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Evaluation of the Effects of Pesticide Residual Levels in Selected Grains

Mohammed-Kamil A. Piegu[1, 2], Fuseini J. Yakubu[2*], William Odoom[3], Hayford Ofori[4]

[1]Department of Agricultural Engineering, Tamale Technical University, Tamale, Ghana

[2]Department of Agricultural and Biosystems Engineering, KNUST, Kumasi, Ghana

[3]Department of Postharvest technology, Koforidua Technical University, Koforidua, Ghana

[4]Department of Agricultural Engineering, Ho Technical University, Ho, Ghana

***Corresponding Author** : Mohammed-Kamil A. Piegu, Department of Agricultural Engineering Tamale, Ghana.
Email: mohakamy05@gmail.com

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ABSTRACT

The use of pesticides to protect stored products is on the ascendency in the grain industry in Ghana. Grains (maize, cowpea and groundnuts) were procured, stored for three months and levels of pesticides residue determined. It was revealed that pesticides levels were still high among all the grains after the storage period of three months. Pesticides residue obtained were potentially harmful to humans when the grains are consumed. Levels of pirimiphos-Methyl and permethrin in maize were 48.71 and 19.39 respectively. In cowpea, pirimiphos-Methyl and permethrin levels were respectively 46.46 and 13.53 and in groundnuts, levels of pirimiphos-Methyl and permethrin were 47.50 and 19.64 respectively. All the identified chemicals exceeded their maximum residual limits in grains.

Keywords: Maize, Cowpea, Groundnut, Residual Effect, Health Implications.

I. INTRODUCTION

The use of pesticides is increasingly gaining recognition and gradually causing a serious environmental problem in the form of water contamination, ecosystem disruption and habitat contamination [12]. Pesticides by nature can be potentially harmful to the people coming into direct contact with it. A significant number of pesticides is used for controlling both field and stored products pests [5]. Pesticides are poisonous by nature and are classified generally as hazardous to human health [3]. Over two decades now, the use of pesticides in developing countries had accounted for approximately 20 % of the world's expenditure [15].

Improper use of pesticides cause human poisoning and accumulates as residues in food and environment [1]. Globally, approximately 300, 000 workers died from exposure to pesticides every year with the developing countries recording higher deaths [11]. In addition, 3,000,000 cases of acute pesticide poisoning occur almost every year [4] The Food and Agriculture Organization of the United Nations (FAO) is promoting the proper use of pesticides with its code of conduct [16]. FAO recommend governments in developing countries to provide personal protective equipment to farmers [14]. The World Health Organization (WHO) has helped in making an Essential Drug List (EDL) categorizing pesticides according to health hazard, going from extremely hazardous to unlikely to present acute hazards. It will help in removing the most dangerous pesticides from the market.

Many pesticides used by farmers in most developing countries are still classified as extremely and highly hazardous [14]. Studies in mainly four African countries revealed the use of unauthorized pesticides and a lack of advice on alternatives [7]. On worldwide basis, approximately 1.8 billion people are engaged in agricultural activities as the primary source of livelihood and therefore use insecticides to protect the food and commercial products they produce [2]. Some of the pesticides such as Endosulfan and DichloroDiphenylTrichloroethane (DDT) have been restricted from use by European Union (EU) due to health and environmental reasons [8], but are still being used in developing countries including Ghana. Residues of pesticides can be found in a great variety of agricultural produce. Washing and peeling alone cannot completely remove the residues. Pesticide residue levels for many agricultural produce in developing countries exceeds the maximum residual levels and these pose great dangers to consumers. Pesticides residues have also been detected in human breast milk samples, and there are concerns about prenatal exposure and health effects in children [10]. Therefore, it was imperative to assess the residual effects of Pesticide (antuka) on maize, cowpea and groundnuts as this is the most commonly used chemical by the farmers to store grains.

Crop damage from pest and disease infestations often results in serious consequences, warranting the need to use insecticides. Each year pests destroy about 30-48 % of the world's food production [17]. Crop loss from pests declines substantially when insecticides are used [13, 9]. It is better to assess the use of pesticides in order that potential consumers are free from any harm from chemical residue. The study assessed the residual levels of pesticides in stored maize, cowpea and groundnuts.

