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Prevalence of Food Imitation and Its Negative Health Implications Amongst Adult Consumers in Port Harcourt Metropolis

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Abstract
This study aims to explore the prevalence of food imitation and its associated negative health impacts among adult consumers in the Port Harcourt metropolis. The research is framed by four primary research questions and corresponding null hypotheses. Employing a survey design, the study involved a sample of 557 adult food consumers selected through random sampling techniques. Data collection utilized a validated 35-item questionnaire with a reliability index of 0.87, established using the Cronbach Alpha formula. Research questions were addressed using mean and standard deviation analyses, while the hypotheses were tested using the independent sample t-test at a significance level of .05. The findings revealed that substitution emerged as the most prevalent form of food imitation in Port Harcourt metropolis, with transshipping being the least common. Alcoholic beverages were identified as the most counterfeited food items, whereas eggs were the least affected by imitation. The study highlighted that food assessment is crucial for mitigating the prevalence of food imitation, emphasizing its potential health risks such as peptic or colon ulcer and bone marrow abnormalities. Significant differences were observed among subjects regarding their perceptions of prevalent food imitations, types of imitated foods, strategies to minimize imitations for optimal health, and the impact of food imitations on adult consumers' health quality in the Port Harcourt metropolis. Recommendations included urging adult consumers to promptly report any instances of Economically Motivated Adulteration (EMA) of food to law enforcement agencies to ensure timely intervention and safeguard public health.

Keywords: Food imitation, Food fraud, Counterfeit food, Health implications, Food safety

Introduction

Food is indispensable for human sustenance, akin to water which is vital for bodily functions and metabolism. The quality of food consumed directly impacts public health, making it a critical intersection. Food, encompassing substances intended for human consumption, whether processed, semi-processed, or raw, plays a pivotal role in providing energy for work and metabolic processes (Codex Alimentarius Commission & Procedural Manual, 2013). However, food imitation poses a significant risk to public health globally (WHO, 2006). Food imitation occurs when production processes are altered, often through deceptive packaging or manipulation during preparation, leading to fraudulent representations of food items (Alan & Tom, 2014). The term "economically motivated adulteration" (EMA), although lacking a standardized statutory definition, refers to the deliberate substitution or addition of substances in food products to enhance perceived value or reduce production costs, primarily for economic gains (Federal Register 64, 2009). This includes dilution or adulteration of products to deceive consumers or mask dilution, potentially posing health risks. Despite regulatory frameworks, the absence of a universally recognized definition of food fraud complicates efforts to combat it. The European Union (EU) regulations, for instance, emphasize the prohibition of misleading food labelling and packaging, yet variations among member states persist, contributing to the challenge of detecting food fraud (European Parliament, 2013).

The United Kingdom's Food Standards Agency (FSA) defines "food fraud" as the deliberate placement of products on the market for financial gain, involving two primary types of fraud: the sale of unfit and potentially harmful food, and the deliberate misrepresentation of food, often by substituting it with cheaper alternatives. Food fraud falls under the broader category of product fraud (Spink, 2011). Drinks are ubiquitous in modern life, readily available

everywhere. However, drink imitation poses severe health risks to adults, including obesity, diabetes, heart disease, gastrointestinal issues, cancer, liver damage, infertility, bone health deterioration, and dental disorders. Imitation beverages contribute to various health problems, including sugar-related complications, kidney failure, metabolic rate reduction, obesity, bone deterioration, and reproductive issues. Recent research indicates that drink imitation also adversely affects brain function and overall bodily systems across all age groups, particularly impacting the female reproductive and circulatory systems, and exacerbating diabetes. Prolonged menstrual cycles, often resulting from the consumption of soda drinks and junk food, are a leading cause of infertility in women. Numerous studies have highlighted the detrimental effects of drink imitation on waistlines and dental health (Bray, 2010).

Hamad (2019) conducted a study highlighting the detrimental effects of drink imitation on human health, emphasizing its significant presence and importance in contemporary discourse. The media plays a crucial role in shaping public perception, with advertisements for various drink brands being extensively promoted, often without adequate awareness of their adverse health effects on the community. Hamad noted that a considerable portion of the Sudanese population, particularly those facing renal and heart diseases as well as dental problems, cannot afford treatment due to financial constraints. He emphasized the urgent need for policy implementation to regulate all types of drink brands, asserting that robust policies could potentially save many lives from the harmful effects of excessive consumption of such beverages. According to Hu and Malik (2010), food imitations pose a significant health risk as they typically contain harmful chemicals detrimental to the body. It is widely acknowledged that food imitations have adverse effects, especially on adults. Recognizing these risks, the Punjab Food Authority took action to prohibit imitated foods, citing concerns that "carbonated food and drinks are injurious to health, affecting the physical growth of children" (Ibrar et al., 2018).

