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*Research Article*

# Assessment of Knowledge and Practice of Pesticide Application Among Beans and Maize Sellers in an Urban South Western Nigerian Market

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**ABSTRACT**

Pesticides impart a crucial role for the improvement of food production according to the requirement of world population. However, pesticide use also has created concern regarding effect on the environment and the potentially toxic residues remaining in the food chain. This study assessed the knowledge and practice of pesticide use among raw food sellers in Bodija market, Ibadan. A cross -sectional study was conducted using all the registered 400 Beans Sellers and 720 Maize Sellers in the market. Majority (60%) of the respondents had good knowledge on pesticide use. Most (66.7%) of the food sellers that sell in retails had good pesticide application practice while only 45.6% of those selling in whole sale had good practice. The association was statistically significant. ($\chi 2$ = 7.977, p=0.019). After adjusting for other variables, the predictors of good practice in pesticide application were level of education and the type of food sold.

**Keywords:** *Knowledge, Practice, Pesticide applications, Beans and maize sellers, Nigerian market*

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## INTRODUCTION

The occurrence of pesticides in our environment as a result of the indiscriminate or intentional use has resulted in its persistence in the environment, thereby affecting the ecosystems and non-target organisms. Acute and chronic pesticide poisoning usually results from consumption of contaminated food, chemical accident in industries and occupational exposure in agriculture. About 15,000 metric tons of pesticides comprising about 135 pesticide chemicals are imported annually into Nigeria (Erhunmwunse *et al*., 2012)

Pesticide use in agriculture over the last several decades had proven to be great benefit to the production of our nation's food supply. The Environmental Protection Agency (EPA) has estimated that 76% of the total pesticide use nationally is for agricultural production, with the remaining 24% used in the urban, industrial, forest, and public sectors (Reagan *et al*., 2017). These chemicals have helped to increase agricultural production with reduced labor. However, problems associated with improper pesticide use had led to human illness, wildlife losses, and water quality degradation(Reagan *et al*., 2017). Studies regarding pesticides are considered important in order to decrease pesticide risk and help to improve public health policies. It has been estimated that about 125,000 - 130,000 metric tons of pesticides are applied every year in Nigeria. (Asogwa and Dongo, 2009).

However, pesticide use also had created concern regarding effect on the environment and the potentially toxic or carcinogenic residues remaining in the food chain. Cases of food poisoning among three families in Kano due to yam flour consumption were reported and investigations indicated that the use of certain lethal preservatives for the processing of the yam flour might be responsible (Adedoyin *et al*., 2008). Another food poisoning report attributed to yam flour consumption in five families in Ilorin, central Nigeria was also reported (Adeleke, 2009). The rising cases of food poisoning in Nigeria were linked to the misuse and abuse of agrochemicals and pesticides on grains and other agricultural products. The report stated that these chemicals were wrongly applied and abused in preventing pests. Over three million cases of acute food poisoning and twenty-thousand deaths occur annually due to exposure of food pesticides. An acute onset of gastrointestinal symptoms among people who had attended and eaten at a burial ceremony resulted in 60 cases patients with food poisoning and three deaths (Fatiregun *et al*., 2010). The objective of this study was to assess the knowledge, and practice of pesticide use among raw beans and maize sellers in Bodija market in Ibadan, Nigeria.

## MATERIALS AND METHODS

### Study location

The study was carried out at Bodija market in Ibadan North Local Government Area of Oyo state, Nigeria in the year 2010. Bodija market is a central and popular market in Oyo state. It is known for storage and marketing of agricultural produce such as beans, maize grains, yam, yam chips, meat, cowpea and other cereals.

### Study design and participants

The study was a descriptive cross-sectional survey of 400 registered beans sellers and 720 maize sellers who were selected by means of a Systematic Sampling method and interviewed using a semi-structured researcher-administered Questionnaire. An observational checklist was thereafter used to inspect their practice of pesticide use**.** The Questionnaire consists of four sections: the socio-demographic section, the knowledge test section, the practice of pesticide application section, the pesticide type and quantity of pesticide used section.

The knowledge score was based on a 24-point knowledge scale on pesticide use. The knowledge score was categorized based on the mean score (14.67) into poor and good knowledge. Scores of 14 and below were categorized as poor knowledge while scores of 15 and above were categorized as good knowledge respectively.

