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Toxicological Assessment of Carbamates and Organophosphorus Compounds in Vegetables Sold at the Agriculture Kalasin Market: A Case Study

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Abstract

Pesticides play a vital role in agriculture by controlling insect populations and increasing crop yields. However, their widespread and uncontrolled use poses significant risks to the environment and non-target organisms. This study aimed to investigate the presence of carbamate and organophosphate residues in vegetable samples collected from the agriculture Kalasin market. A total of 290 vegetable samples representing 29 different plant species were analyzed, including kale, carrots, coriander, parsley, morning glory, lemongrass, bell pepper, lettuce, gourds, tomatoes, collard flowers, thymes, cucumber, potatoes, bean sprouts, cowpea, small eggplant, luffa gourd, cowslip creeper, asparagus, corn, Chinese cabbage, cabbage, golden needle, mushroom, Chinese chives, canton celery, onion, and turnip. The results revealed that all samples were contaminated with carbamate and organophosphate residues. Notably, turnip, celery, corn, and onions had levels below 0.05 mg/kg. On the other hand, kale, carrots, coriander, parsley, morning glory, lemongrass, bell pepper, lettuce, gourd, tomatoes, collard flowers, thyme, cucumber, potato, bean sprouts, cowpea, small eggplant, luffa gourd, cowslip creeper, asparagus, ear mushroom, Chinese cabbage, cabbage, golden needle mushroom, Chinese chives, and canton exhibited residue levels exceeding 0.05 mg/kg. These findings underscore the importance of monitoring pesticide residues in vegetables and raise concerns about food safety associated with the use of carbamates and organophosphates in agriculture. It is imperative to implement measures to reduce pesticide usage, promote sustainable farming practices, and ensure the safety of agricultural products for consumers.

Keywords: pesticide residues, food safety, agricultural market, non-target organisms, risk assessment.

Introduction

Pesticides are a diverse group of chemicals commonly used to manage pests and enhance agricultural productivity. They have become essential components of modern agriculture, although their significance is gradually being overshadowed by other agricultural products (Chowdhury et al., 2012). The widespread use of pesticides is crucial for combating pests and meeting the increasing global demand for food production (Pogačnik & Franko, 2003). However, the improper application and use of pesticides pose risks not only to the intended targets but also to other living organisms, highlighting the need for careful consideration of their impact on the environment. Fresh vegetables and fruits are vital components of a healthy diet, offering a wide range of nutrients and minerals. Unfortunately, they can also serve as sources of toxic substances, such as pesticide residues (Quijano et al., 2016). While pesticides contribute to increasing agricultural yields, their unintended effects can harm various organisms and disrupt ecosystems (Liu et al., 2005). Chronic exposure to pesticides has been associated with genotoxicity, tumor growth, birth defects, genetic alterations, hematological disorders, and endocrine dysfunction (King & Aaron, 2015). Furthermore, the application and use of pesticides can lead to environmental contamination (Jensen et al., 2003). Although pesticides have greatly contributed to the agricultural sector's productivity by controlling pests and insects, their adverse effects on non-target organisms cannot be ignored (Tamaš et al., 2015). Pesticides can be classified into different groups based on their structural characteristics, including organochlorines, carbamates, and organophosphates. Both organophosphate poisoning (OP) and carbamate exposure (CM) can lead to similar symptoms, although the duration of CM poisoning is typically shorter (Li et al., 2017). Considering the potential risks and benefits associated with pesticide use, it is crucial to examine their impact on the environment, non-target organisms, and food safety. This study aims to explore the presence of carbamate and organophosphate residues in vegetable samples obtained from agricultural markets, shedding light on the implications for environmental sustainability and human health. By understanding the extent of pesticide contamination in fresh produce, appropriate measures can be implemented to ensure a safer and more sustainable agricultural system.Insecticides made of carbamates and organophosphates degrade very quickly. As a result, long-term residuals are infrequently found in the environment. However, it is very poisonous. Accumulation of acetylcholine is caused by decreasing the activity of acetylcholinesterase. Acute poisoning results in strong stimulation of the nerve endings at the site. (Boon, P. E., Van der Voet, H., Van Raaij, M. T. M., & Van Klaveren, J. D., 2008). Other symptoms found were nausea, vomiting, diarrhea, tears, sweating, retinal detachment, and urinary incontinence. bronchospasm spasm and have a lot of phlegm (Kanga, L. H. B., Pree, D. J., Van Lier, J. L., & Walker, G.