Johnson (2014) conducted a study on food fraud and "Economically Motivated Adulteration (EMA)" of food and food ingredients, revealing that up to 10% of the global food supply could be affected by food fraud. Consequently, the costs associated with fraudulent food practices are borne by various stakeholders, including industry players, regulatory bodies, and ultimately, consumers. The study estimated that economically motivated adulteration (EMA) of food, also known as food fraud, amounts to a staggering $30–40 billion annually for the food industry. Moreover, according to the Grocery Manufacturers Association (GMA), food fraud is estimated to cost the global economy approximately $49 billion annually. The literature surveyed in the study highlights the diverse forms of food counterfeiting and fraud. The majority of economically motivated adulteration cases involve substitution or dilution, accounting for 65.0% of cases, followed by the use of unapproved additives (13.4%), and counterfeit products (8.5%), among other methods. Geographically, the United States of America witnessed the highest prevalence of food adulteration at 29.8%, followed by China at 13.6% and India at 12.5%, among other countries. Opia (2020) examined the issue of food fraud in Nigeria, focusing on its implications for public health and well-being, and proposed policy interventions to address it at both local and global levels through regulatory and governmental initiatives. The study also explored the relationship between food fraud, food security, and the United Nations Sustainable Development Goals (SDGs). Interviews were conducted with senior officials from the National Agency for Food and Drug Administration and Control (NAFDAC) as well as 68 members of the general public to assess the current state of food fraud in Nigeria. The investigation identified commonly contaminated foods in Nigeria, including fats and oils, alcoholic and non-alcoholic beverages, and honey, attributing these issues to poor food safety and control systems, poverty, and corruption. The study concluded by analyzing various policy frameworks and governmental efforts in Nigeria, offering recommendations to help achieve the Sustainable Development Goals by 2030.

Onyeaka et al. (2022) conducted a review focusing on food theft in the African context, with particular attention to the impact of COVID-19. The study provides examples of food fraud and highlights challenges faced by key stakeholders in the supply chain, including consumers, businesses, and regulatory bodies. Moreover, it offers recommendations for scholars and policymakers on strategies to mitigate fraud and improve the quality and safety of food within the supply chain. The findings underscore a consensus that the COVID-19 pandemic has heightened consumers' vulnerability to food fraud. However, the review also identifies significant data gaps that hinder statistical comparisons of food fraud occurrences. The effectiveness of food fraud prevention measures is hampered by the lack of comprehensive surveillance systems, particularly in Africa. To safeguard consumer health, there is a pressing need for evidence-based action plans to combat fraud at both national and continental levels. This necessitates enhanced data collection efforts and substantial investments in testing infrastructure and technical expertise. Bouzembrak et al. (2018) investigated the development of a food fraud media monitoring system using

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text mining technology, leveraging resources provided by the European Media Monitor (EMM), specifically its MedISys portal. The technology, termed MedISys-FF, gathers, analyzes, and disseminates reports of food fraud from media outlets worldwide. The MedISys-FF system operates continuously, updating every ten minutes. Over 16 months (September 2014 to December 2015), MedISys-FF collected food fraud reports, which were subsequently compared to data from Rapid Alert for Food and Feed (RASFF), HorizonScan, and the Economically Motivated Adulteration Database (EMA). The study findings indicate that MedISys-FF retrieves food fraud publications with high relevance (>75%), with the most frequently mentioned fraudulent commodities in the media being meat, shellfish, milk, and alcohol. These top commodities align with those identified in RASFF and EMA databases, although there are discrepancies in frequency. The analysis of collected articles can provide insights into food fraud issues in different countries, support the development of control measures, and aid in detecting fraud within the food supply chain.

Bouzembrak and Marvin (2016) aimed to identify the expected types of food fraud for imported goods when the product category and country of origin are known, to focus enforcement efforts. They developed a Bayesian Network (BN) model using data from adulteration/fraud warnings reported in the Rapid Alert System for Food and Feed (RASFF) between 2000 and 2013. The study analyzed 749 notifications of food fraud categorized into six types: improper, fraudulent, missing, or absent health certificates; illegal importation; tampering; improper, expired, fraudulent, or missing common entry documents or import declarations; expiration date; and mislabeling. A BN model was constructed using this data, and its accuracy was validated using 88 reports of food fraud submitted to RASFF in 2014. The model correctly predicted 80% of the food fraud types when the type of fraud, country, and food category had been previously reported in RASFF. However, when the country of origin or the product-country combination was not previously recorded in the RASFF database, the model accurately predicted 52% of the 88 food fraud types. The authors suggested that this model could assist risk managers and controllers at border inspection posts in determining which types of fraud to target when importing goods. Beia et al. (2020) examined food fraud incidents based on findings from the latest Rapid Alert System for Food and Feed (RASFF) report. The study aimed to capture the essence of food fraud incidents occurring from May 2019 to the present. It provided a brief theoretical overview of food fraud and analyzed the most recent RASFF report, focusing on the most frequent subjects of incidents, their impact, nature, and the products most affected. The findings revealed that the primary cause of food fraud cases was a lack of documentation for individual food products. While animal hides and other hazardous compounds were only occasionally found, their significance for public health cannot be underestimated.

