REVIEW-DETERMINATION OF PESTICIDES RESIDUES ON FRUITS AND VEGETABLES

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ABSTRACT

The basic requirement of any human beings is food, cloth and shelter. For survival of any human kind food plays a foremost role. We also know that India ranked second in the world in terms of population, so demand of food also increases. To fulfill this need, farmers are using pesticides which help in increase of the production of their commodities. Due to the use of the pesticides, its residues remain on fruits and vegetables after cultivation. It is dangerous to consume it because it may lead to major health problems. So, to overcome this problem, we developed a portable instrument which detects the residues of pesticides on fruits and vegetables.

Keywords: Pesticide detection, Chromatography, Acetyl cholinesterase, Sensors and Biosensors

INTRODUCTION

With a population of 1.27 billion, India is the world's second most populous country. It is the seventh largest country in the world with an area of 3.288 million sq kms. India is the world's largest producer of milk, pulses and jute and ranks as the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruit and cotton. It is also one of the leading producers of spices, fish, poultry and livestock and plantation crops. Worth $ 2.1 trillion, India is the world's third largest economy after the US and China [1].

Among the total population of 1.25 billions, approximately 110.7 million comes under the category of farmers. Also, India ranked fourth in world in the production of agrochemicals and fertilizers. Survey conducted by various institutes indicates that 50-70% of vegetable and fruit production are contaminated with pesticide residues. The increasing population of India, results in higher demand for food, indeed decreases in land for farming. Hence to fulfill the demands of increasing population, food is adulterated to get more quantity in short period of time. [2].

The food that we consume daily, are not healthy. We are not thinking about the chemicals that farmers using to keep their crops free from the attack of insecticides. These chemicals resided on the food and vegetables that we eat. These food is health hazardous and toxic to human health due to large use of pesticides. The most of the fruits and vegetables present in the markets are those which are either artificially grown or are sprayed with several chemicals used for pests. Such type of chemicals and artificial ripeners are like calcium carbide/ethephon and oxytocin respectively [3].

RELATED WORK

There are diversed methods present for finding the pesticide residue in the samples of fruits and vegetables. The common methods are the laboratory methods like many types of chromatography techniques like gas chromatography, liquid chromatography and further joining some methods like mass spectrometry with it to get better results such as Gas Chromatography Mass Spectrometry (GC-MS). Some other methods are also there like flow injection analysis, enzyme linked immunosensor assay and electroanalytical methods. Eventually, the present methods are the biochemical techniques that are used for the detection of particular chemicals. The various biochemical methods are like bioassay for pesticide detection and various types of biosensors are also there [4]. The various

methods for pesticide detection present are given as follows:

I. Spectrophotometry Methods
II. Electroanalytical Technique
III. Chromatographic Technique
IV. Electrochemical Sensors and Biosensors
V. Flow Injection Analysis
VI. Bioassay for Pesticide Detection
VII. Use of Capillary Electrophoresis (CE)
VIII. Enzyme Linked Immunosorbant Assay (ELISA)

Spectrophotometry Methods: - Spectrophotometry is a very important technique which has looney in the field of pesticide analysis over the decades. It is particularly popular because of its features like ruggedness, economical, wide range of pesticides can be detected by using different reagents, detectors and techniques like flow injection, PLS (Partial least square) etc. The spectrophotometric analysis extensively carried out for the detection of fungicides. A sensitive spectrophotometric procedure for the analysis of acaricide; kelthane. This method shows good sensitivity in sub parts per million levels [5].

Electroanalytical Technique: - Electroanalytical techniques appear as an attractive, simple and economical alternative and have been used in the detection of paraquat (a toxic fast-acting herbicide, which becomes deactivated in the soil) with different detection limits. Electrochemical studies have been carried out at chemically processed electrodes, solid electrodes and mercury electrodes. The electrochemical behaviour of paraquat shows two reversible reduction peaks on sweeping the applied voltages in the negative direction [6]. This method is generally used to detect the paraquat pesticides residues on plant and soil.

Chromatographic Technique: - Thin-layer chromatography (TLC) had been widely used in the 1960s and 1970s for detection of pesticide residue on fruits and vegetables, but it has limitation since gas–liquid chromatography (GLC) and high performance liquid chromatography (HPLC) became easily available. In recent years, there have been various developments in the quality of plate coating and in detection systems, as well as in extraction and cleanup methods, that made it possible to apply TLC according to current international quality standards as an alternative technique for determination of known pesticide residues or for confirmation of tentatively identified compounds [7].

Electrochemical Sensors and Biosensors: - Chromatographic methods coupled to selective detectors have used traditional way for pesticide analysis due to their sensitivity, reliability and efficiency. Since, they are time-consuming and laborious, and require expensive equipment and highly-trained technicians are also requires. In last decade, work has been focus on the development of biosensors for the detection of pesticides as a promising alternative. A biosensor is a self-contained device that integrates an immobilized biological element (e.g. enzyme, DNA probe, antibody) that recognizes the analyte (e.g. enzyme substrate, complementary DNA, antigen) and a transduction element used to convert the (bio) chemical signal resulting from the interaction of the analyte with the bioreceptor into an electronic one [8].