M.,1999). These chemicals include carbamate groups and organophosphate groups with widespread commercial names like Parathion, Malathion, Diazinon, Penithion, etc. Methomyl, among other common commercial names Aidicarb, Bendiocarb and Carbaryl Propoxer Rashid, S., Rashid, W., Tulcan, R. X. S., & Huang, H., 2022). The objective of this investigation was to detect the presence of carbamates and organophosphates in samples of vegetables obtained from the agriculture Kalasin marketplaces. A total of 290 vegetable samples, representing 29 different plant species, were included in the study.

Materials and Methods

Research area *and Vegetables Sampling*

The research area focused on examining the presence of organophosphates and carbamates in vegetable samples obtained from the Agricultural Kalasin Market. A total of 290 vegetable samples were collected, representing 29 different vegetable species, providing a diverse range of choices for consumers. The vegetable samples included kale (n=10), carrots (n=10), coriander (n=10), parsley (n=10), morning glory (n=10), lemongrass (n=10), bell pepper (n=10), lettuce (n=10), gourds (n=10), tomatoes (n=10), collard flowers (n=10), thyme (n=10), cucumber (n=10), potato (n=10), bean sprouts (n=10), cowpea (n=10), small eggplant (n=10), luffa gourd (n=10), cowslip creeper (n=10), asparagus (n=10), corn (n=10), mushroom (n=10), Chinese cabbage (n=10), cabbage (n=10), golden needle (n=10), mushroom (n=10), Chinese chives (n=10), canton (n=10), celery (n=10), onion (n=10), and turnip (n=10), respectively.

The vegetable Samples Analysis

From 290 vegetable samples from the Agricultural Kalasin Market, 29 different vegetable various types were chosen using the GT test kit. Pesticides with carbamates and organophosphorus are the most often utilized ones. The development of effective analytical procedures for the detection and measurement of carbamate and organophosphorus pesticides in fruits has thus been necessitated by GT test kit. The method used by the GT-Test kit is based on measuring the inhibition of the cholinesterase enzyme. Numerous herbicides inhibit this enzyme, most notably carbamates and organophosphorus.

Figure 1 Distribution of Pesticide Levels in Vegetable Samples from Agricultural Kalasin Market

Level 1the negative control group (Safe level)
Level 2 pesticide residue but in safe level
Levels 3 exceeding 0.05 mg/kg (critical level)

The solution reaction was visually split into three stages, with the presence of pesticide residue being indicated by darker color. in Figure 1 Level 1the negative control group (Safe level), Level 2 pesticide residue but in safe level (less than 0.05mg/kg) and Level 3 Levels 3 exceeding 0.05 mg/kg (critical level).

Results

The results reveal that turnip, celery, corn, and onions had pesticide residue levels below the threshold of 0.05 mg/kg, indicating a lower presence of pesticides. On the other hand, the remaining vegetable types, including kale, carrots, coriander, parsley, morning glory, lemongrass, bell pepper, lettuce, gourd, tomatoes, collard flowers, thyme, cucumber, potato, bean sprouts, cowpea, small eggplant, luffa gourd, cowslip creeper, asparagus, ear mushroom, Chinese cabbage, cabbage, golden needle mushroom, Chinese chives, and canton, exhibited pesticide residue levels exceeding the threshold of 0.05 mg/kg.

Table 1: Pesticide Residue Levels in Vegetable Samples from Agricultural Kalasin Market

Vegetable Type	Pesticide Residue Level (mg/kg)
Turnip	< 0.05
Celery	< 0.05
Corn	< 0.05
Onions	< 0.05
Kale	> 0.05
Carrots	> 0.05
Coriander	> 0.05
Parsley	> 0.05
Morning Glory	> 0.05
Lemongrass	> 0.05
Bell Pepper	> 0.05
Lettuce	> 0.05
Gourd	> 0.05
Tomatoes	> 0.05
Collard Flowers	> 0.05
Thyme	> 0.05
Cucumber	> 0.05
Potato	> 0.05
Bean Sprouts	> 0.05

Vegetable Type	Pesticide Residue Level (mg/kg)
Cowpea	> 0.05
Small Eggplant	> 0.05
Luffa Gourd	> 0.05
Cowslip Creeper	> 0.05
Asparagus	> 0.05
Ear Mushroom	> 0.05
Chinese Cabbage	> 0.05
Cabbage	> 0.05
Golden Needle Mushroom	> 0.05
Chinese Chives	> 0.05
Canton	> 0.05

Table 1 displays the results of the analysis, indicating the levels of pesticide residues found in different vegetable samples obtained from the Agricultural Kalasin Market. The vegetable types are listed, along with their corresponding pesticide residue levels in milligrams per kilogram (mg/kg).

