

Health Hazard of Plastic: Assessing the Knowledge Level Among Street Food Sellers and Customers in Delta State, Nigeria

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Abstract

The use of plastic in food packaging is growing rapidly. Chemical compounds incorporated within the plastic polymer to improve its functionality have been linked to adverse health concerns. This study examines the knowledge status of street food sellers and customers on the human health concerns posed by plastic in food packaging and portion size vending. A simple questionnaire was developed and administered one on one to the target population. Collected data was then subjected to analysis using SPSS version 20. Finding on socio-demographic characterization reveal that 97.3% of the street food sellers ($n = 150$) were female while 68.7% of the customers ($n=150$) were male. The study further reveals that all the street food sellers (100%) use plastic for food packaging or portion size vending while Low-density polyethylene (LDPE) accounts for 58% of the total plastics used. Knowledge status reveals no knowledge of adverse health risk associated with plastic by the food sellers while customer's knowledge level was generally poor although significantly ($p < 0.05$) better compared to that of the street food sellers. Intervention strategies targeted at informing and educating the public on the adverse human health concerns of plastic (principally bisphenol A and Phthalate) and parameters that accelerate the leaching of the chemicals into the food is hereby recommended

Keywords: Plastics, Additives, Packaging, Food, health

Introduction

Street foods account for a significant proportion of affordable daily food consumption and nutrients to the majority of the people across all ages and social strata (Muzaffar *et al.*, 2009; Ossai, 2012). According to FAO (Food and Agriculture Organization) (2007), over 2.5 billion people eat street food every day. In Nigeria, the poor socio-economic realities: hunger, loss of jobs, the high price of goods and services and rising exchange rate has created an unexplainable poll of people who depend mainly on street foods for nutrition (Oladoyinbo *et al.*, 2015; Alimi, 2016)

Notwithstanding the significant role of street food in the provision of instant meals at a relatively low price as well as providing direct employment to the operators, unwholesome activities characterized the whole chain of street food enterprises from raw material purchase to retail activities leading to adverse human health concerns (Alimi and Workneh, 2016). Numbers of factors and activities of the street food operators which predispose street foods to public health risks have been reported in previous studies (Njaya, 2014). However, budding health risk posed by plastic packaging material application in food portion size vending, cooking and packaging by street food vendors are yet to be well investigated

Plastics have revolutionized the packaging industry and its use has increased worldwide with an estimate at 280 metric tonnes (Paine and Paine, 2012). Plastic use in food packaging application is growing in Nigeria, overtaking other packaging materials. The reasons for the growing application are lightweight, resistance to degradation (by chemicals, sunlight and bacteria), durability and above all low cost. Presently, many of the traditional dishes and snacks such rice (white, jollof and fried rice), eba, fufu, beans, soups, yam pottage, tuwo-shinkafa/tuwo masara, puff-puff, coconut candy, chin-chin, akara, meat pie, donkwa, plantain chips, moi-moi, egg rolls, kuli kuli which were previously vended using other packaging materials are presently portion size and packaged using plastic. Furthermore, Most of the foods like Fufu, moi-moi, okpa which were previously wrapped for cooking using leaves of *musa paradisiaca*, *sterculia tragacanta*, *marantochloa cuspidata*, *thespesia populnea* etc are presently wrapped and cooked at high temperature using plastic or packaged or vended at high temperature using plastic. Li *et al* (2016) established a much higher correlation between the leaching of chemicals from plastic packaging materials to food with the temperature

Plastics are made from monomeric building blocks and additives. Polyethylene is the most common types of plastic in use in Nigeria. Polyethylene (PE) comes in high or low density is widely used for packaging, containment, grocery plastic bags, shrink wrap and other unclassified packaging options. Bisphenol A (BHA) is the best known monomeric building block of polycarbonate plastics while phthalates is a plasticizer incorporated into plastics to impart flexibility, pliability, and elasticity to otherwise rigid polymers (Alin, 2012; Miriany *et al.*, 2014). Previous studies have shown that BHA and plasticizer which are Chemical compounds that are incorporated within polymeric packaging materials migrate into the food endangering the quality and safety of the food (Calafat *et al.*, 2005; Bonefeld-Jorgensen *et al.*, 2007). Epidemiological studies have reported significant associations between blood levels of BHA and phthalates with adverse human health and non communicable disease conditions like obesity, endometrial hyperplasia, recurrent miscarriages, polycystic

ovarian syndromes, testicular dysgenesis syndrome, cancer, heart and liver diseases, tumors, thyroid abnormalities, neuroblastoma etc (Kang *et al.*, 2003; Fierens *et al.*, 2012; Halden, 2012; Bhunia *et al.*, 2013; Nazarudin *et al.*, 2014; Li *et al.*, 2016)