### Observational checklist

Observational checklist was done for the practice of the food sellers on pesticide application. All completed questionnaires were collected and screened for completeness manually while the frequency of all variables was computed. All the data were analyzed using SPSS computer software version 17. The results were presented in frequency tables, chart, and figures, according to each specific objective.

### Data analysis

Data on knowledge of respondents about pesticide use, type and quantity of pesticides use as well as pesticide application practice were analyzed using descriptive statistics. The associations of different variables with practice were done by cross tabulation using the chi-square method. All analyses were done at 5% level of significance. Logistic regression analysis was performed for the various factors to show the predictors of good practice in pepticide application to beans and maize.

### Ethical approval

The study was approved by the Ethical Review Committee of the University College Hospital, Ibadan. Nigeria..

## RESULTS

### Socio-demographic characteristics of the respondents.

The mean age of the respondents was 33.6±8.6 years. Their ages ranged from 20 years to 79 years. A more detailed biographical data of the respondents is outlined in table 1.

**Table 1**
Socio-demographic characteristics of the respondents

| Variable | | Frequency |
|---|---|---|
| **Sex** | Male | 692 (61.8) |
| | Female | 428 (38.2) |
| **Ethnic group** | Yoruba | 1092 (97.5) |
| | Hausa | 25(2.2) |
| | Igbo | 3 (0.3) |
| **Education** | None | 33 (3.0) |
| | Primary | 308 (27.5) |
| | Secondary | 722 (64.5) |
| | Tertiary | 56 (5.0) |
| **Type of food sold** | Beans | 400 (35.7) |
| | Maize | 720 (64.3) |
| | Total | 1120 (100.0) |
| **Type of sale** | Wholesale | 351 (31.3) |
| | Retails | 204 (18.2) |
| | Both | 566 (50.5) |
| | Total | 1120 (100.0) |

### Pesticide application practice of the respondents

Three hundred and seventy-five (33.5) of the respondents apply pesticides on their grains. Two hundred and thirty three (62.1%) respondents reported that they apply the pesticides by sprinkling it on the grains, while 70 (18.7.0%) respondents indicated that they tie the phostoxin tablets in a cloth and put in the bags. Only 6(1.6%) respondents indicated that they use complete protective clothing during the pesticide application. Complete protective clothing includes nose mask, hand glove and wearing of long clothes. A more detailed data on pesticide application practice of the food sellers is shown in table 2A and 2B.

### Types of pesticides used by the respondents

One hundred and thirty seven (36.5%) of the respondents that use pesticides indicated that they used phostoxin only, which is dichlorvos (an organophosphate pesticide) on their grains for storage, 88 (23.5%) indicated that they use DDForce (dichlorvos) only, 103 (27.5%) use either DDForce or phostoxin tablet (both are dichlorvos), only 11 (2.9%) use DDForce and phostoxin together, while 36 (9.6%) use "others" (i.e. jule, Rambo, opaayan) on maize grains.

**Table 2A:**
Pesticides application practice of respondents

| Practice | Variable | Frequency/ percentage |
|---|---|---|
| Apply pesticides | Yes | 375 (33.5) |
| | No | 745 (66.5) |
| | | **1120 (100)** |
| Types of pesticide used to preserve food | DDForce only | 88(23.5) |
| | Photoxin only | 137 (36.5) |
| | DDForce+phostoxin | 11(2.9) |
| | DDForce/Phostoxin | 103(27.5) |
| | Others (jule,Rambo, e.t.c) | 36 (9.6) |
| | **Total** | **375 (100)** |
| What is pesticide mixed with | Water only | 101 (26.9) |
| | Nothing | 238 (63.4) |
| | Water for short preservation/nothing, for long preservation | 35 (9.3) |
| | Phostoxin | 2 (0.4) |
| | **Total** | **375 (100)** |
| Mixing of pesticide | Use of hands | 104(27.7) |
| | Use of bucket and stick | 33(8.8)) |
| | Shaking of the container | 229 (61.1) |
| | Any object | 30 (2.4) |
| | **Total** | **1109 (100)** |
| Application technique | Sprinkling | 233 (62.1) |
| | Spraying | 28 (7.5) |
| | Tying tablet in a cloth and put in the food | 70 (18.7) |
| | Pouring | 14 (3.7) |
| | Throwing the tablet in the store | 30 (8.0) |
| | **Total** | **375 (100)** |