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Statement of the Problem

Food integrity, as emphasized by Manning (2016), is vital for maintaining the intrinsic and extrinsic qualities of food products and upholding their value. However, the World Customs Organization has estimated that the annual cost of food fraud amounts to $49 billion US (Frew & Cannavan, 2015). Similarly, a report by the Congressional Research Service in 2014 suggests that up to 10% of the food supply could be affected by food fraud, highlighting

that the costs of fraudulent food are borne by industry, regulators, and consumers (Johnson, 2014). This estimation aligns with the Grocery Manufacturers Association's assertion that food fraud costs the global economy $49 billion annually. The widespread prevalence of food imitation poses significant health risks, including an elevated likelihood of developing cancer and liver damage problems. Bouzembrak and Marvin (2016) underscore the importance of early detection of food fraud, as it can erode consumer trust and jeopardize human health. Despite the evident risks associated with food imitations, there has been a dearth of research investigating the prevalence of food imitations and their adverse effects among adult consumers in the Port Harcourt metropolis. Thus, the current study aims to address this gap in the literature.

Aim and objectives of the study

The purpose of the study is to investigate the prevalence of food imitation and its negative health implications amongst adult consumers in the Port Harcourt metropolis. Specifically, the study seeks to:

1 Determine the prevalent of food imitations in the Port Harcourt metropolis
2 Determine the imitated (counterfeited/adulterated) food in Port Harcourt metropolis
3 Determine the strategies to minimize food imitations for the optimal health of adult consumers in the Port Harcourt metropolis
4 Determine how food imitations affect adult consumers quality of health in the Port Harcourt metropolis

Research Questions

1 What are the prevalent food imitations in the Port Harcourt metropolis?
2 What is the imitated (counterfeited/adulterated) food in Port Harcourt metropolis?
3 What are the strategies to minimize food imitations for the optimal health of adult consumers in the Port Harcourt metropolis?
4 How do food imitations affect adult consumer quality of health in the Port Harcourt metropolis?

Hypotheses

H_{01}: There is no significant difference between the mean ratings of the male and female adult consumers on the perceived prevalence of food imitations in the Port Harcourt metropolis.
H_{02}: There is no significant difference between the mean ratings of the male and female adult consumers on various types of food imitated in the Port Harcourt metropolis.
H_{03}: There is no significant difference between the mean ratings of the male and female adult consumers on the strategies to minimize food imitations for optimal health of adult consumers in Port Harcourt metropolis
H_{04}: There is no significant difference between the mean ratings of the male and female adults how food imitations affect adult consumer quality of health in the Port Harcourt metropolis

Materials and Methods

This study employed a survey and comparison design for its investigation. It is intended to offer insights into the chosen projects and is coupled with qualitative data. The research design was chosen to facilitate the collection, description, tabulation, and evaluation of data necessary for addressing research questions and testing hypotheses related to the operational variables under investigation. Quantitative data was collected and analyzed to identify differences in the variables under scrutiny. The study's target population comprises all adults residing in the Port Harcourt metropolis. According to the United Nations - World Population Prospects for 2022, the current population of Port Harcourt is estimated to be 3,325,000, representing a 4.86% increase from the previous year. This population is appropriate for the study because it involved all the consumption of food in this area. The study's sample consists of 600 adults who reside in the Port Harcourt metropolis. A portion of the population from which the information was drawn is represented by the sample size. The lowest sample size (400) that could be drawn from the complete adult population of the Port Harcourt metropolitan was calculated using the Taro Yamane formula. Since the formula merely serves as a guide and produces estimates of the minimal sample size to be utilized, Nwankwo (2006) indicated that a sample size greater than the one obtained using these formulas should be employed. In the city of Port Harcourt, a total of 600 adults were chosen using the random sample method.

A researcher-developed questionnaire consisting of 35 items was utilized as the instrument for data collection. The questionnaire aimed to gauge the prevalence of food imitation and its perceived negative effects on human health. It comprised two main sections: Section A focused on gathering demographic information from the participants, while Section B aimed to collect data on the variables under investigation. To assess the prevalence of food imitation and

its associated negative health effects among adults in Port Harcourt metropolis, a modified 4-point Likert scale was employed. This scale included categories such as "Very high extent" (4-point), "High extent" (3-point), "Low extent" (2-point), and "Very low extent" (1-point). Before implementation, a draft of the questionnaire was subjected to evaluation by the researcher's supervisor and two other departmental lecturers to ensure its face and content validity. The researchers provided clear instructions to the lecturers, detailing the specific tasks to be performed along with the objectives, research questions, and hypotheses of the study. This facilitated the assessment process, allowing the lecturers to focus on identifying relevant data points. Additionally, explicit instructions were given to the lecturers to review the questionnaire items for clarity, appropriateness of language and expression for the respondents, and suitability of instructions. A designated space was provided for any comments or suggestions regarding the overall suitability of the instrument at the end of each questionnaire. Subsequently, necessary adjustments were made to the questionnaire based on the feedback received from the lecturers.

