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Research Article

The Possible Intake of Sodium, Impact of Implementing the WHO Global Sodium Benchmark and a Proposed Maximum Sodium Level for Some Mayonnaise Sold in the Nigerian Markets

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Abstract

Introduction: Hypertension is a major cause of premature death worldwide, leading to an estimated 10.8 million avoidable deaths every year. An estimated 1.4 billion adults aged 30-79 years worldwide had hypertension in 2024; this represents 33% of the population in this age range. A 2019 study conducted in Nigeria indicated a prevalence among adults at approximately 31%, the overall age-standardized prevalence was estimated to be 38.1%. A survey revealed that the average sodium consumption among Nigerian adults was 2.8g per day, which exceeds the WHO's maximum daily recommendation of not more than 2g per day. It is believed that sauces, dips, other seasonings and dressings (which include mayonnaise) are significant contributors to sodium intake. An effective way of reducing dietary sodium intake (thus, reducing blood pressure and diet-related non-communicable diseases) is by lowering sodium content in foods that contribute significantly to total dietary sodium intake. The global sodium benchmarks for different food categories have been set by the World Health Organization (WHO) to serve as a guide for countries in setting maximum sodium levels for reformulation and reduction of sodium content in processed foods. However, Nigeria is yet to implement national sodium benchmarks across food categories. The concern raised about the possible intake of sodium, impact of implementing the WHO global sodium benchmark and a proposed maximum sodium level for some mayonnaise sold in the Nigerian markets will be addressed in this study.

Method: Mean sodium level (without outlier) in mayonnaise and suggested serving were estimated by this study from available data on sodium levels from on-pack nutrient declaration panels of the labels of randomly selected and most commonly available brands of mayonnaise in major open markets and supermarkets in almost all the States of the Federation. A total of seven (7) mayonnaise brands were collected, one of which has a sodium content values that is a significant outlier. These data were used to calculate sodium intake from mayonnaise using methodology developed by the Joint Experts Committee on Food Additives (JECFA). This was expressed as a percentage of the WHO dietary goals for preventing obesity and other NCDs or the Nutrient Reference Value - Noncommunicable Disease (NRV-NCD) for sodium to provide an estimate of the potential risk of excess sodium intake and determine if mayonnaise contributes significantly to total dietary intake, according to the sodium threshold contained in the WHO Nutrient Profile Model for the African Region. The mean sodium level was cross-checked against the relevant threshold provided in this Model to determine if the product is high in sodium and its marketing to children is to be prohibited. Outlier was calculated using GraphPad Prism statistical software, which performs Grubbs' test, also called the ESD method (Extreme Studentized Deviate).

Result and Discussion: The sodium content varied widely from 0.15 to 0.83g per 100g of mayonnaise. The mean sodium level was approximately 0.5g per 100g of mayonnaise. Comparing this with the sodium threshold for sauces, dips, other seasonings, and dressings (per 100g) provided in the nutrient profile model for the WHO African region (which is 0.3g), mayonnaise is classified as excessive in sodium. The low-fat version was found to have the highest sodium content. Estimation of sodium intake from three servings of this version per day was 0.35g, which is a lot of sodium. There was a significant reduction in this intake to 0.13g or 0.21g when the WHO global benchmark for sauces, dips and dressings or the proposed maximum sodium level for mayonnaise was used in the estimation respectively.

Conclusion and Recommendation: Mayonnaise is excessive in sodium and could be a significant contributor to sodium intake in Nigeria. The adoption of the global sodium benchmark for sauces, dips, and dressings (0.5g sodium per 100g mayonnaise) or the proposed maximum sodium level (0.3g sodium per 100g mayonnaise) could lead to a significant reduction in sodium content and, subsequently, sodium intake. It is recommended that the marketing of mayonnaise to children should be prohibited, the use of the low-fat claim should take sodium content into account, and the consumption of mayonnaise should not be more than one or two suggested servings (14 - 28g) per day.

