International Journal of Scientific Research and Engineering Development-– Volume 9 Issue 1, Jan-Feb 2026
Available at wwwijsred.com

RESEARCH ARTICLE OPEN ACCESS

# An Analysis on Pesticidal Residue

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## Abstract:

Pesticide residue analysis is a critical component of food safety, public health, and environmental protection. As the use of chemical pesticides continues to rise in agriculture, the risk of their persistence in food products, soil, and water has become a major global concern. Even trace amounts of residues can accumulate in the human body and lead to long-term toxic effects, making accurate detection and monitoring essential. Modern residue analysis involves a systematic process that includes sample collection, extraction of pesticide molecules, cleanup to remove interfering substances, and quantitative analysis using advanced instruments such as GC-MS/MS, LC-MS/MS, and HPLC. Techniques like QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) have revolutionized sample preparation by enabling efficient multi-residue extraction with minimal solvent use. This abstract highlights the principles, significance, and analytical advancements in pesticide residue detection, emphasising the need for strict regulatory limits, continuous monitoring, and improvement of analytical technologies to ensure the safety of food and the environment

*Keywords- QuEChERS, GC-MS/MS, LC-MS/MS, HPLC*

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## Introduction

Herbal medicines have an inherent quality of being pure and free of harmful chemicals and side effects. The name herbal is synonyms with purity and freedom from toxins and chemical contaminants. However increasingly the raw herbs and materials are being sourced from farms where they are grown commercially with modern agricultural practices where a lot of pesticides and plant growth regulators and a variety of other chemicals might be used for enhancing the productivity.

Even if the raw herbs are sourced from natural sources from natural sources or from deep within forest contamination from adjoining farms as well as from contaminated soil and water sources can lead to the presence of pesticides and other chemical contaminants in the raw herbs as well as the standardised extracts and finished single herb or poly herbal formulation.Medicinal plant materials are liable to contain pesticide residues which accumulate from agricultural practices such as spraying, treatment of soil during cultivation and administration of fumigants during storage.

## Materials and Methods

The article is a literary study which includes knowledge from textual references and from various articles.

## Results and Discussion

A Pesticide is any substance or mixture of substance intended for preventing, destroying or controlling any pest, unwanted species of plants or animals harm during or otherwise interfering with the production, processing, storage, transport or marketing of vegetable drugs.

Pesticides are chemicals widely used in agriculture to protect the crop from pest, disease, and weeds.

  

While pesticide contribute significantly to increase agricultural productivity, there use often leads to the presence of residual chemicals on food products and in the environment.
Pesticidal residues refers to the traces of pesticides that remain on or food products, soil, water and air after there application.
The presence of these residues poses a potential risk to human health and the environment, making there analysis, management and regulation essential.

**Types of pesticidal residue**
Pesticides can be classified into several categories

**Type 1**
Based on target organisms,
Insecticides( for insects)
Herbicides(for weeds)
Fungicides (for fungi)
Rodenticides ( for rodents)

**Type 2**
Chemicals differ in their composition, persistance and toxicity, which inturn influences their residual behaviour

- **Persistant organic pollutants :** certain pesticides like DDT are known for their persistence in their environment and ability to bioaccumulate in the food chain, leading to long term adverse effects.[2]
- **Organo phosphates:** although less persistant than persistant organic pollutants these degrade quickly but can be highly toxic even in small quantities.
- **Pyrethroids and Neonicotinoids:** These are most modern pesticides designed to breakdown faster, but their residues can still be found in food and water sources.

**Type 3**

- Chlorinated hydrocarbons and related pesticides
- Chlorinated phenoxyalkanoic acid herbicides
- Organophosphorous pesticides
- Carbamate insecticides
- Dithiocarbamate fungicides
- Inorganic pesticides
- Miscellaneous
- Pesticides of plant orgin

Only the Chlorinated hydrocarbons and related pesticides, few Organophosphorous pesticides have a long residual action. Most other pesticides have very short residual actions. Therefore it is suggested that, where the length of exposure to pesticides is unknown, the medicinal plant material should be listed for the presence of organically bound chlorine and phosporous or the content of these two substances should be determined.
Limit of pesticides are calculated using the equation,

$$\frac{ADI \times M}{MDD \times 100}$$

ADI – Acceptable daily intake
MDD- daily dose of the drug in kgs
M – body mass in kg
For Finished product,

$$\frac{ADI \times M \times E}{MDD \times 100}$$

E- Extraction factor of the method of preparation, determined experimentally.

