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Assessment of Pesticide Residue Content among Vegetables Sold at Chongwe Market, Lusaka Province, Zambia

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Abstract
This study investigated the concentration of dichlorvos and monochrotophos in rape, Chinese vegetable and tomatoes sold at Chongwe market in Lusaka province of Zambia. Ten samples for each type of vegetable were randomly sampled and collected from the market. Each sample was put in its own new polyethene carrier bag. They were taken to the laboratory for sample preparation and chemical analysis. The concentration of dichlorvos in rape (2.4mg/Kg) was alarmingly higher than the maximum residue limit by WHO standards (0.5mg/Kg), while in Chinese vegetable the concentration was only higher by 0.4mg/Kg. In tomatoes, dichlorvos was not detectable. Monochrotophos concentration in rape (0.38mg/Kg), Chinese (0.19mg/Kg) and tomatoes (0.78mg/Kg). It was above the threshold in all the samples. All in all, five out of six samples had both dichlorvos and monochrotophos concentrations higher than the MRL. This could mean that human health is at risk.

Keywords: pesticide residue, maximum residue limit

1. Introduction

Vegetables are important components of the human diet because they provide essential nutrients in the human body required for body functions. A high intake of the vegetables has been encouraged not only to prevent consequences due to vitamin deficiency but also to reduce the incidence of major diseases such as cancer, cardiovascular diseases and obesity (Kalulu, 2023). To prevent vegetable damage, pesticides are used to destroy pests and prevent diseases. Sadly, the use of pesticides often leads to pesticide residues in fruits and vegetables at harvest time. As a result, fresh vegetables sold in markets need to be monitored for their pesticide content in order to ascertain safety of human health since pesticides are hazardous to human health. Pesticide residues may be acute or chronic to human health while others may accumulate and magnify in human tissues to harmful levels (Mulenga, 2010).

Good Agriculture Practices (GAP) says that a pesticide must leave a residue that is small in concentration and have no substantial effect on the health of people. As a result, some of these pesticides have been banned or restricted in other countries because they leave high residue content. Monocrotophos and dichlorvos are among the pesticides used in fruit and vegetables. But some countrie have banned the use of monocrotophos and dichlorvos due to their harmful effects on humans.

1.2 Statement of the Problem

Pesticide residue concentrated in fruits and vegetables is a topical issue among scholars today because of known potential harmful effects to man. Therefore, this study investigated the concentration of pesticide residues on vegetables sold at Chongwe market.

1.3. Purpose of the study

The aim of this study is to quantify the monocrotophos and dichlorvos residue in fruits and vegetables and ascertain whether they are in line with internationally acceptable standards. This is important to safeguard the health of the consumers of the vegetables.

1.4 Objectives of the study

1. To determine the concentration of monocrotophos and dichlorvos residues vegetables sold at Chongwe market.
2. To assess the potential health risks associated with consumption of vegetables containing pesticide residues at Chongwe market.

1.5 . Research Questions

1. What is the concentration of monocrotophos and dichlorvos residue vegetables sold at Chongwe market?
2. What are the potential health risks associated with concentration of monocrotophos and dichlorvos residues in vegetables sold at Chongwe market?

1.6. Significance of the study

There is lack of information on pesticide residue on vegetables sold at Chongwe market. Therefore, this study brings to the fore insights into the safety of these commodities at the market.

Literature Review

Economically, Chongwe district depends mainly on subsistence farming. The main crops are vegetables. While other crops are seasonal, vegetables are grown all year round and are a major source of income for the majority of the farmers. Because of this, pesticides are largely used to control pests and diseases in order to improve their crop yield. Vegetable growers are concentrated along the Chongwe and Chalimbana rivers. The rest depend on dams and seasonal streams. Despite massive use of pesticides in the area, no published study has been carried out to assess pesticide residues in vegetables, hence, the need to study.

Fruits and vegetables are the main source of pesticide residue intake in humans because they are eaten unprocessed. The United Nations through the Codex Alimentarius Commission (CAC) recognize the potential for pesticide residues on fruits and vegetables and has since established their maximum residue limits (Codex Alimentarius Commission, 2010). Studies have shown that some foods may contain pesticide residues above maximum residue limits (MRLs) (Waliszewski & Farag, 2011). In a study done in Germany, 2% of all agriculture products of plant origin examined including plums and lettuce showed signs of inadmissible application of pesticides. In the same study, the levels of contamination detected in 11 samples of pineapple, tomatoes, peaches, nectarines, lettuce and zucchini were considered significantly high to possibly pose acute health effects (Verbranckerschut and Isicherheit, 2011 cited in PAN Germany, 2012).

