

## Awareness of pesticide residues in locally available food and condiments among food sellers: a case study of Osun state, Nigeria

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### Abstract

The specific objectives are: i) to determine the level of awareness of pesticide residue in locally available food among food sellers in Ile Ife area of Osun state, Nigeria; ii) to identify the demographic and socio-economic characteristics of food sellers who use pesticides, natural means in preserving their foodstuff from getting spoiled; iii) to determine the level of understanding of food sellers who use pesticides about the likely health implications that could result. The design of the study is cross sectional. Structured open-ended questionnaires were administered to 98 randomly selected food sellers in Ile Ife area Osun state, Nigeria. This includes males and female. The inference from the study shows that majority of the food sellers were between ages 21 and 30 years, suggesting that more of the young people are involved in the selling of foodstuff in the area of study. Most of the food sellers used phostozin, an organophosphate compound as preservatives for cereals. The majority of those that were aware of the health hazards associated with the usage of pesticides as preservative were literate school leavers. Among respondents to the questionnaire, it was expected that many of those food sellers likely to demonstrate caution in the usage of pesticide would be the literate school leavers. This is because they are more aware of the possible associated health hazards than their fellow food sellers who are not literate. The level of awareness of health implications associated with use of pesticides on consumable food items is higher among school certificate holders who are food sellers. Phostozin, an organophosphate, is a common preservative pesticide used on cereals foodstuff (e.g., bean, rice, maize) in the area of study, especially among the age group between 21 and 30 years.

### Introduction

The use of pesticides as preservatives of locally available foodstuffs is a common practice among farmers and food sellers in both

developing and developed countries.<sup>1</sup> A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest.<sup>2</sup> A pesticide may be a chemical substance, biological agent (such as a virus or bacterium), antimicrobial, disinfectant or device used against any pest.<sup>2</sup> Pests include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, spread disease or are a vector for disease or cause a nuisance.<sup>3</sup> Pesticides are used by farmers to prevent fungal invasion, insect damage, and the growth of unwanted (and often poisonous) plants. This has a positive benefit in terms of public health because fungi, insects and non-crop plants can contaminate crops with many natural toxins injurious to health.<sup>3</sup> Pesticides are probably one of the most regulated chemical products used in developed countries such as US with high standard of compliance in their applications.<sup>4,5</sup> The case may not always be the same in developing countries with poor infrastructures and storage facilities to maintain the active lifespan of the chemicals. Several major organizations regulate the use of pesticide. These organizations include the Environmental Protection Agency, The Food and Drug Administration and the Department of Agriculture of each nation. Despite the many regulations, pesticide residue is found in our food supply.<sup>4,5</sup> Regular food production and its preservation is central to sustainability of adequate food security. Nigeria, a developing country with about 140 million people by the census of 2006,<sup>6</sup> has many of the farmers as workforce producing food mainly in the rural areas of the country.<sup>6</sup> Most foodstuffs produced are sold to food sellers, who serve as middle men between the farmers and the actual consumers. These are preserved by the food sellers with various pesticides from insects which could easily spoil them. Pesticides are a category of chemicals formulated to kill or repel a pest or halt its reproduction.<sup>7</sup> There are potential health risks associated with pesticides. Pesticide residues in consumable foodstuffs can have long term health effect in humans. According to Environmental Protective Agency in Canada chemical pesticides disrupt the human nervous system by interfering with a neurotransmitter called acetylcholine among other side effects.<sup>8</sup> Consequently, to maintain optimal health of a nation, attention must be given to how well foodstuffs sold for public consumption are preserved, minimizing the health risks that could arise from accumulated pesticides residue. Not many studies have been done in this area in Nigeria as a developing country striving to be self sufficient in food production while still relying heavily on imported food items, in order to meet the

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demand of the increasing population. In Nigeria, awareness of the health implications associated with pesticide residues in foodstuffs sold to the public by food sellers is an issue that needs to be addressed to minimize the health challenges resulting from their consumption. It could be recalled that a popular newspaper (Vanguard newspaper) reported a pathetic case of an outbreak of health problem in Edo State (Nigeria), following consumption of beans meal. It was revealed that the beans sold to the public was contaminated with gamalin 20 a popular pesticide used in Nigeria as a preservative.<sup>9</sup> Twenty eight victims were said to have reported at the central hospital for treatment after consuming the contaminated beans. Consequently the state government constituted a six man committee to investigate the matter.<sup>9</sup> What people eat affect their health. For the economy of any developing nation to withstand and survive the wind of economic depression, proper attention must be put in place to ensure a healthy workforce.<sup>5</sup>