These findings highlight the varying levels of pesticide contamination among different vegetable types, emphasizing the need for effective pesticide management strategies to ensure the safety and quality of agricultural produce.The safe use of pesticides that might have an effect on both consumer health and the environment is currently regulated by the Ministry of Public Health and other organizations. because eating poisonous or pesticide-containing fruits and veggies.

Discussion

The discussion revolves around the use of carbamate and organophosphate pesticides in agriculture and their potential adverse effects on the environment and human health. These pesticides are widely used due to their low persistence in the environment, but their application rates and properties can affect their distribution and contamination of water and sediments. Leakage or runoff of these pesticides can contaminate terrestrial and aquatic food webs. Exposure to organophosphates can lead to acute toxicity in humans, animals, plants, and insects. Prolonged exposure may result in various symptoms, including mood swings, anxiety, appetite loss, and cognitive changes. The deliberate release of pesticides into the environment can have negative ecological impacts and harm non-target organisms. To minimize the risk of consuming fruits and vegetables with pesticide residues, certain precautions can be taken. Consumers are advised to choose fruits and vegetables with natural colors, avoiding those with soil residues or pesticide-related spots. Fresh produce with minimal damage from worms or insects is also preferable. Proper labeling and traceability of produce can help consumers identify the source of the products. Purchasing seasonal and locally grown vegetables can reduce the reliance on fertilizers and chemicals. Additionally, varying the consumption of different vegetables is recommended to maximize nutritional benefits and minimize the accumulation of toxins or chemicals.

Overall, the discussion highlights the importance of understanding pesticide risks, implementing sustainable farming practices, and making informed choices as consumers to ensure food safety and minimize environmental impacts.

The most extensively used pesticides globally are carbamate and organophosphate due to their low environmental persistence. (Fatunsin, O. T., Oyeyiola, A. O., Moshood, M. O., Akanbi, L. M., & Fadahunsi, D. E., 2020). These pesticides' application rates, kinds, and physical and chemical properties affect where they are found and how they are distributed in water and sediments. It is possible for OP and CM pesticides to accidentally leak, runoff in an indirect Organophosphates (OPs) are a crucial component of contemporary agriculture; but, due to overuse, pesticide residues from OPs are leaking into the ground, building up, and contaminating terrestrial and aquatic food webs (Neufeld, D. S. G., Savoeun, H., Phoeurk, C., Glick, A., & Hernandez, C., 2010). Acute exposure to OPs may cause toxicity in humans, animals, plants, and insects. (Berman, T., Göen, T., Novack, L., Beacher, L., Grinshpan, L., Segev, D., & Tordjman, K., 2016). Organophosphate exposure for an extended period of time may result in mood swings, melancholy, anxiety, forgetfulness, appetite loss, and personality changes. There may also be additional symptoms like fatigue, headaches, diarrhoea, nausea, and vomiting manner, or drift into the environment (Sun, Z., Tian, L., Guo, M., Xu, X., Li, Q., & Weng, H., 2017). In agriculture, great productivity is attained through controlling pests, and pesticides are crucial to this process. However, pesticides are deliberately poisonous, frequently toward organisms that are not their intended targets, and their intentional release into the environment has negative environmental effects

The best way to purchase fruits and veggies Follow these steps to stay safe and lower your risk of having chemical residues (Magkos, F., Arvaniti, F., & Zampelas, A., 2006). Choose fruits and vegetables that are naturally colored rather than those with flashy soil or pesticide-related white spots. Both fungus and black spots are absent. Including an oddly strong fragrance. Buy fresh vegetables with holes already drilled (Nicastro, R., & Carillo, P, 2021). Some bite marks left by worms or other insects are visible. Alternatively, you should pick produce that has some worms (Yeung, R. M., & Morris, J., 2001) Alternatively, there are a few crawling insects like ants, aphids, etc. because rodent droppings are now commonplace. synthetic borer adding heated sand to the pan to roll on (Shafie, F. A., & Rennie, D., 2012). After that, pour it on the vegetables. to resemble the worm's puncture marks If the grocery store's selection of produce and fruits. should decide to purchase items that are properly labeled. Fruits and vegetables can be tracked back to their source, for instance, by looking up the production location number. or foreign food Buy seasonal produce at the market. because seasonal vegetable cultivation increases the likelihood of successful growth (Li, F., Yuan, Y., Meng, P., Wu, M., Li, S., & Chen, B., 2017). This lessens the need for fertilizers and chemicals. Alternatively, consume readily available vegetables like basil, coriander, morning glory, spring onions, etc. Never purchase any kind of vegetable to consume frequently. should alternate between a number of foods to acquire the full nutritional benefits and prevent the buildup of poisons or chemicals (Nicastro, R., & Carillo, P., 2021).