Keywords: *WHO Global Sodium Benchmarks; Nutrient Profile Model; Mayonnaise; Sodium Intake; Nigeria*

Introduction

Hypertension, defined as systolic blood pressure equal to or greater than 140 mmHg and/or diastolic blood pressure equal to or greater than 90 mmHg is epidemic globally. An estimated 1.4 billion adults aged 30-79 years worldwide had hypertension in 2024; this represents 33% of the population in this age range [1]. A 2019 study conducted in Nigeria indicated a prevalence among adults at approximately 31%, the overall age-standardized prevalence was estimated to be 38.1% [2]. High dietary sodium intake (intake of more than 2g sodium per day), which increases blood pressure and the risk of hypertension, is responsible for about 3 million of the estimated yearly 11 million deaths globally associated with hypertension. A survey revealed that the average sodium consumption among Nigerian adults was 2.8g per day, which exceeds the WHO's maximum daily recommendation of not more than 2g per day [3]. The WHO Member States have agreed to a global target of a 30% reduction in salt or sodium intake by 2025 [4]. The Global Nutrition Report shows that Nigeria is off track with regards to meeting this and other targets in the area of reducing the prevalence of hypertension among its population [5]. An effective way of reducing dietary sodium intake (thus, reducing blood pressure and diet-related non-communicable diseases) is by lowering sodium content in foods that contribute significantly to total dietary sodium intake. To this end, the WHO established global sodium benchmarks across different food categories to serve as a guide for countries in setting maximum sodium levels for reformulation and reduction of sodium content in processed foods [6].

In recent years, because of growing health concerns, mayonnaise, a table sauce, has been reformulated to lower its fat content. However, mayonnaise contains sodium salt and as a result its consumption may be associated with an increased risk of excessive sodium intake and subsequently, an increased risk of hypertension. Researchers have demonstrated that the worldwide popularity of mayonnaise is due to its ready availability, heavy advertising and high palatability. Heavy reliance on the "low-fat" and "light" claims on mayonnaise may also contribute to its increased daily consumption globally. Salt is added to make it more palatable and flavorful. Reducing salt content in mayonnaise by setting maximum sodium level has become a significant goal for regulatory agencies, manufacturers and consumers. In Nigeria, limited data on sodium content is available to the public and there are wide variations of sodium levels in mayonnaise. These large variations of sodium content clearly indicate that reformulation by gradually reducing the sodium content is entirely possible, and technically should not be an issue, given some brands with much lower sodium levels are already in the market.

The global sodium reduction strategy has been recognised as effective, as these changes do not rely on changes in consumer behaviour [4] and are in alignment with the National Policy on Food Safety and Quality and its Implementation Plan 2022, and the Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020 [7]. However, Nigeria is yet to implement national sodium benchmarks across food categories. The concern raised about the possible intake of sodium, impact of implementing the WHO global sodium benchmark and a proposed maximum sodium level for some mayonnaise sold in the Nigerian markets will be addressed in this study. The importance of addressing this concern is stressed in the recently published national policy on food safety and quality and its implementation plan [8].

Methodology

Sodium content and intake from mayonnaise in Nigeria

Mean sodium level (without outlier) in mayonnaise and suggested serving were estimated by this study from available data on sodium levels from on-pack nutrient declaration panels of the labels of randomly selected and most commonly available brands of mayonnaise in major open markets and supermarkets in almost all the States of the Federation (as shown in table 1). A total of seven (7) mayonnaise brands were collected, one of which has a sodium content values that is a significant outlier. These data were used to calculate sodium intake from mayonnaise using methodology developed by the Joint Experts Committee on Food Additives (JECFA) [15,16]. This was expressed as a percentage of the WHO dietary goals for preventing obesity and other NCDs or the Nutrient Reference Value - Noncommunicable Disease (NRV-NCD) for sodium to provide an estimate of the potential risk of excess sodium intake and determine if mayonnaise contributes significantly to total dietary intake, according to the threshold contained in the WHO Nutrient Profile Model for the African Region [9]. The mean sodium level was cross-checked against the relevant threshold provided in this Model to determine if the product is high in sodium and its marketing to children is to be prohibited. Outlier was calculated using GraphPad Prism statistical software, which performs Grubbs' test, also called the ESD method (Extreme Studentized Deviate) [10].

