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Quantitative Analysis of Pesticide Residues in Selected Fruits Sold in Five Major Markets within Jos Metropolis, Plateau State

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A B S T R A C T

This study quantifies pesticide residues in five main Jos markets for tomatoes, oranges, apples, and strawberries. These fruits were tested for pesticide residues and compared to regulation Maximum Residue Limits (MRLs). In tomatoes, Chlorpyrifos and Diazinon residues ranged from 0.01 mg/kg to 0.02 mg/kg, and Diazinon residues from 0.02 mg/kg to 0.12 mg/kg was greatest in the Building Materials market. In citrus products, Fenpropathrin levels ranged from 0.33 mg/kg to 0.38 mg/kg, all within the MRL of 2 mg/kg, whereas Permethrin residues ranged from 0.01 mg/kg to 0.07 mg/kg, with Kugiya market above the MRL of 0.05 In apples, Chlorpyrifos-methyl residues surpassed the MRL of 0.01 mg/kg in all markets, ranging from 0.26 to 0.30 mg/kg, while Diazinon levels exceeded the MRL in Kugiya and Farin Gada markets, ranging from 0.02 to 0.07. Strawberry Permethrin levels above the Building Materials and Gada Biu markets' MRL of 0.05 mg/kg at 0.16–0.20 mg/kg. Safe fenpropathrin residues ranged from 0.32 to 0.38 mg/kg. Several marketplaces had pesticide residue levels over MRLs, raising concerns about pesticide usage and regulatory monitoring. The report emphasizes the need for better monitoring, pesticide control, and regulation enforcement to protect human health and food safety.

Keywords: Tomato, Pesticide. Apple, Strawberry, Residue, Market, Maximum Residue Limits

INTRODUCTION

Pesticide contamination in fruit products is a major public health and security concern due to its harmful effects and persistence in food (Sawye et al., 2024). Chlorpyrifos, Diazinon, Fenpropathrin, and Permethrin are widely used in agriculture, but long-term exposure causes serious health problems (Wang et al., 2022). This study evaluates Jos Metropolis' fruit supply contamination and Maximum Residue Limits.

METHODS

Sixty fruit samples were randomly selected from Jos Metropolis' five largest markets: Farin Gada, Gada Biu, Terminus, Building Materials, and Kugiya Market. Three samples of each fruit were randomly selected from three sellers and places within each market to assure accuracy. The samples were subsequently taken to Plateau State Polytechnic Barkin Ladi's Chemistry lab for pesticide residue examination. Gas Chromatography Mass Spectrometry was used to analyze fruit residues using conventional extraction methods (EFSA et al., 2023).

RESULTS

The data showed pesticide residue levels in tomatoes, citrus, apples, and strawberries across marketplaces. It compares pesticide levels to regulatory Maximum Residue Limits (MRLs) and examines the implications of the findings for other studies.

Table 1: Pesticide Residue Levels in Tomatoes

Pesticide Residue	MRL (mg/kg)	Building Materials Market (mg/kg)	Terminus Market (mg/kg)	Gada Biu Market (mg/kg)	Kugiya Market (mg/kg)	Farin Gada Market (mg/kg)
Chlorpyrifos	0.01	0.01	0.02	0.02	0.01	0.01
Diazinon	0.01	0.12	0.03	0.02	0.03	0.02

Table 2: Pesticide Residue Levels in Citrus

Pesticide Residue	MRL (mg/kg)	Building Materials Market (mg/kg)	Terminus Market (mg/kg)	Gada Biu Market (mg/kg)	Kugiya Market (mg/kg)	Farin Gada Market (mg/kg)
Fenpropathrin	2	0.36	0.34	0.38	0.35	0.33
Permethrin	0.05	0.03	0.01	0.06	0.07	0.06

Table 3: Pesticide Residue Levels in Apples

Pesticide Residue	MRL (mg/kg)	Building Materials Market (mg/kg)	Terminus Market (mg/kg)	Gada Biu Market (mg/kg)	Kugiya Market (mg/kg)	Farin Gada Market (mg/kg)
Chlorpyrifos-methyl	0.01	0.28	0.26	0.30	0.29	0.27
Diazinon	0.01	0.02	0.03	0.02	0.07	0.06

Table 4: Pesticide Residue Levels in Strawberries

Pesticide Residue	MRL (mg/kg)	Building Materials Market (mg/kg)	Terminus Market (mg/kg)	Gada Biu Market (mg/kg)	Kugiya Market (mg/kg)	Farin Gada Market (mg/kg)
Permethrin	0.05	0.19	0.17	0.20	0.18	0.16
Fenpropathrin	2	0.35	0.33	0.38	0.34	0.32