In another study in Korea, (Seo, 2013), pesticide residues were detected in 11 different samples of the selected agricultural products of which 2 samples exceeded the maximum residual limits. Six out of the nine analyzed dried pepper leaves had pesticide residues and one sample exceeded the MRLs. Though the study concluded that the detected pesticide residues could not be considered a serious public health problem, continuous investigations and monitoring was recommended.

In Poland, 376 of 1026 analyzed samples (36.6%) had pesticide residues. In 18 of these samples (1.8%), residues exceeded maximum residue limits. In the same study, substances not recommended for a given crop were detected in 28 (2.7%) of the samples (Szpyrka, 2015).

Monocrotophos

Despite being classified by WHO as highly hazardous and dangerous for the environment, monocrotophos is registered for use in many countries, including Zambia. Exposure to monocrotophos can adversely affect the nervous system, can cause headaches, dizziness, seizures and respiratory failure. Chronic exposure to monocrotophos has been linked to damage to the reproductive and endocrine systems. As a result of these effects, monocrotophos has been banned in USA (Pesticide sheet, 2006).

Dichlorvos

Acute and prolonged exposure may lead to death, genotoxic, neurological, reproductive, and carcinogenic. Also, non-adherence to good agriculture practices may lead to acute hazardous effects on man and the environment.

Materials and Methods

Sampling techniques

Ten samples of each kind of vegetable (rape, Chinese vegetable and tomatoes) were sampled from Chongwe market and each sample was packaged in polyethene carrier bag. They were transported to National Food Laboratory for chemical analysis.

Sample preparation

The samples were cleaned. Each type was mixed evenly and crushed or cut into smaller pieces using a knife. 50g of each sample was taken from the composite sample. These were blended using a laboratory blender.

Extraction of the sample

Extraction solvents used were dichloromethane, hexane and acetone Hipersolv chromanone HPLC grades. A total of 2.0g sample after being milled was placed into a 250mL beaker, 5.0g of sodium chloride was added followed by addition of dichloromethane, extracted by ultrasonic for 30 minutes. After that, 10g of anhydrous sodium suphate was added and stayed for two minutes. The extraction was transferred to a column packaged with 4g anhydrous sodium sulphate and rinsed twice with 5mL of dichloromethane. The eluents were collected and evaporated to nearly dryness under nitrogen stream at 45 degrees Celsius. The residue was re-dissolved in 1mL hexane.

A High-Power Liquid Chromatography (HPLC) was used to analyze the pesticides' concentration in the extracts and the findings are shown in the table 1.

Table 1: Analysis results

S/N	Rape	Chinese	Tomatoes	Maximum Residue level (MRL) mg/kg
Dichlorvos Concentration (mg/kg)	2.4	0.54	ND	0.5
Monochrotophos Concentration (mg/kg)	0.38	0.19	0.75	0.1

Discussion, Results interpretation and conclusion

Interpretation of results was done against the WHO threshold values, as given from the National Food Laboratory. As seen from the results in the analysis report, the concentration of dichlorvos in rape (2.4mg/Kg) was alarmingly higher than the MRL (0.5mg/Kg), while in Chinese vegetables, the concentration was higher by 0.4mg/Kg. In tomatoes, dichlorvos was not detectable. Monochrotophos concentration in rape (0.38mg/Kg), Chinese (0.19mg/Kg) and tomatoes (0.78mg/Kg) was above the threshold in all the samples. All in all, five out of six samples had both dichlorvos and monochrotophos concentrations higher than the MRL. This may put the health of consumers at very high risk, especially that the concentrations are way beyond the permissible limit.

There are various reasons leading to such results. Among them, it could be that waiting or pre-harvest period not being observed by farmers. This could be a result of no formal training on pesticide handling and usage among the farmers.

The study aimed at finding out the concentration of dichlorvos and monochrotophos in vegetables in order to safeguard the health of consumers through making recommendations to relevant authorities. Laboratory findings show that the concentration of both chemical substances was much higher than the allowable limit. This shows that the vegetables are not fit for human consumption as they may lead to acute or chronic effects on human life.

Recommendations

1. ZEMA must regulate the entry and manufacture of such pesticides
2. Ministry of health must regularly inspect the vegetables sold at the market
3. Ministry of agriculture must train the farmers formerly on usage and handling of pesticides

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