Health as a sector in Nigerian economy is like a strong tap root, supporting and reinforcing the entire economy of the nation as a whole. Hence awareness of health implications that could arise from the use of harmful chemicals as preservatives in locally available food cannot be overlooked. Some of the threats to health posed by the use of pesticides as preservatives may well be relevant to other Africa countries. Further studies about the awareness of health hazards associated with the use of pesticides become justified due to noticeable diseases associated with the consumption of foodstuff preserved with pesticides. Diseases such as neurological illness amongst which are Alzheimer's dementia, motor neuropathies, multiple sclerosis, autism

and other learning disabilities in children, Parkinson's diseases, elevated blood pressures, cardiac arrhythmias, cardiomyopathies, allergies, osteoporosis, cancers, autoimmune diseases are associated with the effect of pesticides among humans as reported in a Canadian study.<sup>8</sup>

Food quality and safety depend on sound agricultural practices including appropriate use of pesticides and control of post harvest chemical use. Food safety and quality hygiene, food processing and correct handling by food sellers and consumers are essential to good nutrition.<sup>10</sup>

Some of the pesticides commonly used in Nigeria as preservatives are gammalin 20, an organochlorine insecticide on kola nuts, which has been reported to cause cancers among humans<sup>11,12</sup> and phostoxin, an organophosphate pesticide used to preserve cereals like maize, beans, rice, etc. Other pesticides used in developed countries are: thiabendazole (in treating potatoes), tecnazene, chlorporpham, dichlorodiphenyltrichloroethane.<sup>11,12</sup> Some researchers have substantiated the fact that a positive effect of the use of pesticide as preservatives contributes to the longevity of such foodstuffs from getting damaged by insects, pests and diseases.<sup>13</sup> Every effort must be made to ensure that the application is safe and more importantly to ensure safety for humans and environmental health as studied by Sam Kacew *et al.*<sup>14</sup> This paper examined the level of awareness about the health implications associated with pesticides residue in locally available foodstuffs among food sellers in Nigeria.

## Materials and Methods

### The study area

The study was carried out in Ile Ife, a city located in Osun state in the Southwestern Nigeria, which is one of the six geopolitical zones. There is a Federal University in Ile Ife named Obafemi Awolowo University with an allied Teaching Hospital. Osun state was created from old Oyo state in 1991. Ile Ife has an estimated population of about 850,000 people. Osun state has a population of about 3,423,535 people as reported by the national census of 2006.<sup>6</sup> Majority of the indigenes are Yorubas. There is a main market where various foodstuffs such as rice, beans, maize, yams, vegetables, kola nuts, etc are sold to the public in the town of Ile Ife. There is also an annex of the market at the Obafemi Awolowo University campus in Ile Ife where the same foodstuffs are equally being sold. The food sellers at the main market and those in the university campus share the same characteristics except in

population size. Food sellers in the main market are more in number compared with those on the University Campus.

### Sample size and sample selection

The study design was a cross sectional study. The target population for the study was food sellers in Nigeria. Two market centers were purposively selected namely the main market at the heart of Ile Ife town and the annex (mini) market located in the university campus of Obafemi Awolowo University Ile Ife. The distance between the two markets is about 8 km. The two locations were selected based on the geographical centrality and accessibility.

Seventy three food sellers were selected from the main market in town and 25 respondents were selected from the mini market on campus of Obafemi Awolowo University, Ile Ife by convenience sampling method. Facilitated self administered, closed ended structured questionnaires were used to collect data after obtaining verbal consents from the respondents. The questionnaires were duly pretested before they were employed to elicit information from the respondents in the study area. Thus a total of 98 foodstuff sellers were interviewed for the study.

### Definition and measurement of variables

Two categories of variables were involved in the study: the dependent and independent variables.