**Reasons for Pesticides Residues Are,**
1)Indiscriminate use of chemical pesticides
2) Non observance of prescribed waiting periods
3)Use of substandard pesticides
4)wrong advice and apply pesticides to the farmers by pesticide dealers.
5) continuance of DDT and other use of pesticides in public health programme.
6) effluents from pesticides manufacturing units.
7) pre-marketing pesticides.
8) wrong disposal of left over pesticides & cleaning and of plant protection equipments.

**Factors Influencing Pesticidal Residue**

  

Several factors determine the amount and persistence of pesticidual residue in the environment and on agricultural products.

1) Pesticide type & composition
   Chemical properties such as solubility, volatility, and degradation rate, affect how long residues stay on crops or in the environment.
2) Application method and dosage
   The way pesticides are applied influences how much residue remain. Excessive or improper application can increase residue level.
3) Environmental conditions
   Weather conditions such as rainfall, temperature, sunlight can accelerate the breakdown of pesticidal residue conversely slow it down.
4) Crop type and harvesting type
   Certain crops especially those with large surface area or soft skins are more prone to pesticide accumulation.

**Objective of pesticide residue analysis[1]**

- ✓ To study the persistence of pesticide in or on the soil, plant and water or other matrices
- ✓ To establish maximum residue limit of pesticide by conducting field trails adapting GAP in conjugation with the data obtained from toxicological studies.
- ✓ To establish safe waiting periods or preharvest intetrvals on the basis of multilocational trail.
- ✓ To screen various methods for effective decontamination of pesticide residues.

**Steps in pesticide residue analysis**

There are 4important steps in pesticide residue analysis.
1, Sampling
2.extraction
3. Cleanup
4. Analysis

**Sampling:** including 4 steps like Collection, Transport, Selection, Storage

Sample collection is the process of taking portion of a food or other substance for laboratory analysis so that the resulting analytical data and conclusion can be applied to the orginal food or substance sampled. The sample should always be representative and sufficiently large.
The aim is to reduce the total sample into manageable portion.

**Extraction:** most nonionic compounds are extracted with acetone, the residues are partioned from aqueous acetone to a suitable solvent in which the compound is highly soluble and can be portioned from the aqueous media.

**Clean up-** The pesticide residue present in extract contain different co-extractives that may interfere during the detection of pesticidal residue. These coextractives are removed by clean up
In this process the concentrated extract is passed through the glass coloumn containing different types of materials like activated charcoal, silica gel, alumina etc to remove the co-extractives. Now a days different types of catridge are used for removing the co-extractives from the sample.

**Analysis-** it includes identification, confirmation, and quantification
Different techniques are there. Most commonly used are use of chromatographic instruments like, GC, HPLC, GC-MS, LC-MS, GC-MS, LC-MS

1. Gas chromatography and liquid chromatography
   Coupled with detectors such as mass spectrometer these methods allow for precise identification and quantification of pesticides residues in complex samples.
2. High performance liquid chromatography
   Commonly used for the detection of pesticide residue in liquid and solid samples provide accurate and sensitive results.
3. Enzyme linked immunosorbent assay (ELISA): a more rapid and cost effective method for screening samples for specific pesticide residues.

  

4. Infrared spectroscopy : used for non invasive detection and quantification of pesticide residues on agricultural products.

❖ The present study demands a rapid turn around time where analysis need to be completed within 24-48 hrs after a sample submitted to laboratory. This is necessary to have an analytical method by which we can simultaneously target. Pesticides in any sample by a single effort with equivalent or superior overall efficiency.

The QUECHERS

Means quick, easy, cheap, effective,rugged and safe.

**Advantages over the other**

high recovery
very accurate
solvent usage and waste are limited
a single person can perform it

**Regulation and Management of Pesticidal Residue**

Regulatory agencies such as EPA (Environmental protection agency)
EFSA (European food and safety authority and codex allimentarius establish maximum residue limit to ensure that pesticidal residues in food remain in the same level.

**Conclusion**

WHO recommends that medicinal plants which form the raw material for the finished products should be checked for presence of heavy metals, pesticides, aflatoxins in the finished products. Medicinal herbs are easily contaminated during growth, development and processing

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