The content validity of the instrument was established in two phases. Initially, three departmental experts were provided with copies of the instrument to solicit their input. They were requested to augment the instrument's content coverage by proposing additional relevant items (questions). Each copy of the instrument provided to the experts was accompanied by the study's topic, problem statement, purpose, objectives, research questions, and hypotheses to guide their contributions. In the second phase, two additional departmental experts were presented with revised copies of the instrument to assess the relevance of its items. The scores obtained were analyzed using mean and standard deviation, with items scoring below the 2.5 criteria mean cutoff being replaced with more suitable alternatives. Further modifications were incorporated into the final version of the instrument based on this feedback. To assess the instrument's reliability, Cronbach's alpha procedure was employed, focusing on its non-cognitive aspects. A sample of 40 respondents from the community, not part of the study, was selected using a simple random sampling technique. Each participant was administered the instrument, and the retrieved copies were coded and analyzed using Cronbach's alpha method, yielding a reliability coefficient of 0.87. This result affirmed the instrument's reliability for use in the study. Upon obtaining a letter of identification from the department head for field investigation, the researchers administered the instrument to the subjects face-to-face. This approach allowed them to address any queries from the respondents and provide clarifications, encouraging the participants to engage seriously with the questionnaire. In total, 600 copies of the instrument were distributed, with 557 copies retrieved, resulting in a return rate of 92.8%. Descriptive statistics, including bar graphs and mean values (with a criterion mean cutoff of 3.0), were employed to address the research questions. Hypotheses testing was conducted using t-statistics at a significance level of 0.05, employing the formula for computing the t-statistics for two means of independent samples.

$$t = z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1 - 1} + \frac{S_1^2}{n_2 - 1}}} \quad (1)$$

or

$$t = z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_1^2}{n_2}}} \quad (2)$$

where $t \approx z$ if $N \geq 50$ and:

$\bar{X}_1$ and $\bar{X}_2$ = mean of the male and female groups respectively.
S_1 and S_2 = Standard deviation of the male and female groups respectively
n_1 and n_2 = sample size of the male and female groups respectively

Results

Table 1 shows the summary of descriptive statistics on the prevalence of food imitations(or Economically Motivated Adulteration(EMA) of food in the Port Harcourt metropolis. It shows that the grand mean rating of the respondents over the prevalence of food imitations in the Port Harcourt metropolis was 3.18, SD=0.38. Specifically, the result shows that substitution had a mean rating of 3.72, SD=0.45, this was followed by mislabeling with a mean rating of

3.58, SD=0.57, others with a mean rating of 3.44, SD=0.64 and unproved additive with a mean rating of 3.39, SD=0.68 among others.