With the sheer variety of gastronomy across Nigeria and obvious role of plastic material in virtually all food packaging application; assessing the knowledge of the street food sellers and customers on the human health risk of plastic packaging materials is therefore imperative. Thus, the aim of this study is to assess the usage of plastic in food packaging and knowledge of its health hazard among the street food sellers and customers in Delta State, Nigeria

2.0 MATERIALS AND METHODS

2.1 Study location

The study was undertaken in Delta State, Nigeria. Delta State is one of the 36 States in Nigeria, located in the region known as the South-South geopolitical zone with a population of 4,098,291 (males: 2,674,306; females: 2,024,085). The State lies approximately between Longitude 5°00 and 6°45' East and Latitude 5°00 and 6°30' North with land area of about 16,842km².

2.2 Sampling and data collection

A cross-sectional study was utilized. The study was accomplished over a period of 4 months (February to May, 2018). To ensure adequately representative sampling the State was divided into three zones based on the existing three Senatorial districts in Delta State: North, South and Central. The study used both quantitative and qualitative data collection techniques. Three instruments of data collection were adopted in this study. These were the questionnaire, Focus Group Discussion guide and in-depth interview methods. The major instrument chosen for collecting data for the study was the questionnaire which was complemented with the Focus Group Discussions (FGDs) and in-depth interview methods. This enabled the researcher to ask standardized questions and to collect uniform data from the studied population. Fifteen (15) field assistants were recruited and trained on the methods and objectives of the study. Five of the field assistants were in charge of each Senatorial district under-study. Administered questionnaires were 210, distributed equally amongst the three Senatorial districts. Questionnaires consisted of open and close-ended questions related to the topic of study. A uniform set of questionnaire was administered to all respondents but where the respondents were not literate, the questionnaire was other – administered. The questionnaire was translated into vernacular for those who cannot read or write

2.3 Statistical analysis of data

Questionnaires were sorted out, coded and data entered into excel spreadsheet and analyzed using SPSS software version. Descriptive statistics such as means, frequencies and simple percentages were used to summarize the collected data and present the findings. Chi-square test was used to test association and p-value < 0.05 was considered as a significant association.

3. RESULTS

Table 1 shows socio-demographic characteristics of the respondents. From the finding, 57.3% which represents the highest percentage of the total population of the street food sellers (n = 150) were aged between 30 – 39 years while 39.3% of the customers which represents the highest percentage of the age customers were ranged between 18-29 years. Sex distribution of the respondents shows that 97.3% of the street food sellers were female while 68.7% of the customers were male. Educational profile of the studied population shows that a little over half (51.3%) of the street food sellers have uncompleted secondary school education while 58% of the customers completed secondary school education. Respondent marital status reveals that greater proportion of the street food sellers (45.3%) were married 45.3% while a greater proportion of the customers (40.7%) were not married

Table 2 shows material types used for portion size serving and packaging or take away packs the food sellers. Findings in Table 2 show that 100% of the food sellers use plastic materials for portion size serving and packaging of food.

Table 3 shows that 58% of the food sellers use Low-density polyethylene (LDPE) for portion size food packaging and take away packs while Styrofoam (polystyrene) represents 26% of total plastics in used for portion size vending or take away packs by the street food sellers

Table 4: depicts the knowledge profile of plastic food packaging on human health amongst the street food sellers and customers. Findings show that 100% of the street food sellers and 74% of the customers have zero knowledge that plastic packaging's materials contain chemical additives while 15.3% of the customers indicate knowledge. 100% of the food sellers and 81.3% of the customers have no knowledge that the chemical additives in plastic packaging material pose a human health risk while 8.7% indicates knowledge. 89.3% of the food sellers and 59.3% of the customer indicate no knowledge that wrapping of hot food or cooking or boiling of food using plastic packaging poses a health risk while 10.7% indicates knowledge. The food sellers and customers

indicate no knowledge that washing of plastic packaging material repeatedly with soaps and reusing it for food packaging or serving accelerate leaching of chemicals into the food while the street food sellers indicate zero knowledge with only 4% of the customers having knowledge that chemical additives in plastic packaging cause an adverse human health risk