**Table 2B:**
Pesticides application practice of respondents

| Practice | Variable | Frequency/ Percentage |
|---|---|---|
| Use of protective equipment | Complete protective clothing | 6 (1.6) |
| | Nose mask and hand glove | 54 (14.4) |
| | Nose mask only | 182 (48.5 ) |
| | Hand glove only | 4 (1.1) |
| | Nothing | 129 (34.4) |
| | **Total** | **375 (100)** |
| Procedure use for application | Manufacturer/label | 55 (14.7) |
| | That of the store of purchase | 23 (6.1 ) |
| | Boss | 169 (45.1) |
| | Own idea | 67 (17.8 ) |
| | Other people | 61 (16.3 ) |
| | **Total** | **375 (100.0)** |
| Care after pesticide application | Hand washing with soap and bathing | 21 (5.6) |
| | Hand washing with soap and water | 300 (80.0) |
| | Rinsing of hands with water | 18 (4.8) |
| | Nothing | 5 (1.3 ) |
| | Hand washing and dinking of milk | 10 (2.7) |
| | Hand washing and then take drug | 3 (0.8) |
| | Hand cleaning with cloth | 18 (4.8) |
| | Total | **375 (100.0)** |
| Period of preservation before sale | At least 3 months | 180 (48.0) |
| | 1-3 months | 69 (18.4) |
| | Less than 1 month | 6 (1.6) |
| | 24 hours | 57 (15.2) |
| | Immediately | 63 (16.8) |
| | **Total** | **375 (100.0)** |

**Quantity of pesticide use:** One hundred and thirty eight (36.8%) of the 375 respondents who indicated that they use pesticides apply 2 tablets of phostoxin into 1 bag of food stuff. Fifty seven (15.2%) of the respondents that use pesticides used 1 tablet of phostoxin into 1 bag of food stuff (beans).Twenty four (6.4%) of the respondents said they use 500ml of DDForce into 20 bags of food, 18 (4.8%) of the respondents use either 1 litre of DDForce to 20 bags or 2 tablets of phostoxin into 1 bag of food stuff, only 2 (0.5%) respondents used 5 tablets of phostoxin into the store where the food are kept. Only four (1.1%) respondents used 1 litre to 200 bags while 20(5.3%) used 1 litre of DDForce to 40 bags or 50 bags with 2 tablets of phostoxin into each bag. 20 (1.8%) of the respondents used 1 litre of DDForce to 400 bags while 83 (7.4%) respondents used 1 litre of DDForce to 30 bags or 2 tablets of phostoxin to 1 bag .11 (2.9%) respondents used 200ml of DDForce to 20 bags. Majority of them use the quantity of pesticide within the recommended dose (1 Litre to 30 bags)

**Relationship between knowledge score of respondents and their pesticide application practice:** A minority (45.1%) of the food sellers with good knowledge score, had good pesticide application practice while majority (60.5%) of those with poor knowledge score had good practice as shown in table 3. The association was statistically significant. ($\chi2$ = 8.693, p=0.003).

Table 3 also shows that 72% of those with tertiary education have good pesticide application practice while 51.3 % of those with primary education have good pesticide application practice. The association was statistically significant. ($\chi2$ = 10.294, p=0.016).

**Table 3:**
Relationship between level of education, knowledge score of respondents and their pesticide application practice

| Variable | Poor practice n (%) | Good practice (%) | $\chi^2$ | p-value |
|---|---|---|---|---|
| **Primary** | 56 (48.7%) | 59 (51.3 %) | 10.294 | 0.016* |
| **Secondary** | 106(45.1%) | 129(54.9%) | | |
| **Tertiary** | 7(28.0%) | 18 (72.0%) | | |
| **Poor knowledge** | 60(39.5%) | 92 (60.5 %) | 8.693 | 0.003* |
| **Good knowledge** | 120(55%) | 98(45.1%) | | |