#### Dependent variables

The dependent variable employed in this study was level of awareness of the health implications of pesticide residue in locally available foodstuffs commonly sold by the respondents. A negative response *no* indicated that the respondents were unaware of any health hazards associated with pesticide residue, while a positive answer *yes* indicated that respondents were aware of associated health risks of pesticide residues in foodstuffs sold commonly in the study area.

#### Independent variables

These include the socio-demographic characteristics of the respondents such as age, religion, level of education and sex.

The interview scheduled used for the study was pre-tested on 5 randomly selected food sellers outside the actual respondents used for the study, who shared similar characteristics with other food sellers in Ile-Ife area, in terms of their background and exposure in foodstuff marketing.

The data collected for the study was subjected to both descriptive and inferential statistical analysis using Statistical Package for Social Sciences (SPSS) version 16.

## Results

### Socio-demographic characteristics

The inference from Table 1 shows majority of the food sellers to be between ages 21 and 30 years (31.6% of the total number of respondents), suggesting that more of the young people are involved in selling foodstuff in the area of study. The next age group with more food sellers is between 31-40 years (22.5%). Most respondents were females (78.6%) as against male food sellers (21.4%). Not many males make foodstuff selling an occupation in the study area. The majority of food sellers in the study area are Christians (72.5%). From Table 1 the percentage of people who engage mostly in the business of foodstuff selling are secondary school certificate leavers (42.9%). National Certificate of Education holders (3.1%) constitute the least percentage of people who engage in the occupation of food selling in the study areas.

### Means of food preservation

Figure 1 shows that phostoxin was the pesticide mostly used by food sellers used against insects, which infest stored food commodities, and to control burrowing pests. The active ingredient in phostoxin pesticide is aluminum phosphide (55.0%). The inert ingredient is

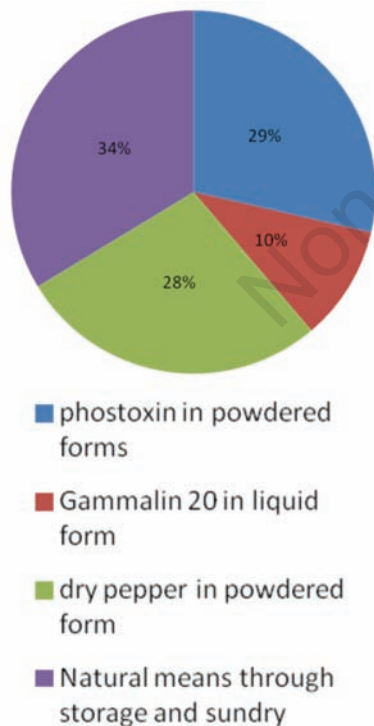
Table 1. Socio-demographic characteristics of respondents.

Characteristics	Frequency (n.)	Percentage (%)
Age (Years)		
<21	11	11.2
21-30	31	31.6
31-40	22	22.5
41-50	19	19.4
51-60	14	14.3
>60	1	1.0
Total	98	100
Gender		
Male	21	21.4
Female	77	78.6
Total	98	100
Religion		
Christian	71	72.5
Islamic	27	27.5
Total	98	100
Level of education		
Illiterates	25	25.5
Primary school certificate holders	24	24.5
Secondary school certificate holders	42	42.9
National certificate of education	3	3.1
Degree holders	4	4
Total	98	100

45%.<sup>15</sup> It is used as a preservative on cereals, such as beans, rice, maize, etc.; it is even referred to as *rice tablet*.<sup>15</sup>

It was reported by some of the food sellers that foodstuffs treated with pesticides were kept for a period of 3 to 5 months, at which time the concentration of such pesticide would have reduced below toxic level before they are brought out for sale to consumers. Compliance to this directive still needs to be explored. Twenty-nine percent of respondents use phos-toxin as preservatives, while ten percent use gammalin 20 as preservatives of kola nuts. Twenty-eight percent of respondents use dry pepper in powdered form as preservatives on cereal foodstuffs for not being damaged by insects. Though this is not a common method of food preservation in the developed world, yet foodstuffs preserved this way have no risk of harmful chemical pesticide residues. The drawback is that the method cannot be effective on a large scale of foodstuff preservation.

