Original Research Article

SURVEY OF COMMON PESTICIDES USED IN STORAGE OF AGRICULTURAL PRODUCE WITHIN MAKURDI, BENUE STATE NIGERIA.

Barizomdu T. Pii [1*] R.A Wuana [2] S.P Malu [3] and S.C Nwafor [4]

[1]Center for Food Technology and Research, Benue State University Makurdi, Benue State Nigeria

[2] Department of Chemistry and Center for Agrochemical Technology, Federal University of Agriculture, Makurdi-Nigeria.

[3]Department of Chemical Sciences, Federal University Wukari, Taraba State, Nigeria

[4]Center for Food Technology and Research, Benue State University Makurdi, Benue State Nigeria

Authors' contributions

This research was a collaborative work of all authors. Author BTP designed the study, performed the statistical analysis, and wrote the protocol and first draft of the manuscript. Authors RAW and SPM managed the analyses of the study. Authors RAW and SCN managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

The objective of the study was to survey the common pesticides used in postharvest storage of agricultural produce within Makurdi, Nigeria and to test the knowledge of the farmers and marketers on the health effects of these chemicals. The study provides information on the type of pesticides used by farmers, marketers and consumers of stored agricultural food products such as cowpea, yam chips, cassava chips, sesame seeds, maize and soybeans being major farm produces found within Makurdi and Benue State in general. Selection of 100 respondents were done using simple random sampling techniques across five major markets (Modern, Wurukum, North bank, Wadata and High level markets) through structured interview schedule. Socio-economic characteristics of the respondents were analyzed using frequency and percentages. Percentages were used to determine the common storage pesticides used within Makurdi, storage time, the frequency of customer purchase and perceived health impact of the storage pesticides. Data obtained were analyzed using descriptive statistics. The results revealed that 51% of the respondents were males with 41% between the ages of 30-39. Married respondents accounted for 52% and 48% having household sizes of 1-5, only 20% had no form of formal education and 75% were marketers. In a multiple response schedule, aluminium phosphate tablets ranked 80% for storage pesticide while dichlovos was 60%, DDT 35%. Others such as endosulfan, gamalin, carbofuran, carbendazim and permethrin were between 5-15%. Furthermore the study revealed the use of many restricted and obsolete pesticides still in use within this state and in outrageous quantities which could pose health challenge to consumers of these food products.

Comment [h1]: not clear, please clarify. By multiple response we mean a single respondent could choose more than one pesticide and the percentages of the pesticides chosen will be calculated individually. In this survey therefore, the respondents use 80% aluminium phosphate for storage some among those that use aluminium phosphate also uses dichlovos which amounted to 60% and so on. Each of the pesticides are calculated at 100%

**Corresponding author: E-mail: justiceisgood.jp@gmail.com*

Key words: postharvest losses; food security; pesticides; storage; agricultural produce.

1. INTRODUCTION

Postharvest loss of food is a global challenge affecting all food producing nations of the world especially developing countries lacking modern technology for food preservation and food security [1, 2]. This has led to untold hardship and huge economic loss to farmers and marketers of agricultural commodities [3]. The quest for food security and sustainability has led to the use of divers' methods of preservation and storage, and an effective pest management is vital in assuring food security and sustainability. [2]. It is in this light farmers and marketers as well as consumers have embraced modern methods of preservation and the use of pesticides comes handy [4]. Pesticides as a term encompasses wide range of substances which could be either natural or synthetic used to prevent or inhibit or eliminate the pests that may damage or hinder the growth or health of living organisms [5]. Although pesticides are very important in crop protection and ensures all year round availability of agricultural produces, the menace of residual impact on human health and the environment undermines its usefulness [6, 7, 8] Residues especially those of organochlorine origin persist for several years before degradation and may generate metabolites or degradation products even more harmful than the parent molecules [9, 10]. The persistent nature helps in their transport across the food chain [11] Benue state as the food basket of Nigeria produces both perishable and durable crops in large and commercial quantities. Until recently, many of these crops ended in the trash and amounted to huge postharvest losses to the farmers and marketers but now the discovery of pesticides have contributed to the reduction in postharvest waste. The challenge is the lack of knowledge on the right application and good agricultural practice (GAP) of these chemicals leading to indiscriminant and uncensored use of the chemicals on food products even those that have been banned [12]. Therefore the objective of this study was to survey the common pesticides used in postharvest storage of agricultural produce within Makurdi, and to test the knowledge of the farmers and marketers on the health effects of these chemicals.

2. MATERIALS AND METHODS

Makurdi Local Government Area has a population of 300,000 and lies between latitudes $7^0 40^I$N and $7^0 53^I$N of the equator, and between longitudes $8^0 22^I$E and $8^0 35^I$E of the Greenwich Meridian. It is a 16km radius circle, covering 804km^2 lands mass [13].