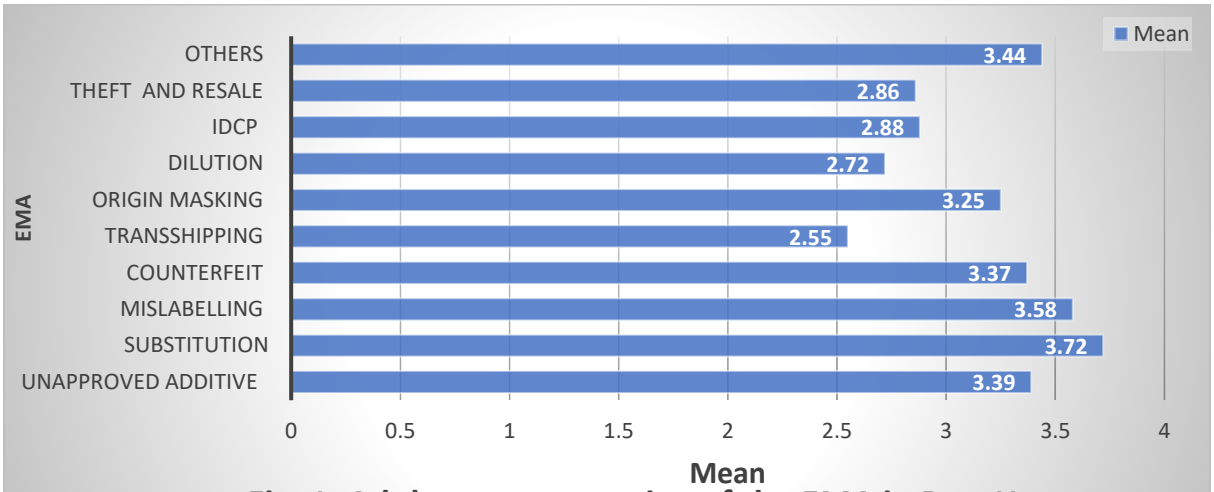

Fig. 1: Adult consumer rating of the EMA in Port Harcourt Metropolis

The findings presented in Table 2 provide a summary of descriptive statistics concerning imitated (counterfeited/adulterated) food in the Port Harcourt metropolis. The overall mean rating assigned by the respondents regarding imitated food in the Port Harcourt metropolis was 3.11, with a standard deviation (SD) of 0.33. Specifically, the analysis revealed that alcoholic beverages were the most commonly counterfeited items, receiving a mean rating of 3.44 with a standard deviation of 0.64. Following closely were honey/sweeteners, which garnered a mean rating of 3.40 with an SD of 0.53. Nutraceuticals obtained a mean rating of 3.40, with an SD of 0.69, while dairy products, meat products, and oil and fats received mean ratings of 3.25 (SD=0.81), 3.33 (SD=0.71), and 3.12 (SD=0.77), respectively, among others.

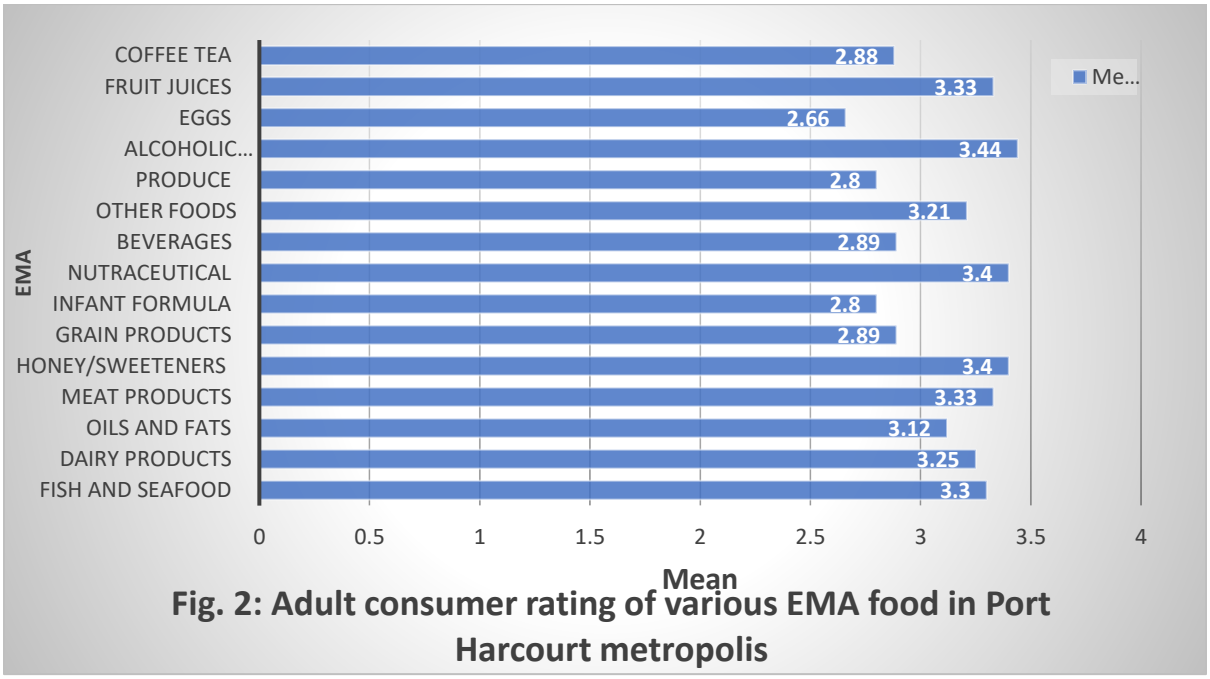

Fig. 2: Adult consumer rating of various EMA food in Port Harcourt metropolis

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The findings presented in Table 3 offer a summary of descriptive statistics concerning the strategies aimed at minimizing food imitations for the optimal health of adult consumers in the Port Harcourt metropolis. The overall mean rating assigned by the respondents regarding these strategies was 3.27, with a standard deviation (SD) of 0.37. Specifically, the analysis revealed that assessment was the most highly rated strategy, receiving a mean rating of 3.52 with an SD of 0.57. This was closely followed by record-keeping, which garnered a mean rating of 3.43 with an SD of 0.57, and law enforcement, which obtained a mean rating of 3.21 with an SD of 0.74, among other strategies.

Fig. 3: Adult consumer rating of various ways EMA of food could be minimised.

The findings presented in Table 4 provide a summary of descriptive statistics regarding the impact of food imitations on the quality of health among adult consumers in the Port Harcourt metropolis. The overall mean rating attributed by the respondents concerning this aspect was 3.02, with a standard deviation (SD) of 0.58. Specifically, the analysis indicates that respondents expressed concerns regarding the potential health effects of food imitations, with the highest-rated concern being the risk of colon or peptic cancer, receiving a mean rating of 3.30 with an SD of 0.72. This was followed by concerns about bone marrow abnormality, which garnered a mean rating of 3.07 with an SD of 0.85, and the risk of liver or kidney disease, which obtained a mean rating of 2.97 with an SD of 0.80, among other health-related concerns.