Table 5 shows the knowledge level of a specific disease associated with the use of plastics in food packaging among the studied population. Finding on the knowledge level of the studied population on specific diseases associated with the use the plastic in food packaging indicates that 100% of the street food sellers could not name any diseases while 12.7% of the customers showed poor knowledge with all the respondents identifying cardiovascular disruption as the associated disease

4.0 Discussion

Food safety, nutrition and food security are inextricably linked as unsafe food create a vicious cycle of disease and human health hazards (Mizanor *et al.*, 2012) Street foods ranging from traditional meals, snacks and beverages are presently portion sized or vended and packaged prior to consumption using plastic materials. Thus with the growing scientific evidence that even at low level of exposure chemicals additives (bisphenol A and phthalates) added to plastics to give it the right mechanical properties poses human health hazard (Halden, 2012), this study was thus structured to find out the possible knowledge status of health hazards associated with the use of plastics material in food packaging and portion size vending

Age and sex distribution reveal that majority of the street food sellers 86 (57.3%) were within the age range of 30 - 39 years while the majority of the customers 59 (39.3%) were aged between 18 – 29 years. This result was in line with the finding of Zain and Naing (2002) and Smith *et al* (2010). The result is further corroborated by age and sex dynamics from a similar study which reported women within the age range of 25 to 45 years accounted for 90% of street food sellers in Accra, Ghana (<http://www.empowerwomen.org>). Sex-specific distribution of the street food sellers shows significantly different ($p < 0.05$) disproportionate percentage of male (4.7%) and female (95.3%). Njaya (2014) also reported that women predominate in street food vending enterprise representing above 85 percent of the vendors. This confirmed earlier study by Chung *et al* (2010) that 82% of the street food business in Bangkok is owned and operated by women

The finding that 100% of street food sellers use plastic packaging materials for food portion size packaging or take away packs or convenience retail pack is a confirmation of earlier report that food packaging application of plastic materials have increased worldwide (Paine and Paine, 2012) and revolutionized our daily lifestyle as food such as cooked rice and beans and other delicacies which were formally served with leaves or glass or metal plates have been replaced by plastic material. The significantly different ($p < 0.05$) use of plastic far above other packaging materials may be attributed mainly to its low cost to performance ratio, lightweight, shatter resistant and good barrier properties (Raheem, 2012; Ayuso *et al.*, 2016).

Polyethylene (PE), from Table 3 is the most widely used plastic or polymer by the street food sellers as the LDPE accounted for 58% of the total plastic used for food packaging application. The extensive and significantly different ($p < 0.05$) use of LDPE (low-density polyethylene) compared to other plastic packaging material types may be attributable to low cost: performance ratio, good flow, good thermal stability, broad density range, high clarity, excellent organoleptic properties and chemical resistance (Ayuso *et al.*, 2016). This study confirms an earlier report in Accra, Ghana that LDPE followed by styrofoam packs forms the preferred containers for takeaway food like rice, porridge or stew (www.modernghana.com/lifestyle/3733). The preference for LDPE (low-density polyethylene) followed by Styrofoam by the street food sellers found in this study was low price, easy availability, light weight and convenience. The trend observed in this study is in agreement with previous report on the usage of plastic done in an urban area of Ethiopia by Adane and Muleta (2011).

The Low knowledge level reflected in this study may be partly tied to the participant's poor educational status, as only 6.7% of the street food sellers had a tertiary education, while over 93.3% were below the tertiary level of education. Also, 23.1% of the customer had a tertiary education while 76% of the customer's educational status was below the tertiary level of education. Poor knowledge among the people has been reported as the leading cause of many human health challenges and morbidity and mortality in Nigeria (Ossai, 2017). This study is inconsistent with the high awareness level (74.5%) on health hazard associated with the use of plastics among housewives in Delhi, India (Abhigyan, 2008). Although in Nigeria, there is a paucity of data with regard to awareness of health hazards of plastic used for food packaging among the general population; the finding is consistent with previous studies on food safety knowledge and practices among food vendors (Oladoyinbo *et al.*, 2015; Nne, 2017). For example, 100% of the street food sellers have no knowledge that plastic packaging materials contain chemical additives and that the additives pose human health risk while the knowledge level amongst the customers of 15.3% and 8.7% respectively were also abysmally low although indicated a significantly different measure compared to the zero level of the street food sellers ($p < 0.05$). Chemical additives are monomeric ingredients (e.g. reinforcing fibers, fillers, and coupling agents; plasticizers; colorants; stabilizers, processing aids, flame retardants and antistats)

Compounded with the pure harmless form of plastic polymer to imparts desired functionalities, improve their processing and end-use performance (Bonefeld-Jorgensen *et al.*, 2007; Halden, 2012).