*Significant at 5% level of significance

**Table 4:**
Association of type of food sold by the food sellers, how the food sellers sell their food and their practices

| Variable | Poor practice (n) | Good practice (n) | $\chi^2$ | p-value |
|---|---|---|---|---|
| **Beans** | 132(55.5%) | 106(45.5 %) | 14.534 | 0.0001* |
| **Maize** | 48(35.0%) | 89(65.0%) | | |
| **Wholesale** | 62 (54.4%) | 52 (45.6 %) | 7.977 | 0.019* |
| **Retail** | 23 (33.3%) | 46 (66.7%) | | |
| **Both whole sale and retail** | 95 (49.5%) | 97 (50.5%) | | |

*Significant at 5% level of significance

**Table 5:**
Logistic regression analysis of good practice on selected variables

| Variable | Odd Ratio | 95% CI | p-value |
|---|---|---|---|
| **Educational levels** | | | |
| No school | | | |
| Primary | | | |
| Secondary | 0.738 | 0.146- 3.727 | 0.713 |
| Tertiary | 2.693 | 0.997 – 7.273 | 0.051* |
| | 2.730 | 1.068-6.979 | 0.036* |
| **Type of food** | | | |
| Beans sellers | 0.515 | 0.319 – 0.829 | 0.006* |
| Maize sellers | 1 | | |
| **How do you sell your food** | | | |
| Whole sale | 0.414 | 0.161 – 1.064 | 0.067 |
| Retail | 1 | | |
| Both | | | |

*Significant at 5% level of significance

**Association of type of food sold by the food sellers and their practice:** More than half (65%) of those selling maize have good pesticide application practice while only 45.5% of those selling beans have good pesticide application practice as shown in table 4. The association was statistically significant. ($\chi^2$ = 14.534, p=0.0001).

**Association of how the food sellers sell their food and their practice:** Most (66.7%) of the food sellers that sell in retails had good pesticide application practice while only 45.6% of those selling in whole sale had good practice as shown in table 4. The association was statistically significant. ($\chi^2$ = 7.977, p=0.019).

**Logistic regression analysis of good practice on selected variables:** Table 5 shows Logistic regression analysis of good practice of pesticide application on selected variables. After adjusting for other variables, the predictors of good practice in pepticide application were level of education and the type of food sold.

Table 5 shows Logistic regression analysis of good practice on selected variables. Those who had tertiary educations were about 2.7 times more likely to have good application of pesticides compared to those who did not go to school (OR= 2.73; 95%CI= 1.068 – 6.979). Respondents who sell maize were about twice more likely to have good application of pesticides compared with those who sell beans. (OR= 0.515; 95%CI= 0.319 – 0.829).

## DISCUSSION

The educational background of the food sellers in this study was low of which those with secondary education constitute a significant figure. Food sellers with little formal education might misuse the pesticides possibly due to difficulties in understanding the instructions and safety procedures included on the product labels. The majority of food sellers in this study had good knowledge of pesticide use but contrary to expectations, this did not significantly influence their practices on safe pesticide use. Similar results were found by Lekei *et al* (2014) that knowledge of route of exposure was not associated with safety practice.

The inability of the food sellers to indicate some health effects that they might have experienced is because some other health effects cannot be traced to pesticide application. This is because it was difficult to characterize pesticide exposure risk among the food sellers due to the marked differences in the type of pesticide used, and the background. This is in agreement with the findings of Linda *et al*. (2001) which reported that it is difficult to characterize pesticide exposure among agricultural communities. The finding that food sellers were aware that pesticide residue in food reduces during storage, processing and when exposed was in agreement with the findings of Kaushik *et al*.( 2009) and Neela *et al*. (2016) which reported that storage and other post-harvest practices may alter pesticide residues via chemical and biochemical reactions.

It was discovered that majority of the food sellers used pesticides for both short and long term storage of their grains, of which almost all of them were beans sellers. This is due to the fact they believed that beans grains are easily infested with pest than maize grains. Despite high knowledge of the food sellers, majority of them have poor practice, of which most of them were beans sellers. This is inconsistent with the findings of Saʾed *et al*., 2010 and Mustapha *et al* 2017, that farm workers with good pesticide knowledge were more inclined to use pesticides according to the recommended guidelines for protective measures. But similar to the finding of Salamah *et al* (2004) who reported high levels of knowledge of pesticide use, but the use of protective measures was poor.

