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

Samson Ayo Deji
Department of Community Health, Obafemi Awolowo University Teaching Hospital Complex, Ile Ife, Nigeria

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 spoilt; 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. A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacterium), antimicrobial, disinfectant or device used against any pest. 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. 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. 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. 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 pesticides. 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. 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, has many of the farmers as workers producing food mainly in the rural areas of the country. 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. 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. 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 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. 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. 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. 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. 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.

Some of the pesticides commonly used in Nigeria as preservatives are gammain 20, an organochlorine insecticide on kola nuts, which has been reported to cause cancers among humans11,12 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), tecnazine, chlororpam, dichlorodiphenyltrichloroethane.11,12 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.13 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.14 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 2006.6 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 town of Ile Ife. There is also an annex of the University Campus in Ile Ife where the same foodstuffs are sold commonly in the study area. 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.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency (n.)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;21</td>
<td>11</td>
<td>11.2</td>
</tr>
<tr>
<td>21-30</td>
<td>31</td>
<td>31.6</td>
</tr>
<tr>
<td>31-40</td>
<td>22</td>
<td>22.5</td>
</tr>
<tr>
<td>41-50</td>
<td>19</td>
<td>19.4</td>
</tr>
<tr>
<td>51-60</td>
<td>14</td>
<td>14.3</td>
</tr>
<tr>
<td>&gt;60</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>21.4</td>
</tr>
<tr>
<td>Female</td>
<td>77</td>
<td>78.6</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christian</td>
<td>71</td>
<td>72.5</td>
</tr>
<tr>
<td>Islamic</td>
<td>27</td>
<td>27.5</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>Level of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterates</td>
<td>25</td>
<td>25.5</td>
</tr>
<tr>
<td>Primary school certificate holders</td>
<td>24</td>
<td>24.5</td>
</tr>
<tr>
<td>Secondary school certificate holders</td>
<td>42</td>
<td>42.9</td>
</tr>
<tr>
<td>National certificate of education</td>
<td>3</td>
<td>3.1</td>
</tr>
<tr>
<td>Degree holders</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
</tbody>
</table>
45%.\textsuperscript{15} It is used as a preservative on cereals, such as beans, rice, maize, etc.; it is even referred to as rice tablet.\textsuperscript{15}

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 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 thiaben-diazole to preserve their tuber food stuffs.\textsuperscript{11}

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.\textsuperscript{16,17} 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.\textsuperscript{18} 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.\textsuperscript{14} 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.\textsuperscript{14} The gen-

![Figure 1. Means of preserving foodstuffs from getting spoilt as reported by respondents.](image-url)

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

\(\chi^2\) value=10.0; P-value=0.265.
eral symptoms that could result from acute poiso-
ning of ingested pesticide residues in food-
stuffs as studied by Sam Kacew et al.14 are
vomiting, respiratory distress, nausea,
abdominal cramps, coma, etc.14

The two major pesticides used by the
respondents in the study area were phospho-
tin and gammalin 20. Twenty nine percent of
respondents used phosphotin and ten percent
used gammalin 20 respectively as pesticides
for preserving their foodstuffs. Phosphotin 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 phosphotin was used on grains but the
application was in pellet forms as against the
powdered form used in the study area.13
Gammalin 20, a liquid pesticide was sprayed
on kola nuts as reported by few respondents
(10%) in the study area. This is in conso-
rance with a study conducted in Ghana that
showed the use of gammalin 20 in the preser-
vation of raw kola nuts before exporting
them.20 These pesticides have their health
hazards when there is significant residue in
foodstuff as reported in the incidence of gam-
malin 20 used for beans preservation which
when eaten resulted in health problems in
Edo state, Nigeria.9

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 foodstuffs as preser-
vatives 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 com-
pared with synthetic chemical pesticides. The
drawback is that the method cannot be effec-
tive on a large scale for foodstuff preservation.
Most food sellers who used this method oper-
ate on a small scale. This is contrary to what
operates in the developed world as reported by
Lewis et al. that chloropaham is used as pesti-
cides to preserve their cereal foodstuffs.11

Thirty four percent of respondents use natu-
ral 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 larg-
er 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 preserva-
tion 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.13

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.21
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 implica-
tion associated with pesticide residues the
advantages of the use of pesticides, as preser-
vatives 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 lev-
els are peasant farmers who may not have
access to modern methods of foodstuff preser-
vatives 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 preserva-
tives.

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 man-
ifest a chronic long term diseases such as can-
cers, neurological effects, birth disorders, etc.

Related public enlightenment campaign espe-
cially among food sellers will go a long way to
address the possible problems that could arise
due to poor knowledge about the health haz-
dards associated with pesticide residues 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.
Phostin 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.

References

1. International Labor Office (ILO). Safety
and health in agriculture. Geneva:

Available from: http://www.ilo.org/wcmsp5/
groups/public/---ed_protect/---protrav/---
safework/documents/publication/wcms_11_0193.pdf
2. US Environmental Protection Agency
(EPA). What is a pesticide? (July 24,
pesticides/about/index.htm
3. Gilden RC, Huffling K, Sattler B. Pesticides
and health risks. J Obstet Gynecol
4. Food and Agriculture Organization of the
United Nations (FAO). International code
of conduct on the distribution and use of
pesticides. Rome: Food and Agriculture
Organization of the United Nations (FAO);
WAICENT/FAOINFO/AGRICULT/AGP/AGPP/
Pesticid/Code/Download/code.pdf
5. Educational and informational strategies
to reduce pesticide risks. Council on
Scientific Affairs. Prev Med 1997;26:191-
200.
6. Official census result of Nigeria. December
www.nigeriavillageesquare.com/official-
census-resultsnigeria
Pesticide fact sheets and tutorial, module
4. Pesticide Safety Education Program;
2007.
8. Ann V. Kuczera. Compliance and enforce-
ment, human health/environmental
health, pesticides and toxic substances;
General of Canada. Request to withdraw
the registration of neurotoxic pesticides in
Canada. Available from: http://www.oag-
bc.gc.ca/internet/English/pet_266_e_321_98.html
9. Simon Eebegbulem. Beans sold to the pub-
lic contained gammalin 20. Vanguard
(Nigeria) August 12, 2008. Available from:
http://allafrica.com/stories/2008080
120734.html
10. Chambers R. Rapid but relaxed and partic-
ipating rural appraisal; towards applica-
tion in health and nutrition. In: Scrimshaw NS,
Gleason GR. Rapid assessment procedures. Quantitative methodology
for planning and evaluation of health