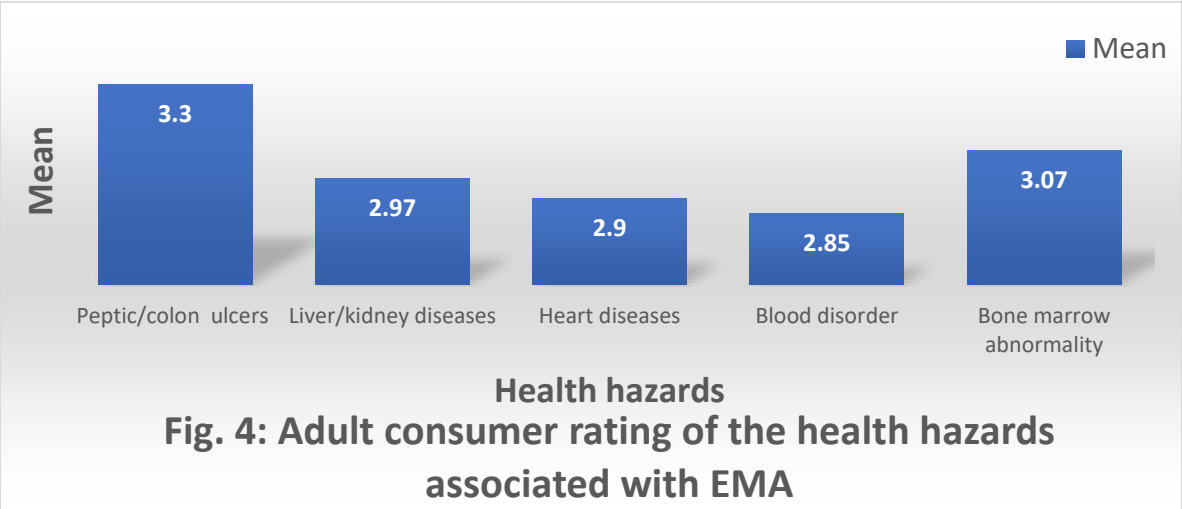

Fig. 4: Adult consumer rating of the health hazards associated with EMA

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Table 5: Summary of independent sample t-test on the difference between the mean ratings of the male and female adult consumers on the perceived prevalent of food imitations in the Port Harcourt metropolis

Gender	N	Mean	SD	t	df	p-value	Decision
Male	275	3.23	0.35				
				3.187	555	.002	Retain H_{01}
Female	282	3.13	0.39				

The result from Table 5 shows the summary of the independent sample t-test on the difference between the mean ratings of the male and female adult consumers on the perceived prevalence of food imitations in the Port Harcourt metropolis. It shows that there is a significant difference between the mean ratings of the male and female adult consumers on the perceived prevalence of food imitations in Port Harcourt Metropolis (t=3.187, df=555, p=0.002). The null hypothesis one was rejected at a .05 level of significance.

Table 6: Summary of independent sample t-test on the difference between the mean ratings of the male and female adult consumers on various types of food imitated in Port Harcourt metropolis

Gender	N	Mean	SD	t	df	p-value	Decision
Male	275	3.18	0.32				
				4.873	555	.000	Reject H_{02}
Female	282	3.02	0.32				

The result from Table 6 shows the summary of the independent sample t-test on the difference between the mean ratings of the male and female adult consumers on various types of food imitated in the Port Harcourt metropolis. It shows that there is a significant difference between the mean ratings of the male and female adult consumers on various types of food imitated in the Port Harcourt metropolis (t=4.873, df=555, p=0.00). The null hypothesis two was rejected at a .05 level of significance.

Table 7: Summary of independent sample t-test on the difference between the mean ratings of the male and female adult consumers on the strategies to minimize food imitations for optimal health of adult consumers in Port Harcourt metropolis

Gender	N	Mean	SD	T	df	p-value	Decision
Male	275	3.35	0.30				
				4.649	555	.000	Reject H_{03}
Female	282	3.20	0.42				

The result from Table 7 shows the summary of the independent sample t-test on the difference between the mean ratings of the male and female adult consumers on the strategies to minimize food imitations for optimal health of adult consumers in the Port Harcourt metropolis. It shows that there is a significant difference between the mean ratings of the male and female adult consumers on the strategies to minimize food imitations for optimal health of adult consumers in the Port Harcourt metropolis (t=4.649, df=555, p=0.00). The null hypothesis three was rejected at a .05 level of significance.