The poor pesticide application practice of the food sellers was due to low level of formal education among majority of them because it was discovered that majority of those that have tertiary education have good practice, this is in agreement with the study of Mustapha *et al*.,2017 that educated farmers are more knowledgeable about pesticide safety. Many of the respondents used phostoxin tablets because with the use of this tablet, they can start selling the food immediately or after 24 hours, this finding is in agreement with the statement of (Manahan, 2005) that organophosphate insecticides are generally chemically unstable with short half-lives, and are easily biodegradable into harmless substances which do not pose any serious environmental problems when compared to organochlorines.

Majority of the food sellers that applied pesticides follow the procedure taught them by their boss and not the instructions on the label. The reason given was that it is what they had learnt and they have been doing for long so there is no need of reading the label anymore, this may be due to the fact that most of them had secondary school education. Mustapha *et al*.,2017 stated in their study that even when able to read, some respondents in the study acknowledged they were reluctant to read pesticide labels because of their experience with pesticide use. This practice is not in accordance with the statement of the stewardship community, 2011 that it is important to read the label each time one buys the product as there may have been changes to either the advice notes or the conditions of use. Some conditions of use may be required by the law of the country or by the international markets. Every pesticide is required to bear a label that conforms to U.S.A Environmental Protection Agency standards. (Blog, 2011). Sa̓ed *et al*,2010 also reported in their study that Farm workers with little formal education might be at higher risk when using pesticides, possibly due to difficulties in understanding the instructions and safety procedures included on the product labels.

Some respondents even said they applied the pesticides according to their own wish based on the quantity of grains to be treated. However, this increases the risk of harm due to pesticide residue. It was stated by Blog, 2011 that the stated rates on the label are the only ones for which the products" use has been tested and approved. Increasing that rate is not likely to neither increase the effectiveness of that product nor control other non-listed pests. It will, however, increase the risk of harm and may lead to prosecutions if unacceptable residue levels were used.

The beans sellers applied pesticides at any time of the year especially when they suspect pest infestation on the grains. This is due to the fact that they can easily get these pesticides anywhere without having to go through a long process like prescription from a specialist. This finding is in accordance with the finding of Margam, (2008) which stated that indiscriminate use of insecticides on cowpea, both in the field and storage, throughout the cowpea-growing region, increases in pesticide-related agricultural extension activity and greater availability of insecticides in the local markets may be the probable causes for this unexpected high level of insecticide use.

The maximum duration of storage of grains among the raw food sellers before selling to consumers was six months. This is a poor practice because a study in Bodija market, Oyo state by Yusuf and Bolaji, 2017 and in Dawanu market, Kano state by Yusuf *et al*.,2017 indicated the presence of dichlorvos (an organophosphate) insecticide in cowpea grains six months after application and this situation highlights among others, the dangers and disadvantages associated with the use of synthetic chemicals used for the protection of stored cowpea grains against insect pests . Different classes of insecticides have also been studied and their dissipation during grain storage was found higher for natural pyrethrin residues (a complete disappearance was observed by Caboni *et al*.2007 after 8 months of storage at ambient temperature) and lower for organochlorines and synthetic pyrethroids that are very stable under the reported main mechanisms of dissipation through typical storage conditions.

Observation of some of the raw food sellers during pesticide applications, indicated that the pesticide applications were done within the market in front of the stall for sales of the food grains. The raw beans grains were sprayed directly with pesticides, this practice is poor and it contradicts the statement of Dugje *et al*., on pesticide guide, 2008 that cowpea grains should not be sprayed directly with insecticide before storage. Instead, recommended fumigants should be used for grains in bags with an inner lining before stacking them in the store. The sprayed beans were also packed into the sack and kept in the shop and covered immediately.

In this study, it was also discovered that the food sellers have many misconception and carefree attitude about proper protective clothing, with some food sellers believing that ineffective devices such as bandanas, handkerchief only, will provide protection against pesticide exposure.