The soil of Markurdi is rich for agricultural purpose being a tropical area within the guinea savanna region. Climatically, Makurdi falls within the tropical, sub humid, wet and dry climate which has two distinct seasons, namely wet season and dry season [13]. The wet season starts from April and lasts till October; while the dry season starts in November and lasts till March. Rainfall ranges from 775 millimeters to 1792 millimeters, with a mean annual value of 1190 millimeters. Mean Monthly Relative Humidity in Makurdi LGA varies between 43% in January to 81% in July-August period. The rural dwellers and surrounding local governments are mostly agrarians and produce varieties of crops such as yam, cassava, soybeans, maize, sweet potatoes, oranges and mangoes in

*Corresponding author: E-mail: justiceisgood.jp@gmail.com

commercial quantities. Many of its farm produce are sold within and outside the state and the sales points are the market places of which Wadata, Wurukum, North Bank, High level, Railway and Modern markets are the major markets within the city. Samples of stored agricultural products for this study cover these major markets.

2.1 SAMPLING PROCEDURE

Both primary and secondary sources of data were employed for this study. Structured questionnaires were administered to obtain primary data for the study. Respondents were randomly selected from each of the markets to ensure effective coverage of the study areas. The respondents were 100 selected from the five markets making a total of 20 respondents for each market.

2.2 DATA COLLECTION AND ANALYSIS

Socio-economic characteristics of the respondents were analyzed using frequency and percentages, percentages were used to determine the common storage pesticides used within Makurdi, storage time, frequency of customer purchase and perceived health impact of the storage pesticides.

RESULTS AND DISCUSSION

The results of the socio-economic characteristics of respondents are presented on Table 1. The age distribution of the respondents shows highest values between 30-39yrs (41%) which comprises a population of young adults at marriageable ages and families to fend for and of those who have carved a career of either farming or marketing of stored products. As vibrant youths, a show of smartness, competition and need for survival among other competing factors may lead to the smuggling and use of pesticides indiscriminately for crop protection even when they are aware of the menaces. Yet, some, due to lack of education and awareness may be ignorant of the correct use and dangers of misuse of the pesticides. In addition, a large percentage of the respondents are married (52%) while 38% are single and the remaining 10% are either widowed or divorced, this corroborates the point earlier stated on the age bracket of the respondents which stretches the fact that as married people, pressure for family upkeep especially in the face of the present economic meltdown in the nation and other marriage related responsibilities could contribute to undermining the dangers of the pesticides just to keep business moving in other to settle immediate needs. Based on gender distribution of the respondents as presented on table 1, male and female are 59% and 41% respectively. It is an indication that both males and females are actively involved in farming and marketing of stored products of legumes, cereals and tuber products making it available all year round as a confirmation that Benue state is the food basket of the nation. On the educational level of the respondents, only about 20% have no formal education. The remaining 80% is distributed between primary, secondary and tertiary educational levels of which 33% have primary education, 36% secondary and 11% tertiary education. This implies that at least a good percentage of the respondents could read and understand the dose and recommended use of the pesticides. Although the respondents with tertiary education may be more informed about the effects and current reports on regulated, banned and recommended pesticides but

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*Corresponding author: E-mail: justiceisgood.jp@gmail.com

the percentage of the tertiary respondents are few which means that only about 11% of farmers and marketers may be fully knowledgeable on pesticide safety. Furthermore, 75% of the respondents are marketers while 20% are farmers and 5% are both farmers and marketers. This implies that most of the stored products sold within Makurdi are brought in from the nearby communities where majority of the farmers reside and that the use of pesticides for long-term storage of stored products are majorly done by marketers who would want to maximize profit on purchased goods by avoiding crop damage. On the bases of household sizes of respondents, 48% have a household size of 1-5, 37% 6-10 while 15% have household sizes of 11-15 members. Considering that this respondents are equally consumers of stored products of cereals, legumes and tubers being a staple food consumed regularly across Makurdi according to the result of the survey on Table 1, consumption of food products treated indiscriminately with hazardous pesticides predisposes an entire family to both acute and chronic effects as well as cumulative effect of pesticides from a combination of these food products.

Table 1. Socio-economic Characteristics of Respondents

Variables	Frequencies	Percentages
Age (years)		
Less Than 20 Yrs	5	5
20-29yrs	28	28
30-39yrs	41	41
40-49yrs	15	15
50 And Above	11	11
Total	**100**	**100**
Gender		
Male	51	51
Female	49	49
Total	**100**	**100**
Marital status		
Single	38	38
Married	52	52
Widowed	5	5
Divorced	5	5
Total	**100**	**100**
Household size	**Frequency**	**Percentage**
1-5	48	48
6-10	37	37
11-15	15	15
Total	**100**	**100**
Education		
No Schooling	20	20
Primary	33	33
Secondary	36	36
Tertiary	11	11
Total	**100**	**100**
Occupation		
Farmer	20	20
Marketer	75	75
Farmer/marketer	5	5
Total	**100**	**100**

Source: field survey 2018

Distribution of Respondents Based on the Type and Amount of Synthetic Pesticides Used for Storage.