Thirty four percent of respondents use natural storage of foodstuffs such as yams, cocoyam, sweet potatoes, etc. This method is also not common when compared with the developed countries using pesticides like thiabendazole to preserve their tuber food stuffs.<sup>11</sup>



**Figure 1.** Means of preserving foodstuffs from getting spoilt as reported by respondents.

## Level of awareness of health implications of pesticide residues in locally available foodstuff

The respondents demonstrated a sense of awareness of the possibilities of health hazards associated with consumption of foodstuffs with considerable pesticide residues (Table 2).

A larger percentage of food sellers who were illiterates (84%) demonstrated ignorance of health hazards associated with pesticide residues on foodstuffs they sell to consumers. On the contrary, a larger percentage of food sellers who are degree holders showed they were aware of the possibilities of health hazards associated with the consumption foodstuffs with pesticide residues.

## Discussion

It is worthy of note that the largest number of those engaged in foodstuffs selling fall within the age group of 21-30 years (31.6%). This shows that young adult who probably fall within the category of secondary school leavers were engaged in food selling in the area. Most food sellers who leave secondary school without a good certificate, or who have not been able to gain admission to higher education institutions, engage in non-skilled occupations, such as food selling, until they can go on to further education or find more lucrative jobs. It was observed that most of the food sellers were females. This is in consonance with a study in Haiti showing that most women were involved in selling foodstuff in the market especially in the rural areas.<sup>16,17</sup> Most of the women who were not employed in the public service or in any private organization take interest in opening their private shops where they sell foodstuffs to consumers. Women contribute to the sustenance of their families through these ventures. In most developing countries especially in rural areas, the males engage in farming to produce foodstuffs,

which are taken by female folks for sale in the markets. It was observed that there was a higher percentage of respondents among the well educated (degree holders; 75%) demonstrating awareness about health hazards associated with pesticide residues than those with lesser or no education. Only very few food sellers who were educated demonstrated ignorance of health implications associated with pesticide residues in foodstuffs when consumed. It could be concluded that education has a positive influence in creating awareness among food sellers about the health hazards associated with the use of pesticides as preservatives of foodstuffs in the area.

This is in consonance with a study carried out in India showing that the level of education contributes to increase knowledge and awareness of health risk associated with consumption of foodstuff with pesticide residues.<sup>18</sup> The educated respondents most likely take better precautions in strict compliance to directives when applying pesticides as preservatives than the less educated. In the study, only a small percentage of respondents (7.1%) were well educated with certificates from tertiary institutions. Most well educated people take the job of foodstuff selling for a menial one.

There was however no report from the respondents that any consumer of the foodstuff they sell ever presented with symptoms shortly after eating food items sold to them. This reflected that they were aware of the possible immediate risks that could occur when foodstuff with accumulated pesticide residues are consumed, but they were ignorant of the long-term effect of the bound fraction on the human body tissues by the residues of this chemical. The work done by Sam Kacew *et al.*<sup>14</sup> on the bio availability of bound pesticides residue and potential toxicological consequence showed that the toxicological consequences of gammalin 20 pesticides residue fraction could pose health hazard on human beings upon consumption, causing carcinogenic changes over time because of the covalently bound fraction on the tissues.<sup>14</sup> The gen-

**Table 2.** Awareness of health hazards associated with pesticide residue in foodstuffs by the level of respondents' educational status.

Level of education	Respondents aware of any health hazards (Yes: n.; %)	Respondents unaware of health hazards (No: n.; %)	Total (n.; %)
Illiterates	4; 16.0	21; 84.0	25; 100
Primary school certificate holders	13; 54.2	11; 45.8	24; 100
Secondary school certificate holders	21; 50.0	21; 50.0	42; 100
National certificate of education holders	2; 66.7	1; 33.3	3; 100
Degree holders	3; 75	1; 25.0	4; 100
Total	43; 43.9	55; 56.1	98; 100

$\chi^2$  value=10.0; P-value=0.265.

eral symptoms that could result from acute poisoning of ingested pesticide residues in foodstuffs as studied by Sam Kacew *et al.*<sup>14</sup> are vomiting, respiratory distress, nausea, abdominal cramps, coma, etc.<sup>14</sup>

