

Analysis of pesticide residues in tomato crops using GC-MS

Abstract

The purpose of this study was to assess pesticide residual levels that are often applied to tomato crops in Western Algeria. It revealed that a considerable amount of pesticides, particularly fungicides and insecticides, were used in agricultural fields. Following QuEChERS extraction, five tomato samples in total were examined utilizing multi-residue analysis by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Three samples revealed the presence of five pesticides: methomyl, triadimenol, metalaxyl, chlorpyrifos, and dipenoconazole. Two distinct pesticide kinds' residues were found in five of these samples. One sample had a methomyl residue level that was higher than the EU's maximum limit (MRLs). Our findings show a clear disregard for proper agricultural practices and widespread overuse of pesticides. It is advised to regularly check for pesticides to protect consumer health.

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Introduction

Pesticides are frequently used to keep pests under control when plants are growing and being preserved. It is now commonly acknowledged that the use of pesticides in agriculture results in undetectable residues on food that could pose a major risk to consumers' health. Particularly vulnerable to pests are often consumed crops like tomatoes, where this danger is very high. Many regulations, known as Maximum Residue Limits (MRLs) on treated foods, were created to maintain pesticide residues below acceptable thresholds to preserve consumer health and the environment (Alamgir 2013). MRLs represent good agricultural methods that produce residue levels without having a negative impact on human health. They are based on toxicological and agronomic research. To identify and quantify extremely low quantities of pesticides, however and sensitive analytical procedures must be developed because the acceptable values are steadily declining (Alejandro 2014).

This led us to carry out an investigation to assess and examine fresh tomato pesticide residue levels and their adherence to maximum residual levels. The overall methodology involves a descriptive study of the application of pesticides in agriculture, encompassing several agricultural fields from the country's western region. Using a particular survey, farmers in these locations provided information on the use of pesticides. The tomato crop, which is the predominant crop in these areas and plays a significant role in Algerian cuisine, is the focus of the matrix selection. Tomatoes can also be eaten whole and fresh. Furthermore, tomato crops are notoriously delicate, which leads to a high pesticide usage rate (Al Nasir 2020, Andrade 2014). Tomato samples that were taken from crop fields were analyzed at the Oran University Hospital's Pharmacology-Toxicology Department. The work involves refining the

extraction technique known as QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) and creating and verifying a method for determining multiple residues using a liquid chromatographic chain connected to a tandem mass spectrometer (HPLC-MS/MS).

Pesticides

Pest control agents are compounds known as pesticides. This comprises pesticides for insects, rodents, and animals as well as bactericides, microbicides, fungicides, and lampricides. Pesticide is defined by the Food and Agriculture Organization (FAO) as any substance or combination of substances meant to prevent, destroy, or control any pest, including those that spread disease to humans or animals, undesired plant or animal species, and substances that harm or otherwise interfere with food production, processing, storage, transportation, or marketing. It also includes wood and wood products, animal feedstuffs, agricultural commodities, and substances that may be given to animals to control insects, arachnids, or other pests in or on their bodies (Bakirci 2014).

Pesticide Effects

These are made with harmful chemicals that are intended to be discharged into the environment on purpose. Even though the purpose of each pesticide is to kill a specific bug, a very high proportion of pesticides end up somewhere other than their intended target. Rather, they find their way into the water, air, sediments, and even our food. Pesticides have been connected to several health risks for people, ranging from immediate effects like headaches and nausea to long-term effects including cancer and reproductive damage. Additionally, using these reduces the soil's overall biodiversity. Higher soil quality results from the absence of pesticides, which also increases soil retention—a requirement for plant growth (Benzidane 2013).

Object and Study Area

Determining whether pesticide residues were present in tomatoes from the Rampur region was the aim of the experiment. District Rampur lies between latitudes 28–25 and 29–10 North and longitudes 78–0-54 & 69–0-28 East. Scattered over 2367 square kilometers, it is in the Uttar Pradesh state's Moradabad Division. Districts Udham Singh Nagar in the north, Bareilly in the east, Moradabad in the west, and Badaun in the south encircle it. In the Indian state of Uttar Pradesh, Rampur is both a city and the municipality's headquarters for the Rampur District. It was historically well-known for a variety of businesses, including cotton milling and sugar refining. Its library holds a magnificent collection of Mughal miniature paintings in addition to over 12,000 unique manuscripts. The state capital Lucknow lies 322 kilometers to the northwest of it.