II. MATERIALS AND METHODOLOGY

The samples for the present study were procured at the farm gate of Nafaring, a farming community in the Tolon district of Northern Ghana. The grains were thereafter cleaned manually to remove all foreign matter such as stone, immature grains, broken grains, and impurities. The initial moisture content was measured using hot air oven dry method at 105° for 24 hours as used by [4]. A random sampling was used in the selection of grains for the study. Selected grains were moistened with calculated amount of distilled water and conditioned to raise their moisture contents to the desired levels. Equation [1] was used to calculate the amount of distilled water used according to [7, 12]

$$Q = \frac{W_i\,(M_f - M_i)}{100 - M_f} \qquad [1]$$

Where;

Q is the mass of be added in kg;

W_i is the initial mass of the sample kg;

M_i is the final moisture content of the sample in (%) the samples were sealed in separate polythene bags and kept in a refrigerator at 5°C for five days in order to achieve uniform moisture distribution within them. Before proceeding with the experiment, a known quantity of the grains was taken out from the refrigerator and allowed to warm up to room

temperature for about three hours [19]. Five levels of moisture contents were used for the all the grains (20, 25, 30, 35, and 40% wb.). These values are within the range of moisture contents encountered for the grains [20] during harvest to storage. It is recommended however that for storage, the moisture content for the various grains should be 20% [21].

III.EXPERIMENTAL DESIGN

The experiment was a single factor at three levels; maize, cowpea and groundnuts. This was then laid out in a Completely Randomized Design and replicated three times.

The chemical used was Antuka with active ingredients Pirimiphos-methyl and permethrin applied at a rate of 15 g/l to each of the grains. The chemical residue in produce after three months of storage was then taken to assess the residual level and its effects.

The chemical residual levels were determined following the Ghana Standard Authority method (2019). Data collected were analysed using Microsoft software Genstat and tables were generated using Excel.

IV. RESULTS AND DISCUSSIONS

Analysis of Residual levels in the maize, cowpea and groundnut

Table 4.12.1a Maize (Zea mays)

Test Code	Test Conducted	Unit	Results	Test Methods	Specifications
					EU MRLs for Maize
PIM	Pirimiphos-Methyl	Mg/kg	48.71	MRM by GC-PFPD and GC-ECD	0.500
PER	Permethrin	Mg/kg	19.39	GSA-SM-T03* (2013-08)	0.05

The values for residual levels of Pirimiphos-Methyl and Permethrin in maize were respectively 48.7 Mg/kg and 19.39 Mg/kg. It was observed that the residual levels exceeded their maximum residual levels.

A produce with such residue of chemicals in it should not be consumed by man or animal. Although it is indicated on usage guide of Antuka that it is for three months storage, this research "chemical residual analysis" shows that, at the end of three months of storage of maize, cowpea and groundnut the produce was still not safe for consumption, as the residues levels exceeds their maximum limits [17, 18].

Table 4.12.1b Cowpea

Test Code	Test Conducted	Unit	Results	Test Methods	Specifications
					EU MRLs for Cowpea
PIM	Pirimiphos-Methyl	Mg/kg	46.46	MRM by GC-PFPD and GC-ECD	0.01
PER	Permethrin	Mg/kg	13.53	GSA-SM-T03* (2013-08)	0.05

From the table given above, the chemical residual remains in the produce (cowpea) showed that, the active Pririmiphos-Methyl had a potency of 46.46 Mg/kg, whereas that for Permethrin was 13.53 Mg/kg. These showed that, the produce was still not safe for human consumption after storing it for three months. The residual levels for the chemicals Pirimiphos-methyl and Permethrin under storage for cowpea was exceedingly higher than their maximum residual levels.

Table 4.12.1.c Groundnut

Test Code	Test Conducted	Unit	Results	Test Methods	Specifications
					EU MRLs for Groundnut
PIM	Pirimiphos-Methyl	Mg/kg	47.50	MRM by GC-PFPD and GC-ECD	0.50 (Max)
PER	Permethrin	Mg/kg	19.64	GSA-SM-T03* (2013-08)	0.05 (Max)

The given table above shows the computed figures and analysis for groundnut which is stored using the same chemical and condition with the same period given and at the same time, as in the case of the maize and cowpea, for the period of three months. The testing and analysis show that, the active ingredients in the chemical, thus; Pirimiphos-Methyl still has a potency of 47.50 Mg/kg, whereas that for Permethrin is 19.64 Mg/kg. Pirimiphos-Methyl and Permethrin residue levels in the Groundnut exceeded their maximum residual levels and therefore not safe for human consumption. The results given in the tables above showed that, the residual remains in the stored produce after the period of three months, still showed that the produce can still not be consumed safely, according to [17, 18]. If the chemicals used to store produce are still high such that it is still contaminated, and that the potency of the chemical is almost still at its peak, the produce is not safe for consumption.

V. CONCLUSION

Prevention of pest is one of the means to prevent losses in both field and storage period. Pesticide residual effect on food can make it unwholesome for consumption. Giving special attention to pesticide residual management in stored products is critical in preventing diseases among consumers. Special education is needed in how to use pesticide and also on the rate at which pesticide should be applied to products before storage. This, when done will reduce the levels of pesticide contamination in stored products.

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