In the same context, 89.3% of the food sellers and 59.3% of the customer have no knowledge that wrapping of hot food or boiling food or cooking of food using plastic is hazardous to human health. Previous studies by Kang *et al.*, 2003 and Hourieh *et al.* 2008 reported that leaching of monomeric building blocks (e.g., bisphenol A), additives (e.g., plasticizers or anti-microbial-polycarbonate) are accelerated at elevated temperature. According to Bhunia *et al.* (2013) Chemical migration from plastic food packaging is affected by a number of parameters including the nature and complexity of food, the contact time and temperature of the system, the type of packaging contact layer, and the properties of the migrants; however Li *et al.* (2016) established a much higher correlation between leaching or migration of chemicals from plastic packaging materials to food with temperature and that the effect of temperature on the diffusion coefficients followed an Arrhenius-type model with active energies ranged from 40.4 to 113.8 kJ mol⁻¹ for the target compound. Temperature role in accelerated leaching of chemicals in plastic packaging materials is further supported by previous study by Taksuga *et al.* (2007). This finding presents major public health concerns in view of the future risk of developing diet-related chronic diseases. Thus, given the rapidity with which traditional diets have been adapted to suit the emerging fast food style and the growing consumer interest in ready-to-serve foods packed in plastic material, the future disease burden with its attendant co-morbidities - heart disease, hypertension, stroke, diabetes, cancer etc present a major healthcare challenges notably in Nigeria where knowledge and awareness level is poor as shown in Table 1

Majority of the subjects (100% for street food sellers and 87.3% for the customers) in this study have no knowledge of any specific disease caused by leaching of plastic additives into food while only 12.7% of the customers indicated poor knowledge of specific disease caused by plastic additives. Epidemiological studies have found associations between major chemicals in plastic principally bisphenol A and phthalates (monomeric building blocks (bisphenol A – monomeric building block and phthalates a plasticizer incorporated into plastics to impart flexibility, pliability, and elasticity to otherwise rigid polymers) and impaired health like obesity, endometrial hyperplasia, recurrent miscarriages, polycystic ovarian syndromes, testicular dysgenesis syndrome, cancer, heart and liver diseases, tumors, thyroid abnormalities, neuroblastoma etc (Halden, 2012, Bhunia *et al.*, 2013; Nitin *et al.*, 2016; Li *et al.*, 2016). Notwithstanding the poor knowledge level of customers, p-value ($p < 0.05$) indicated significant differences compared to the zero-knowledge status of the food sellers. The significant difference ($P < 0.05$) better knowledge level of the customers compared to no knowledge level of the food sellers may be attributed to the educational status of the customers - 21.3% compared to street food sellers - 6.7% having tertiary education.

5.0 Limitation

The finding of this study is limited to Delta State and hence cannot be generalized to the entire nation.

6.0 Conclusion

This study established that (a) plastic plays a huge role in portion size packaging of foods (b) knowledge level of the studied population about the human health risk concerns associated with the diverse application of plastics for food packaging and portion size vending of ready to eat foods was generally poor. Thus, with the increasing role of plastic material in food packaging and portion size of ready to eat foods; behavioral intervention strategies targeted at informing and educating the public on the adverse human health concern of plastic principally linked to the leaching of bisphenol A and Phthalate presents cost-effective possibility aimed primarily at knowledge and awareness sufficient to influence health behavior

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Table 1: socio-demographic characteristics of the respondents (street food sellers and customers)