Flow Injection Analysis: - A flow-injection analysis (FIA) method is generally used to detect the chlorophenoxyacid herbicides, based on Photochemically Induced fluorescence (PIF) detection technic. Photochemically Induced Fluorescence tubing was coiled around a low-pressure mercury lamp located between the injection valve and the detector. Mainly two analytical procedures are used, continuous flow mode or stopped-flow mode, according to the photochemical behaviour of the analyte. Ultraviolet (UV) photolysis in a buffer solution provoked a more or less marked increase of the fluorescence signal depending of the herbicide structure. In the stopped-flow mode, UV irradiation times ranged between 90 sec and 12 min. linear dynamic graphs were established over a concentration range of nearly two orders of magnitude. The FIA-PIF limits of detection ranged from 23 to 98 ng/ml, according to the compound. Relative standard deviations were between 0.7 and 2.7%. The proposed method has been applied to determine these herbicides in spiked river water samples, with mean recoveries ranging from 96 to 108%. It shows the usefulness of this technique for chlorophenoxyacid herbicides analysis [9].

Bioassay for Pesticide Detection: - The established rapid bioassay of pesticide residues (RBPR) system is aiming at detecting the noxious organ phosphorus, carbamate insecticides as well as ethylene bisdithiocarbamate fungicides using housefly

acetylcholinesterase and Bacillus thuringiensis as the probes. The standard procedures have been developed for the detection of pesticides residues on fruits, vegetables, rice, tea, spices, etc., In Taiwan, more than 300 RBPR stations inspect a half million agricultural products annually, and they have developed a residue control system that covers farmer association and farm cooperative in production areas; wholesale markets; food suppliers for military services, school and group lunching; supermarket chain stores; private enterprises, etc. RBPR has also been adopted by the Republic of Korea, Vietnam, Philippines, Panama and many Southeast Asian countries, and 11 international RBPR training workshops were held during 1993-2010. The institute also is responsible for supplying RBPR reagent kits and high quality of housefly acetylcholinesterases to local users and abroad [10].

Use of Capillary Electrophoresis: - Capillary electrophoresis (CE) is becoming an advantageous tool for determining pesticide residues in environmental matrices because of its simplicity and high separation efficiency. However, inadequate limits of detection (LODs) and a lack of selective detectors limit the technique. The present review gives an overview of current developments in off-column and on-column approaches to trace enrichment in analyzing real samples, and summarizes the determination of pesticides residues by conventional CE as well as by the emerging techniques, such as Capillary electrophoresis-mass spectrometry (MS). The usefulness of these approaches in environmental applications is documented [11].

Enzyme Linked Immunosorbant Assay: - An acetylcholinesterase inhibition method was employed for detection of 21 carbamate pesticides in bananas, peaches, strawberries, and tomatoes. These four fruits was spiked with 0.1 to 10 ppm of each of the 21 carbamates and individual detection levels were determined. Similar responses and detection limits were observed for all four fruits commodities when tested. The detection levels was ranged from 0.1 ppm for carbofuran and 3-hydroxycarbofuran to 6 ppm for promecarb and aldicarb sulfoxide where observed. The detection principle of Acetylcholinesterase (AChE) biosensor is work on the principal of changing the activity of AChE composure to the pesticides before and after. Following enzymatically catalyzed hydrolysis of acetylthiocholine, the oxidation current of thiocholine is produced and monitored by instrument [12].

Discussion: - Spectrophotometry Method and Bioassay method are generally used for the detection of fungicides. These methods are ruggedness, economical and can be used for detecting wide range of pesticides. For the detection of herbicide Electroanalytical techniques and flow-injection analysis are used. Herbicides is a substance that is toxic to plants, used to destroy unwanted vegetation, now a days farmers are using this type of pest on a large scale. Chromatographic Technique is of two type gas–liquid chromatography (GLC) and high performance liquid chromatography (HPLC). However better results can be obtain from Gas Chromatography Mass Spectrometry (GC-MS) method. Expensive techniques are Electrochemical Sensors and Biosensors and Enzyme Linked Immunosorbant Assay. These techniques requires highly-trained technicians, they are also time consuming. In these enzyme, DNA probe, antibody are used to detect the pesticides resides on fruits and vegetables. Transducers are also used to convert the biochemical signals to the electric signal. Analyzing real samples and summarizes the determination of pesticides residues by conventional CE as well as by the emerging techniques.

Name	Expansive	Sensitive	Efficient	Herbicide	Economical
Spectrophotometry Methods	×	×	×	×	✓
Electroanalytical Technique	×	×	×	✓	✓
Chromatographic Technique	×	×	✓	×	×
Electrochemical Sensors and Biosensors	✓	✓	×	×	×

Flow Injection Analysis	×	×	×	✓	×
Bioassay for Pesticide Detection	✓	✓	×	×	×
Use of Capillary Electrophoresis (CE)	✓	×	✓	×	×
Enzyme Linked Immunosorbant Assay (ELISA)	✓	×	✓	×	×

Conclusion

Different technique where studied for the detection of pesticides residues on fruits and vegetables. Electroanalytical Technique and Flow Injection Analysis are used to detect herbicide only. Electrochemical Sensors and Biosensors is efficient and sensitive technique, but it is expansive. We can replace Sensors and Biosensors by IR Sensor which are cheaper. By using IR sensor the system will be economical, efficient and more sensitive.

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