The two major pesticides used by the respondents in the study area were phostoxin and gammalin 20. Twenty nine percent of respondents used phostoxin and ten percent used gammalin 20 respectively as pesticides for preserving their foodstuffs. Phostoxin was applied on bags containing cereal foodstuff by direct spraying. This is in consonance with a well documented study on insect, mites and moulds in farm store in Canada that showed how phostoxin was used on grains but the application was in pellet forms as against the powdered form used in the study area.<sup>19</sup> Gammalin 20, a liquid pesticide was sprayed on kola nuts as reported by few respondents (10%) in the study area. This is in consonance with a study conducted in Ghana that showed the use of gammalin 20 in the preservation of raw kola nuts before exporting them.<sup>20</sup> These pesticides have their health hazards when there is significant residue in foodstuff as reported in the incidence of gammalin 20 used for beans preservation which when eaten resulted in health problems in Edo state, Nigeria.<sup>9</sup>

Most of the foodstuffs consumed in the study area are cereals such as rice, beans, maize, guinea corn, etc., tubers such as yam, cocoa yams, sweet potatoes, etc. It is worthy of note that twenty eight percent of respondents use dry pepper in powdered form as preservatives on cereal foodstuffs from being damaged by insects. Dry pepper does not contain any known harmful chemical ingredient that could be as harmful as chemical pesticide to humans. Though this method is not popular in the modern age, yet foodstuffs preserved this way have no known health risks when compared with synthetic chemical pesticides. The drawback is that the method cannot be effective on a large scale for foodstuff preservation. Most food sellers who used this method operate on a small scale. This is contrary to what operates in the developed world as reported by Lewis *et al.* that chloropham is used as pesticides to preserve their cereal foodstuffs.<sup>13</sup>

Thirty four percent of respondents use natural method of storage in barns and sundry to repel insects on tuber foodstuffs such as yams, sweet potatoes, etc., in the study area. This perhaps may account for the reason why a larger percentage in the study areas were not aware of the risks associated with pesticides usage. However it carries no risks of pesticides effect when such foodstuffs are consumed. This is not a popular method of food preservation in the developed countries. This is a poor method of preserving foodstuffs especially in developing countries with poor environmental

hygiene and climatic conditions that favors the proliferation of insects. In most developed countries as reported by Lewis *et al.*, pesticides such as thabendazole and techazene are used as preservatives of tuber foodstuffs such as potatoes and yam.<sup>13</sup>

The use of synthetic chemical pesticides in developing countries as preservatives is less advanced when compared with the developed world as observed in a study by Shepherd.<sup>21</sup> Consequently majority may not be well informed of the health risks associated with the consumption of food items with pesticide residues as reported from the study areas.

Despite the concerns about health implication associated with pesticide residues the advantages of the use of pesticides, as preservatives cannot be over emphasized. However it must be emphasized that not all food sellers in the study area have access to pesticides due to low socio-economic factors. The fact remains that most of the food producers at the farm levels are peasant farmers who may not have access to modern methods of foodstuff preservatives with pesticides. This could possibly account for the reason why some of the respondents choose to use natural means to preserve their foodstuffs instead of purchasing expensive chemical pesticides as preservatives.

## Conclusions

Majority of food sellers are still very much unaware of the health hazards associated with pesticides residue in foodstuff sold in the study area despite reported cases of health problems arising from consumption of food with pesticides residues in Nigeria. This is a public health challenge that should be addressed most especially that the effect of this residue may not be expressed immediately on the consumers. Some of the effects manifest a chronic long term diseases such as cancers, neurological effects, birth disorders, etc. Regular public enlightenment campaign especially among food sellers will go a long way to address the possible problems that could arise due to poor knowledge about the health hazards associated with pesticide residues in highlighted foodstuffs consumed by teeming masses of people in Nigeria. In conclusion this study showed that the level of awareness of health implications associated with the use of pesticides on consumable food items is higher among school certificate holders who are food sellers.

No chemical pesticides are used on yams, potatoes and onions in the area of study, except that they are preserved by natural sundry and storage in well ventilated places. Phostoxin is a common preservative pesticide

used on cereals foodstuff, *e.g.* bean, rice, maize in the area of study, especially among the age group between 21 and 30 years. Gammalin 20 is a pesticide used by kola nut sellers as preservatives in the area of study.

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