Variables	Respondents					
	Food sellers (Sex)			customers (Sex)		
Age range	Food sellers	Consumers	Female	Male	Female	Male
Below 18 years	0 (0%)	17(11.3%)	0%	0%	6 (4%)	11 (7.3%)
18 – 29 years	18(12%)	59 (39.3%)	18(12%)	0%	21(14%)	38(25.3%)
30 – 39 years	86(57.3%)	42 (28%)	82(54.7%)	4(2.7%)	15(10%)	27 (18%)
40 – 49 years	31(20.8%)	22 (14.7%)	31(20.8%)	0%	5 (3.3%)	17(11.3%)
50 years and above	15 (10%)	10 (6.7%)	15 (10%)	0%	0%	10 (6.7%)
Total	150 (100%)	150 (100%)	146(97.3%)	4 (2.7%)	47(33.3%)	103(68.7%)
Educational status						
None/primary	(0%)	19(12.7%)	0%	0%	8 (5.3%)	11(7.3%)
Uncompleted secondary school	77 (51.3%)	41 (27.3%)	74 (49.3%)	3 (2%)	7 (4.7%)	34(22.7%)
Completed secondary school	63 (42%)	58 (38.7%)	63 (42%)	0%	11(7.3%)	47(31.3%)
Diploma/University degree	10 (6.7%)	32 (21.3%)	10 (6.7%)	0%	9 (6%)	23(15.3%)
Marital status						
Single	41 (27.3%)	61(40.7%)	38(25.3%)	3 (2%)	17(5.3%)	53(35.3%)
Married	68(45.3%)	54(36%)	68(45.3%)	0%	8 (11.3%)	37(24.7%)
Divorced/separated	22 (14.7%)	23 (15.3%)	22(14.7%)	0%	6 (4%)	17(11.3%)
Widowed	19 (12.7%)	12 (8%)	19(12.7%)	0%	4(1.3%)	15 (10%)

Table 2: Types of materials used for portion size vending and take away pack by street food sellers

Variables	Food sellers (%)
Paper	0 (%)
Leaves	0 (0%)
Plastic	150 (100%)
Metal/foils	0 (%)
Breakables	0 (0%)

Table 3: Types of plastics used for portion size vending or take-away pack

Variables	Food sellers (%)
LDPE	87 (58%)
HDPE	24(16%)
Styrofoam (polystyrene) pack	39 (26%)
Others	Nil

Table 4: knowledge of human health risk of plastic material use for food wrapping and packaging

Variables	Food sellers (n=150)	Customers (n=150)
Knowledge that plastic packaging materials contains chemical additives		
Yes	Nil	23 (15.3%)
No	150 (100%)	111(74%)
Not sure	Nil	16 (10.7%)
No answer	Nil	Nil
Total	150 (100%)	150 (100%)
Knowledge that the chemical additives in plastic packaging materials poses human health risk		
Yes	Nil	13 (8.7%)
No	150 (100%)	121(81.3%)
Not sure	Nil	15 (10%)
No answer	Nil	Nil
Total	150 (100%)	150 (100%)
Knowledge that wrapping of hot food or cooking or boiling of food using plastic packaging materials poses health risk		
Yes	Nil	16 (10.7%)
No	134 (89.3%)	126 (84%)
Not sure	16 (10.7%)	8 (5.3%)
No answer	Nil	Nil
Total	150 (100%)	150 (100%)
Knowledge that chemical migrates from the plastic packaging's into the food		
Yes	Nil	23 (15.3%)
No	143(95.3%)	111 (74%)
Not sure	7 (4.7%)	9 (6%)
No answer	Nil	7 (4.7%)
Total	150 (100%)	150 (100%)
Knowledge that cooking in plastic/wrapping food while hot in plastic packaging materials is hazardous		
Yes	Nil	10 (6.7%)
No	119 (79.3%)	97 (64.7%)
Not sure	22 (14.7%)	39 (26%)
No answer	9 (6%)	4 (2.6%)
Total	150 (100%)	
knowledge that chemical additives in plastic packaging's can be linked to reproductive and human developmental disruption		
Yes	Nil	6 (4%)
No	150 (100%)	126 (84%)
Not sure	Nil	16 (10.7%)
No answer	Nil	2 (1.3%)
Total	150 (100%)	150 (100%)

Table 5: knowledge level of specific disease associated with the use of plastics in food packaging among the studied population

Knowledge level	Respondents	
	Food sellers	consumers
None	150 (100%)	131(87.3%)
Poor < 2	Nil (0%)	19 (12.7%)
Fair > 3	Nil (0%)	0 (0%)
Good > 4	Nil (0%)	0 (0%)