Table 1: *Sodium content of some mayonnaise in Nigeria.*

S/N	Brand name	Sodium content (g per 100 g/ml)
1	Bama	0.5
2	Jago low fat	0.83
3	Frolic	0.6
4	Jago light	0.48
5	Remia	0.48
6	Laziz	0.150
7	Tiger	1.600
8	Hellmann's	0.69
9	Vitalis	0.49
	Mean ± SD	0.53 (without the outlier) ± 0.418

Table 2: *Calculation of significant outlier.*

Row	Sodium value (g) per 100g mayonnaise	Z = [mean - value] / SD	Significant Outlier
1	0.150	1.2134	
2	0.5	0.3907	
3	0.83	0.3849	
4	0.6	0.1557	
5	0.48	0.4377	
6	0.48	0.4377	
7	1.6	2.1946	Significant outlier. P < 0.05
8	0.69	0.0558	
9	0.49	0.4142	

Here are explanations of some of the terms and methods used in this paper:

- Sodium intake was calculated according to the formula: (Sodium content in g per 100g of the mayonnaise x suggested serving in g per day)/100).
- The sodium intake goal was obtained from the WHO Population Intake Goals for preventing diet-related chronic diseases [11] and the Nutrient Reference Value - NonCommunicable Diseases (NRV-NCD) [12].
- The risk of excess sodium intake was estimated by expressing the intake as a percentage of the WHO population intake goal or NRV-NCD for sodium.
- Relative Reduction formula (proposed) = (highest sodium content in the market - global sodium benchmark or proposed maximum sodium level/highest sodium content in the market) x 100.
- 4.184 Kilojoule = 1 Kilocalorie.

Result and Discussion

This study estimated that the mean sodium content was 0.53g per 100g mayonnaise. A 2022 study by Ojo found that sauces, dressings, spreads and dips (which include mayonnaise) had a high median sodium content of 0.56 g/100g, ranking it among the food categories with the highest median sodium content [18]. According to the Nutrient Profile Model for the WHO Africa Region, a product, under the food category of sauces, dips and dressings, is considered excessive in sodium if its sodium content exceeds the threshold of 0.30g (on a per 100 g/ml basis). Comparing this with the mean sodium content estimated in this study, mayonnaise contains excess amount of sodium and its consumption makes it more likely for the diet to exceed the maximum level recommended in the WHO salt guidelines [3]. It is strongly recommended that mayonnaise should be subject to restricted marketing to children.

The sodium content in mayonnaise varied widely, with levels from 0.15 to 0.83 g/100g. This highlights a need to set and implement a maximum sodium level in a way that the consumer is adequately protected against excessive sodium intake. Table 4 reveals the WHO

Table 3: *The nutrient profile model for the WHO African region [9].*

Food category	Examples of food items	Codex Food Category code	Total fat (g)	Saturated fat (g)	Total sugars (g)	Added sugars (g)	Sodium (g)	Energy (kcal)
Sauces, dips, other seasonings and dressings	Emulsified, non-emulsified mixes as concentrated, clear sauces and like products, soybean-based seasoning and condiments. Examples: mayonnaise, salad dressing, onion dips, tomato ketchup, gravy, cheese sauce, cream sauce, bouillon cubes, seasoning powder, fermented and unfermented soy sauces, fish sauce, sweet chili sauce, spaghetti sauce, BBQ sauces	12.6, 12.9.2	8.0	No threshold provided	No threshold provided	0.0	0.30	No threshold provided

NB: Marketing is prohibited if products exceed values in this model per 100g.

Source: World Health Organization, 2019. 'Nutrient Profile Model for the WHO African Region: a tool for implementing WHO recommendations on the marketing of foods and non-alcoholic beverages to children'.

global sodium benchmark for sauces, dips and dressings, which is intended to be useful for countries in setting national policies and strategies for reducing sodium intakes in their populations. This benchmark can also serve as guide in setting maximum sodium levels to facilitate reformulation of food products (sauces, dips and dressings) to lower sodium concentrations [6].

The low-fat version was found to have the highest sodium content. This may be due to the addition of sodium salt to compensate for the reduced flavor and texture. The use of low-fat claim on mayonnaise is of concern as it may not only make sodium content 'invisible' to the consumers but also mislead them to consume the product in large amounts, increasing their risk of excessive sodium intake, and subsequently the risk of hypertension. It should be noted that "Low-fat" is not a license to overeat. In the case of fat claims on mayonnaise, sodium content should be taken into account.