During observation of pesticide application practice of the food sellers, all the men that applied the pesticide were not wearing any protective clothing. This practice is not in accordance with the statement of Dugje *et al*, on pesticide guide, 2008 that in hot weather, the human body tends to absorb toxic substances faster, which means that it is extremely important to wear protective clothing. Some of the food sellers refuse the use of protective clothing because they found it uncomfortable to wear. This finding is in agreement with the statement of Dugje *et al*, on pesticide guide, 2008 that farmers often find that protective clothing is uncomfortable to wear and chose not to use it, which adds unnecessary risk. Although most of the food sellers were aware of the importance of use of protective equipment when applying pesticides, there was no significant positive relationship between awareness and use of protective equipment. Their main reason for not wearing protective clothing was discomfort, this finding is corroborating with the findings of Bhoopendra and Mudit 2009. The poor practice of the food sellers is very dangerous to their health, according to Yusuf *et al*, 2017

Despite the high knowledge about pesticide use of the beans sellers, majority of those that apply pesticides on the food were beans sellers. Most of the beans sellers with good knowledge score still practice indiscriminate use of pesticide this finding was inconsistent with the finding of Sa̓ed *et al*. 2010 that farm workers with good pesticide knowledge were more inclined to use pesticide according to the recommended guidelines for protective measures. In Lebanon, assessment of pesticide use in farmworkers were done by Salamah *et al*, 2004, who reported high level of knowledge of pesticide use but that the use of protective measures were poor.

Many of the beans sellers apply pesticides and they know the implication of pesticide residue in food but majority of them indicated that they occasionally sell the beans before the normal date of expiration of the pesticides if they are in need of money. Margam, (2008) also stated that during surveys, he met farmers who were treating cowpea seeds for storage with highly concentrated liquid insecticide formulations (meant only for spraying on crops) for long term storage. Such treated cowpeas could make their way into the market either when the farmer is in need of money or when it is especially profitable to sell cowpeas. Treated cowpeas, once in the market can no longer be distinguished from normal untreated cowpeas and so the buyers have no way of distinguishing between the two The most widely studied insecticides in grain storage are the organophosphates (malathion,pirimiphos methyl, chlorpyrifos methyl) and their dissipation after five to eight months of storage could range from 50-86% depending on pesticide Kow, type of applied formulation and storage temperature and humidity (Uygun *et al*,2009;Uygun *et al*, 2008; Uygun e t al, 2007; Uygun *et al*, 2005

In conclusion, more than half of the food sellers had good knowledge score on pesticide use; this was higher among the beans sellers than the maize sellers. Majority of those that use pesticides as food preservatives were beans sellers and their pesticide application practice was poor especially in terms of adequacy of quantity and duration of storage of the preserved grains before selling them to the consumers. This study reveals that knowledge does not have influence on pesticide application practice therefore it is recommended that there should be proper monitoring of pesticides application and promotion of good pesticides application practice. All pesticides including insecticides for use in grain storage must be approved and regulated by government authorities under legislation established in the country. Highly toxic pesticides should be substituted with less toxic pesticides that have short half- lives

**REFERENCES**

**Adedoyin O.T., Ojuawo A., Adesiyun O.O., Mark F., Anigilaje E.A (2008):** Poisoning due to yam flour consumption in five families in Ilorin, central Nigeria. West Afr. Med. J.; 27:41–43.

**Adeleke S.I. (2009):** Food poisoning due to yam flour consumption in Kano (Northwest) Nigeria Online J of Health and Allied Sci 8 (2).

**Asogwa E.U. and Dongo L.N (2009):** Problems associated with pesticide usage and application in Nigerian cocoa production: A review. Afric J of Agric research. vol. 4 (8), pp675-683

**Bhoopendra Singh and Mudit Kumar Gupta, (2009):** Pattern of use of personal protective equipments and measures during application of pesticides by agricultural workers in rural area of Ahmednagar district, India. Ind J of Occ and Env Med 13(3);127-130

**Blog, J.S (2011).** Safe effective crop protection. Pesticide spraying basics. www.stewardshipcommunity.com

**Dugje I.Y, Ekelem F. Kamara A.Y, Omoigui L.O, Tegbaru. A. Teli I.A and Onyibe . (2008):** Guide to safe and Effective use of Pesticide for Crop production in Borno State. Nigeria. Int inst of Tr Agric pp 2, 4-8, 22.

**Erhunmwunse., A. Dirisu and J.O. Olomukoro (2012):** Implication of pesticide usage in Nigeria. Tropical Fresh water Biology, 21 (1) 15-25.

**Fatiregun A.A., Oyebade O.A., Oladokun L. (2010):** Investigation of an outbreak of food poisoning in a resource-limited setting. Trop. J. Health Sci. 17:1117–4153.