Table 8: Summary of independent sample t-test on the difference between the mean ratings of the male and female adults on how food imitations affect adult consumer quality of health in the Port Harcourt metropolis

Gender	N	Mean	SD	t	df	p-value	Decision
Male	275	2.83	0.66				
				-8.191	555	.000	Reject H_{04}
Female	282	3.21	0.41				

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The result from Table 8 shows the summary of the independent sample t-test on the difference between the mean ratings of the male and female adults and how food imitations affect adult consumer quality of health in the Port Harcourt metropolis. It shows that there is a significant difference between the mean ratings of the male and female adults on how food imitations affect adult consumer quality of health in the Port Harcourt metropolis (t=8.191, df=555, p=0.00). The null hypothesis four was rejected at a .05 level of significance.

Discussion

The results presented in Table 1 indicate that the overall mean rating provided by respondents regarding the prevalence of food imitations in Port Harcourt metropolis was 3.35, with a standard deviation (SD) of 0.31. Specifically, the analysis reveals that various forms of food imitation were identified, with substitution being rated highest, receiving a mean rating of 3.72 with an SD of 0.45. This was followed by mislabeling, which obtained a mean rating of 3.58 with an SD of 0.57, transshipping with a mean rating of 3.55 and an SD of 0.54, and unapproved additives with a mean rating of 3.39 and an SD of 0.68, among other identified forms of food imitation. The statistical analysis presented in Table 4.5 suggests that there is no significant difference between the mean ratings provided by male and female adult consumers regarding the perceived prevalence of food imitations in the Port Harcourt metropolis (t=1.763, df=555, p=0.078). Consequently, the null hypothesis was upheld at the 0.05 level of significance. This finding aligns with the findings of Johnson (2014), who also identified substitution and mislabeling, among other forms, as types of Economically Motivated Adulteration (EMA) in food and food ingredients.

The findings presented in Table 2 indicate that the overall mean rating provided by respondents regarding imitated (counterfeited/adulterated) food in the Port Harcourt metropolis was 3.11, with a standard deviation (SD) of 0.33. Specifically, the analysis reveals that alcoholic beverages were highly counterfeited, receiving a mean rating of 3.44 with an SD of 0.64. This was closely followed by honey/sweeteners, which obtained a mean rating of 3.40 with an SD of 0.53. Nutraceuticals had a mean rating of 3.40 with an SD of 0.69, dairy products with a mean rating of 3.25 and an SD of 0.81, meat products with a mean rating of 3.33 and an SD of 0.71, and oil and fats with a mean rating of 3.12 and an SD of 0.77, among other identified food items. The statistical analysis presented in Table 6 indicates a significant difference between the mean ratings provided by male and female adult consumers regarding various types of food imitated in the Port Harcourt metropolis (t=4.873, df=555, p=0.00). Consequently, the null hypothesis two was rejected at the 0.05 level of significance. This finding aligns with the research conducted by Johnson (2014), which investigated food fraud and "Economically Motivated Adulteration (EMA)" of Food and Food Ingredients, and similarly identified alcoholic beverages and honey/sweeteners, among other items, as EMA foods.

The findings presented in Table 3 reveal that the overall grand mean rating provided by respondents regarding strategies to minimize food imitations for the optimal health of adult consumers in the Port Harcourt metropolis was 3.27, with a standard deviation (SD) of 0.37. Specifically, the analysis indicates that assessment was rated the highest at 3.52, with an SD of 0.57, followed by record-keeping with a mean rating of 3.43 and an SD of 0.57, and law enforcement with a mean rating of 3.21 and an SD of 0.74, among other strategies identified. The statistical analysis presented in Table 7 demonstrates a significant difference between the mean ratings provided by male and female adult consumers regarding strategies to minimize food imitations for optimal health in the Port Harcourt metropolis (t=4.649, df=555, p=0.00). As a result, the null hypothesis three was rejected at the 0.05 level of significance. This finding is consistent with previous research by Bouzembrak and Marvin (2016), which emphasized the critical importance of detecting food fraud early to safeguard customer trust and protect human health.

The findings from Table 4.3 indicate that the overall grand mean rating provided by respondents regarding how food imitations affect the quality of health among adult consumers in the Port Harcourt metropolis was 3.02, with a standard deviation (SD) of 0.58. Specifically, respondents highlighted that food imitation could lead to colon or peptic cancer, as evidenced by a mean rating of 3.30 and an SD of 0.72. Bone marrow abnormality was identified as a concern, with a mean rating of 3.07 and an SD of 0.85, followed by liver or kidney disease, which received a mean rating of 2.97 and an SD of 0.80, among other health issues identified. The statistical analysis presented in Table 4.8 demonstrates a significant difference between the mean ratings provided by male and female adult consumers regarding how food imitations affect the quality of health in the Port Harcourt metropolis (t=8.191, df=555, p=0.00). Consequently, the null hypothesis four was rejected at the 0.05 level of significance.