Conclusion

In conclusion, the presence of carbamate and organophosphate residues in vegetable samples collected from the Agricultural Kalasin Market highlights the potential food safety concerns associated with the use of these pesticides in agriculture. The study found that all samples were contaminated with these pesticide residues, with some vegetables exceeding the critical level of 0.05 mg/kg. Carbamates and organophosphates are widely used pesticides due to their effectiveness in pest control. However, their indiscriminate use and accidental leakage can lead to environmental contamination, affecting terrestrial and aquatic food webs. Acute exposure to these pesticides can pose health risks to humans, animals, plants, and insects, while prolonged exposure may result in various symptoms and adverse effects.

To reduce the risk of consuming vegetables with pesticide residues, it is important to adopt safe purchasing practices. Choosing naturally colored fruits and vegetables, inspecting for visible signs of damage by worms or insects, and avoiding produce with rodent droppings can help minimize exposure to pesticides. Additionally, selecting items with proper labeling and traceability can ensure transparency in the food supply chain. Promoting sustainable farming practices, reducing pesticide usage, and opting for seasonal and locally sourced produce are effective measures to minimize the need for excessive chemicals and fertilizers. Encouraging dietary diversity by consuming a variety of vegetables can help optimize nutritional intake while reducing the potential accumulation of toxins or chemicals from a single source.

Overall, monitoring pesticide residues in vegetables and implementing strategies to promote food safety are essential for protecting consumer health and mitigating the negative environmental impacts associated with pesticide use in agriculture. Pesticides, particularly carbamates and organophosphates, are widely used in agriculture due to their low environmental persistence. The application rates, types, and physical-chemical properties of these pesticides influence their distribution in water and sediments. Unfortunately, the overuse of organophosphates has led to pesticide residues seeping into the ground, accumulating, and contaminating terrestrial and aquatic food webs. Acute exposure to organophosphates can have toxic effects on humans, animals, plants, and insects. Prolonged exposure to these pesticides may result in various symptoms such as mood swings, anxiety, forgetfulness, appetite loss, and personality changes. Additional symptoms like fatigue, headaches, diarrhea, nausea, and vomiting can also occur. Furthermore, pesticides can unintentionally drift into the environment, causing negative environmental effects.To minimize the risk of consuming fruits and vegetables with pesticide residues, certain measures can be taken when making purchases. It is advisable to choose fruits and vegetables that have natural colors and do not exhibit flashy soil or pesticide-related white spots. Look for produce without fungus or black spots and pay attention to any unusually strong fragrances. Additionally, fresh vegetables with visible holes or bite marks left by worms or insects can indicate lower pesticide exposure. Alternatively, some crawling insects like ants or aphids may suggest a reduced use of pesticides. Avoid purchasing produce with signs of rodent droppings. One method to simulate worm puncture marks is by using a synthetic borer with heated sand and rolling it on the vegetables. When shopping, opt for properly labeled items that allow for traceability back to their production location. Buying seasonal produce from local markets is also beneficial as seasonal cultivation reduces the need for excessive fertilizers and chemicals. Consuming readily available vegetables like basil, coriander, morning glory, or spring onions is recommended. It is important to vary the selection of vegetables to obtain a wide range of nutritional benefits and prevent the accumulation of toxins or chemicals from consuming the same type of vegetable frequently. By following these guidelines, individuals can make informed choices when purchasing fruits and vegetables, reducing their risk of chemical residues and promoting safer and healthier food consumption.

The reason that this study discovered residual contamination in vegetables is that farmers lack protective knowledge and skills, they want to produce to meet consumer demand, and the law on the use of pesticides is not strict enough for both sellers and users. Due to their low environmental persistence, carbamate and organophosphate are the two pesticides that are most commonly employed worldwide. Exhaustion, headaches, diarrhea, nausea, and vomiting are a few additional indications and symptoms that could exist. Due to their low environmental persistence, carbamate and organophosphate insecticides are the most widely used pesticides worldwide. Acute exposure to OPs may cause toxicity in humans, animals, plants, and insects (King, A. M., & Aaron, C. K., 2015). Pesticides are a crucial part of pest management in agriculture, which is necessary for producing good yields. Contrarily, pesticides have negative environmental effects since they are intentionally released into the environment and frequently cause harm to organisms other than their intended targets.

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Conflict of Interest

The authors have no conflicts of interest.

Data Available

The author confirms that the data were significant in obtaining to this finding.

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