**Hallberg, G.R. (1989):** Pesticide pollution of groundwater in the humid American States, Agril. Ecosyst Environ. 26, 299-367.

**Kaushik ,G., Satya, S., and Naik., S.N. (2009):** Food processing a tool to pesticide residue dissipation- A Review. Food Research International 42 200926-40 Centre for rural development and technology, Ind Instit of Techn Delhi, New Delhi

**Kaushik, G., Satya, S., Naik, S.N. (2009):** Fate of pesticide residue on Raw Agricultural crops after Post harvest storage and food detesting to edible portions

**Lekei E.E. Ngowi A.V and London L. (2014)**:.Farmers knowledge, practices and injuries associated with pesticide exposure in rural farming villages in Tanzania. BMC Public Health 14:389 doi:10.1186/1471-2458-14-389

**Linda, A. M., Michael R., Lasarev, Gregory, H., Joan R., Juan M., Caren, E., and Jacki Phillips, (2001)** Work Characteristics and Pesticide Exposure among Migrant Agricultural Families: A Community- Based Research approach. Envir Health Perspectives.Volume 109 (5):537-538. Biomed.Environ.Mass Spectrom 18:820-827.

**Manahan E. S. (2005):** Environmental Chemistry. 8th Edition.CRC Press. ISBN: 1-566706335. Bova Raton Florida. pp.33

**Margam Venu (2008):** Increase in insecticide use on cowpea in Africa- not surprising anymore. Network for the genetic improvement of cowpea for Africa.

**Mustapha F.A. Jallow, Dawood G. Awadh, Mohammed S. Albaho, Vimala Y. Devi, and Binson M. Thomas. (2017):.** Pesticide Knowledge and Safety Practices among Farm Workers in Kuwait: Results of a Survey. Int J Environ Res Public Health. 2017 Apr; 14(4): 340. doi: 10.3390/ijerph14040340 PMCID: PMC5409541

**Neela Satheesh and Kumera Nema, (2016):** Arch. Appl. Sci. Res., 2016, 8 (3):55-60.

**Phillips, (2001):** Work Characteristics and Pesticide Exposure among Migrant Agricultural Families: A Community- Based Research approach. Envir Health Perspectives.Volume 109 (5):537-538.

**Reagan Waskom, Troy Bauder, Robert Pearson, and Colorado Department, (2017):** Best Management Practices. Agricultural Pesticide Use. May 2017 Bulletin #XCM-177

Sa ed H. Zyoud, Ansam F. Sawalha, Waleed M.Sweileh, Rahmat Awang, Suleiman I. Al-khalil,

**Samah W.Al-jabi and Nihaia M.Bsharat, (2010):** Knowledge and practices of pesticide use among farmers in the West Bank, Palestine: Safety implications .Envir Health and Prevent Med J. Clinical Toxicology Programme. National Poison centre, Universiti Saina Malaysia (USM), Penang Malaysia.

**Salameh P R, Baldi. I, Brochard P, and Abi Saleh B. (2004):** Pesticides in Lebanon; A knowledge, attitude and practice study. Envir Research; 94 (1): 1-6.

**Uygun, U., Koksel, H., and Atli, A. (2005):** Residue levels of malathion and its metabolites and fenitrothion in post-harvest treated wheat during storage, milling and baking. Food Chem. 92: 643–647.

**Uygun, U., Ozkara, R., Ozbey, A., and Koksel, H. (2007).** Residue levels of malathion and fenitrothion and their metabolites in postharvest treated barley during storage and malting. Food Chem. 100: 1165–1169.

**Uygun, U., Senoz, B., and Koksel, H. (2008).** Dissipation of organophosphorus pesticides in wheat during pasta processing. Food Chem. 109: 355–360.

**Yusuf B.I, Bolaji O.M.(2017).**Concentration of Pesticide Residue in Beans and Maize grains in Bodija Market, Ibadan, Nigeria. Afr J of Envi H Sci 6: 69-77.

**Yusuf .S.R,Lawan S.H, B.S Wudil and H.Sule, 2017.** Detection of Dichlorvos Residue in Cowpea Grains, Six Months after Application Using High Performance Liquid Chromatography. Asian Res J of Agric 7(4): 1-6