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Conclusion

The study established that substitution is the most prevalent food imitation in the Port Harcourt metropolis with the least being transshipping. Alcoholic beverages were the food mostly counterfeited and the least were eggs. Food assessment is the best approach to minimizing food imitation and food imitation could lead to peptic or colon ulcer and bone marrow abnormality among others. The subjects however differed significantly over the perceived prevalence of food imitations in the Port Harcourt metropolis; various types of food imitated, strategies to minimize food imitations for optimal health and how food imitations affect adult consumer quality of health in Port Harcourt metropolis. The male adult consumers agreed to with the responses more than their counterparts. The findings imply that food counterfeiting of Economically Motivated Adulteration (EMA) of food is prevalent in the Port Harcourt metropolis. Adult consumers should report any form of EMA observed to law enforcement agencies for urgent action. This would save lives because EMA of food has been found to impact negatively on the health of adult consumers in the study area.

Recommendations

1. All adult consumers should report any act of EMA of food to law enforcement agencies for urgent actions to save lives
2. Consumers should try to assess the food before consumption to detect any form of food imitation or EMA of food
3. The government should try to swing into action by empowering NAFDAC and SON to do their job and minimize the menace.

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Appendices

Table 1: Summary of descriptive statistics on the prevalence of food imitations (or Economically Motivated Adulteration (EMA) of food in Port Harcourt metropolis

SN	Food imitations	Mean	SD	95% CI LB	95% CI UB	Decision
1	Unapproved additive	**3.39**	0.68	3.33	3.44	*
2	Substitution	**3.72**	0.45	3.69	3.76	*
3	Mislabelling	**3.58**	0.57	3.53	3.63	*
4	Counterfeit	**3.37**	0.48	3.33	3.41	*
5	Transhipping	2.55	1.01	2.47	2.64	
6	Origin masking	**3.25**	0.79	3.18	3.31	*
7	Dilution	2.72	1.05	2.64	2.81	
8	IDCP	2.88	1.02	2.79	2.96	
9	Theft and resale	2.86	1.02	2.78	2.94	
10	Others	**3.44**	0.64	3.39	3.49	*
	Grand mean	**3.18**	**0.38**	**3.15**	**3.21**	*

IDCP: *Intentional Distribution of a Contaminated Product* **High Extent*

Table 2: Summary of descriptive statistics on the imitated (counterfeited/adulterated) food in Port Harcourt metropolis

SN	Counterfeited Food	Mean	SD	95% CI Lower	95% CI Upper	Decision
11	Fish and seafood	**3.30**	0.55	3.25	3.35	*
12	Dairy products	**3.25**	0.81	3.18	3.32	*
13	Oils and fats	**3.12**	0.77	3.06	3.19	*
14	Meat products	**3.33**	0.71	3.27	3.39	*
15	Honey/sweeteners	**3.40**	0.53	3.35	3.44	*
16	Grain products	2.89	0.99	2.80	2.97	
17	Infant formula	2.80	1.02	2.71	2.88	
18	Nutraceutical	**3.40**	0.69	3.34	3.46	*
19	Beverages	2.89	0.98	2.81	2.97	
20	Other foods	**3.21**	0.65	3.15	3.26	*
21	Produce	2.80	1.08	2.71	2.89	
22	Alcoholic beverages	**3.44**	0.64	3.39	3.49	*
23	Eggs	2.66	0.85	2.59	2.73	
24	Fruit juices	**3.33**	0.67	3.27	3.38	*
25	Coffee tea	2.88	0.80	2.81	2.94	*
	Grand mean	**3.11**	**0.33**	**3.08**	**3.14**	*

***High extent**

Table 3: Summary of descriptive statistics on the strategies to minimize food imitations for optimal health of adult consumers in Port Harcourt metropolis

				95% CI		
SN	**Solution**	**Mean**	**SD**	**LB**	**UB**	**Decision**
26	Assessment	**3.52**	0.57	3.47	3.56	*
27	Record-keeping	**3.43**	0.57	3.38	3.48	*
28	Training	**3.11**	0.76	3.04	3.17	*
29	Food safety inspection	**3.10**	0.46	3.06	3.14	*
30	Law enforcement	**3.21**	0.74	3.15	3.27	*
	Grand mean	**3.27**	**0.37**	**3.24**	**3.30**	*

Table 4: Summary of descriptive statistics on how food imitations affect adult consumer quality of health in Port Harcourt metropolis

				95% CI		
SN	**Health hazards**	**Mean**	**SD**	**LB**	**UB**	**Decision**
31	Peptic/colon ulcers	**3.30**	0.72	3.24	3.36	*
32	Liver/kidney diseases	2.97	0.80	2.90	3.04	*
33	Heart diseases	2.90	0.99	2.82	2.98	*
34	Blood disorder	2.85	0.85	2.78	2.93	*
35	Bone marrow abnormality	**3.07**	1.07	2.98	3.16	*
	Grand mean	**3.02**	**0.58**	**2.97**	**3.07**	*

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