The residue level of Chlorpyrifos (0.01 mg/kg MRL) in the five markets (table 1), in tomato ranged from 0.01 mg/kg to 0.02 mg/kg, which is within the MRL. Terminus and Gada Biu markets had slightly higher values. Nguyen and colleagues (2022) found chlorpyrifos residual levels in tomatoes around the MRL, indicating usual agricultural pesticide use. Levels of Diazinon (MRL = 0.01 mg/kg) residues in tomato varied from 0.02 to 0.12 mg/kg, with the Building Materials market having the greatest concentration. Pesticide overuse hazards are raised by its exceeding the MRL. Adebisi et al. (2023) found that Diazinon residues surpassed MRLs in agricultural goods in locations with lower pesticide control and enforcement.

Fenpropathrin (MRL = 2 mg/kg): Citrus fruits (table 2) in all markets contain 0.33 to 0.38 mg/kg, well below the MRL. Pesticide use in citrus agriculture is safe at these levels. Minea and Radulescu (2023) reported low Fenpropathrin levels in citrus fruits across Indian marketplaces, suggesting successful pesticide control in citrus production. Permethrin (0.05 mg/kg MRL): Permethrin residues in citrus fruits vary from 0.01 mg/kg to 0.07 mg/kg, with Kugiya slightly above the MRL. Other markets report acceptable residues. Kowalska et al. (2022) found that post-harvest treatments caused some citrus markets to exceed MRLs for Permethrin residues.

Apple residue levels (table 3) of chlorpyrifos-methyl range from 0.26 mg/kg to 0.30 mg/kg, significantly exceeding the MRL. Endocrine disruption and carcinogenicity have been linked to prolonged pesticide exposure, making these elevated levels concerning (Odabas et al., 2024). Many studies, including Yalçın et al. (2021), found that Chlorpyrifos-methyl residues in apples often exceed safe levels, especially in regions with weak pesticide regulations.

Diazinon (MRL = 0.01 mg/kg): Apple residue levels range from 0.02 to 0.07 mg/kg, exceeding the MRL in several markets. Mackialeagha and Farahani (2012) found elevated Diazinon levels in apples, especially in countries with lax pesticide regulations. This suggests tighter pesticide monitoring in fruit production.

Permethrin (0.05 mg/kg MRL): Strawberry residue levels (Table 4) range from 0.16 mg/kg to 0.20 mg/kg, with Building Materials and Gada Biu markets above the MRL. Hernandez (2019) found that strawberry pesticide residues often exceed the MRL due to improper handling and use. Fenpropathrin (2 mg/kg MRL): The residue levels in strawberries range from 0.32 mg/kg to 0.38 mg/kg, all of which are well below the MRL. This suggests that Fenpropathrin use in strawberries is within safe limits. Luo et al. (2023) observed similar results in strawberries, where Fenpropathrin levels were consistently low and within regulatory limits. The pesticide residue levels found in this study are consistent with findings from other regions, though some markets show residue levels that exceed the MRL, particularly for pesticides like Chlorpyrifos, Diazinon, and Permethrin. Studies done in other countries also reveal comparable exceedances in agricultural goods, raising concerns about pesticide usage and poor regulatory control (Odabas et al., 2024; Yalçın et al., 2022; Mackialeagha & Farahani, 2012), This shows that the issue of pesticide residues in food is a widespread concern that requires better monitoring and control.

Conclusion

The findings of this study suggest that while many pesticide residues in fruits are within acceptable MRLs, some markets show pesticide levels exceeding the MRL, particularly for Chlorpyrifos, Diazinon, and Permethrin. The markets that exhibit higher residue levels, such as the Building Materials and Kugiya markets, may be experiencing issues related to improper pesticide application, inadequate post-harvest handling, or a lack of proper regulatory oversight. These exceedances represent possible health hazards, as sustained exposure to pesticides over MRLs can lead to serious health consequences.

Recommendations

1. There is a need for stronger monitoring and enforcement of pesticide laws, particularly in markets where residual levels exceed MRLs. Regular testing of fruits and vegetables for pesticide residues can assist assure compliance with safety regulations.

2. Farmers should learn safe pesticide application, doses, and post-harvest management. Training programs can decrease pesticide usage and maintain acceptable levels.

3. Markets should develop stronger post-harvest handling practices, as incorrect handling might result to increased pesticide residues. This involves appropriate washing, storing, and transportation of fruits to decrease the danger of pesticide contamination.

4. Further Research should be performed to understand the sources of excessive pesticide residues in certain markets. Such research would assist identify the elements contributing to pesticide overuse and provide measures for improving agricultural practices.

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