Material and Methods

Sample Preparation:

Took 5-10 grams of sample in a 50 ml polypropylene tube (centrifuge tube). Added 10ml of Mili Q water, vortex and add 10ml of Acetonitrile with 0.1% formic acid and shake well. Added 2.0 grams of Anhydrous Magnesium Sulphate + 0.5 grams of Sodium Acetate or QUECHERS Pouch. Handshake vigorously and vortex for 2 min. Centrifuge the tube at 5000rpm for 5 min. Pipetted out 4-8 ml of the supernatant into 15ml tube already consist of 200-500mg of anhydrous magnesium sulphate and 100-200mg of PSA or add 2ml supernatant in dispersive SPE 2ml. Vortex for one min, centrifuged at 5000rpm for 5 min. Pipetted out 2ml and dry under nitrogen gas, makeup the volume 1.0ml with Ethyle Acetate for GCMS/MS. Filter with 0.22 μ nylon syringe filter into 2ml vial. Run in GCMS OR GCMS/MS Instrument (Bojaca 2012).

Instrumental identification and quantification techniques

Gas chromatography and liquid chromatography are the two primary analytical methods used in food analysis, and both enable the detection and measurement of pesticides. Selecting the class of pesticide to be quantified, multiple types of quantification techniques are paired with GC (Fajgeli 2000). Different types of methods have been used to measure the presence of pesticide residues in grain samples, including mass-selective detection (MSD), flame-ionization detection (FID), nitrogen-phosphorus detection (NPD), and electron capture detection (ECD).

The Gas Chromatography/Mass Spectrometry (GC/MS) apparatus is used to identify the components at the molecular level (the MS component) and to separate chemical mixtures (the GC component). It is among the most precise instruments available for examining environmental sample data. The idea behind how the GC operates is that heat causes a mixture to split into its constituent substances. The hot gases are sent through an inert gas column (like helium). The separated materials flow into the MS when they exit the column aperture. Compounds are identified using mass spectrometry based on the mass of the analyte molecule. On a computer is kept a "library" of known mass spectra that covers thousands of substances (Golge 2015).

Results and Discussion

This study has discovered five pesticides in total, which are divided into three categories: herbicides, fungicides, and insecticides. Furthermore, our investigation reveals the use of certain broad-spectrum pesticides, such as nematicides, which are insecticides like ethoprophos, and acaricides, which are insecticides like methomyl and chlorpyrifos (Omwenga 2021).

It is evident from the analytical data that three samples had detectable amounts of pesticide residues. Insecticides methomyl and chlorpyrifos were less commonly found than the fungicides difenoconazole, triadimenol, and metalaxyl. Two of the pesticide residues found in the HPLC-MS/MS study of five tomato samples were fungicides. The high frequency of fungal attacks, the great susceptibility of tomato crops to fungal pests when compared to insects, and farmers' significant concern about fungal pests on tomatoes can all be used to explain this high share of fungicides (Stachniuk 2016).

The fungicides triadimenol and difenoconazole are most detected in our samples. The triazole family, which includes these two fungicidal agents, is extensively employed in crop treatment, particularly in the production of tomatoes. Despite being widely used to treat tomato crops, insecticides are less frequently detected in positive tomato samples than fungicides, according to the results of the descriptive survey. This is likely since insecticides are unstable in the environment due to oxidation and hydrolysis, as well as their sensitivity to photolysis and microorganisms, as sunlight can destroy them in as little as two days (Vander 2012).

One sample that included methomyl surpassed the MRL. Because this pesticide is known to be neurotoxic and an inhibitor of cholinesterase (a member of the carbamate family), its presence on a food that is often eaten raw, like tomatoes, is cause for serious worry. Methomyl exposure, whether repeated or protracted, may cause a cumulative reduction in cholinesterase activity. Pesticides are generally thought to be linked to several illnesses, including cancer, neurological disorders, and endocrine disruption (Wilkowska 2011).

Furthermore, according to the IPPUA (2015), methomyl is no longer registered. Two distinct pesticide kinds' residues were discovered in 20% of the examined samples. The increase in residues found can be attributed to poor adherence to recommended agricultural practices (doses, pre-harvest delays), which is closely linked to the development of analytical methods, particularly sensitivity, made possible by HPLC-MS/MS equipment. Two fungicides from the same family with identical characteristics and a same action spectrum were discovered in certain samples. This implies the usage of these products in an uncontrolled or possibly unreasonable manner.

Conclusion

The present investigation assessed the pesticide residue levels in fresh tomato samples obtained from Rampur. The amounts discovered are noteworthy and could prompt concerns about their possible negative effects on consumers' health. This study should be expanded to include a more representative sample program, additional pesticides, and their degradation products, a longer collecting period, and different matrices to assess food safety more accurately. Based on a nationwide plan for monitoring pesticide residues, these preliminary findings may help to reinforce the need for Algeria to implement a more thorough and stringent regulation over pesticide usage.

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