Table 4: *WHO global sodium benchmark [6].*

Main food category	Subcategory	Subcategory description	Global benchmark (mg per 100g)	Lowest maximum target on which the benchmark is based
Sauces, dips and dressings	18d. Emulsion- based dips, sauces and dressings	Cream or cheese dips and sauces, standardized salad dressing (including mayonnaise-based dressing, refrigerated and shelf-stable oil and vinegar-based dressings, and creamy dressings), and mayonnaise. Includes mayo- type spreads. Includes low-fat and fat-free versions.	500	United Kingdom: Mayonnaise (not reduced fat/calorie), 500 mg

Source: World Health Organization, 2019. 'World Health Organization, 2021: WHO global sodium benchmarks for different food categories'.

This study estimated 40% relative reduction in sodium content of mayonnaise in the Nigerian market if the WHO global sodium benchmark for sauces, dips and dressings were implemented. It also revealed that some mayonnaise with sodium content lower than this benchmark already exist in the Nigerian market, thereby suggesting that reformulation to meet this target is feasible and suggests that significant reduction in sodium content can be achieved without affecting sensory properties of mayonnaise. A 2024 study indicated that up to 50% reduction in sodium content of sauces, dips and dressings did not have significant impact on sensory differences compared with the control [17]. The adoption of this benchmark as a national strategy to reduce sodium intake from mayonnaise could be one of the key activities for the implementation of the National Policy on Food Safety and Quality 2023, and support government actions to improve the healthiness of the food supply [8].

Table 5 shows the nutrient reference value - noncommunicable disease (NRV-NCD) for sodium. Based on the Nutrient Profile Model for the WHO African Region for sauces, dips, other seasonings and dressings, more than 15% of the 2 grams of sodium (on a 2,000 kcal diet per day), which is more than 0.3g, is a significantly high amount from mayonnaise per day. Three servings (42g) of the mayonnaise brand (with the highest sodium content) contains about 0.35g of sodium, which is a lot of sodium according to the Model, posing high risk of excess sodium intake and subsequently, risk of hypertension. There was a significant reduction in this intake to 0.13g or 0.21g when the WHO global benchmark for sauces, dips and dressings or the proposed maximum sodium level for mayonnaise was used in the estimation from respectively. The consumption of three servings of this mayonnaise makes it more likely for the consumer to exceed the WHO recommended maximum daily sodium intake. Consumption of not more than one or two servings per day is strongly recommended.

Given that some mayonnaise identified in this study had already achieved or below (as low as 0.15g sodium per 100g mayonnaise) this global target, there is need to implement a maximum sodium level for mayonnaise that is lower than the WHO global sodium benchmark for sauces, dips and dressings. If a maximum level of 0.3g sodium per 100g mayonnaise were implemented, there would be an estimated 64% relative reduction in the sodium content.

Table 5: *Nutrient reference value - noncommunicable disease for sodium [12].*

Nutrient	Levels not to exceed	Levels to achieve
Saturated fatty acids	20g	
Sodium	2g	
Potassium		3.5g

Conclusion and Recommendation

Mayonnaise is excessive in sodium and could be a significant contributor to sodium intake in Nigeria. The adoption of the global sodium benchmark for sauces, dips and dressings (0.5g sodium per 100g mayonnaise) or proposed maximum sodium level (0.3g sodium per 100g mayonnaise could lead to a significant reduction in sodium content and subsequently, sodium intake. It is recommended that the marketing of mayonnaise to children should be prohibited, use of low-fat claim should take sodium content into account, and consumption of mayonnaise should not be more than one or two of the suggested servings (14-28g) per day.

Limitation and Assumption

1. A more accurate sodium intake estimate could not be made as it requires a national mayonnaise consumption data.
2. It was assumed that the on-pack sodium content data reflect the correct analytical data and serving suggestion. There was no food analysis conducted. The exact amount of sodium content in the mayonnaise could not be examined.
3. Mayonnaise was eaten daily.

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