/100g

Figure 2

Phased Reformulation Impact Model.