The data on Table 2 is a multiple response result for the common pesticides used for storage within Makurdi. 80% of the respondents uses Aluminium phosphate (phostoxin) tablets, 60% uses Dichlovos, 35% uses Dichlorodiphenyltrichloroethane commonly known as DDT, 15% uses Carbendazim, 10% each for Chloripyrifos, Endosulfan, Carbofuran and Gamalin while 5% each uses Eldrin, Pyroclostrobin and Permenthrin. The 80% that uses Aluminium phosphate claimed that about 3-4 tablets are added to the grains wrapped in fabric for the length of time of storage while the gas is slowly released into the products. This is quiet safe if they truly wait for the expiration of the chemical before the products are sent

*Corresponding author: E-mail: justiceisgood.jp@gmail.com

to the market. The other 60% that uses Dichlovos add 100 mL directly to a bag of the stored grains as against the recommendation of diluting 7 mL in 300 mL of water before application. Same applies to other pesticides except Endosulfan of which 20-50 mL are applied directly to the crop under storage. This may result to a large residual impact on consumers especially when the products are sent to the market before its waiting period is expired.

Table 2. Distribution of Respondents Based on the Type and Amount of Synthetic Pesticides Used for Storage.

Pesticides	Frequency	Percentage	Amount/Bag or basin
Alumunium phosphate	80	80	3-4 tab
Chlorpyriphos	10	10	100 mL
DDT	35	35	50-100 mL
Endosulfan	10	10	20-50 mL
DDVP (Dichlovos)	60	60	100 mL
Carbufuran	10	10	100 mL
Gamalin	10	10	100 mL
Carbendazim	15	15	100 mL
Eldrin	5	5	100 mL
Pyraclostrobin	5	5	100 mL
Permethrin	5	5	100 mL

Source: field survey, 2018

Distribution of Respondents Based on Storage Time, Frequency of Customer Purchase and Health Impact of the Storage Pesticides

Time is an important factor in storage especially with the use of chemicals. The time it takes for a pesticide to be metabolize into inactive compounds or completely broken down during storage is known as its waiting period [14]. Each agrochemical has its waiting period which must be adhered to for safety of human consumers. Looking at the result on Table 3 below, 57% of the respondents store their products with the pesticides listed on Table 2 within 0-1 month before marketing, 24% store it between 2-4 months, 14% store for 5-8 months while 5% store for 9-12 months. These storage times may not be centered on the waiting period of the pesticides but on the perceived market demand for the products. It therefore means that, a product stored with pesticide whose waiting period is around two to four months can be taking to the market within 0-1 month once the demand for the product is on the increase. In addition, cereals, legumes and tuber crops are staple crops consumed regularly by sub-Saharan Africans. These crops' being produced in large quantities in Benue state meets the food demand of the people almost on daily basis. It could be eaten alone or in combination with other diets. Table 3 gives a value for daily purchase of 57%, 27% of the respondents indicated that purchase of these products are done on regular bases, the remaining 16% said weekly or once awhile. It therefore implies that if purchases of these products are done daily and regularly, its consumption could also be daily or regularly which could predispose consumers to high residual impact once the pesticides are incorrectly applied. The distribution of respondents based on their knowledge of the impact of

*Corresponding author: E-mail: justiceisgood.jp@gmail.com

pesticides on human health as shown on Table 3 clearly shows that, 64% of the respondents are not sure if pesticides used in food storage has any effect at all on consumer health which shows a high level of ignorance on the effect of these pesticides on human health hence their misuse and adulteration of the products. Only about 15% know that the pesticides used for storage could adversely affect human health and listed such impact as nausea, headache, heartburn, sterility and even cancer while the remaining 21% denied the impact of storage pesticides on human health implying that it is completely safe to consume pesticide treated foods without any effect on human health.

Table 3. Distribution of Respondents Based on Storage Time, Frequency of Customer Purchase and Health Impact of the Storage Pesticides

Variables	**Frequency**	**Percentage**
Time of storage		
0-1 month	57	57
2-4 months	24	24
5-8 months	14	14
9-12 months	5	5
Total	**100**	**100**
Customer purchase		
Daily	57	57
Weekly	11	11
Regularly	27	27
Once a while	5	5
Total	**100**	**100**
Effect of storage pesticides on consumers	**Frequency**	**Percentage**
Yes	15	15
No	21	21
Not sure	64	64
Total	**100**	**100**

Source: field survey, 2018

CONCLUSION

This study provides information on the type of pesticides used by farmers, marketers and consumers of stored agricultural food products such as cowpea, yam chips, cassava chips, sesame seeds maize and soybeans being major farm produces found within Makurdi and Benue State in general. The study revealed the use of many restricted and obsolete pesticides still in use within this region and in outrageous amounts which could pose health challenge to consumers of these food products and even environmental nuisance within the storage facilities. There is therefore need for urgent monitoring of the levels of residues of these pesticides in food products within the region and the regulation and restriction of importation and smuggling of the pesticides into the country. Strict law enforcement measures should be put in place to check mate the use of pesticides for storage. Again, it is also recommended that the farmers, marketers and consumers of these products are educated and enlightened through extension services on the right use and dangers of misuse of chemicals in storage as well as greener

*Corresponding author: E-mail: justiceisgood.jp@gmail.com

approach to storage which will limit and with time eliminate the use of pesticides during storage.

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*Corresponding author: E-mail: justiceisgood.jp@gmail.com

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*Corresponding author: E-mail: justiceisgood.jp@gmail.com