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# Pesticide Residues in Selected Vegetables Collected from Local Markets in Vijayawada City

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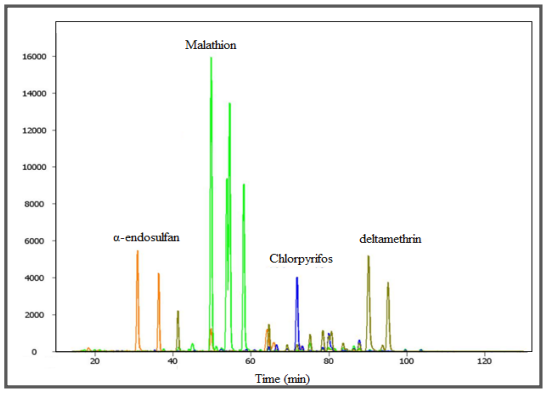
## ABSTRACT

*Vegetable samples of green chilly, cabbage, tomato and brinjal collected from market in five regions of Vijayawada municipality in April 2017. Selected vegetables tested for the presence of pesticide residues like pyrethroids, organo chlorine compounds and organo phosphorous compounds using a gas chromatograph equipped with electron capture and Thermo sensitive detectors of the samples tested, chilly, cabbage, Tomato and brinjal were found to have pesticide residues in above the permissible residues. Among the organo chlorine compounds α-endosulfan, was detected in 2.34 % of the samples with residues. These were taken from green chili and cabbage samples. Parathyroid residues, such as deltamethrin detected in 10.24 % of the samples with residues in tomato and brinjal, organo phosphate compound residues such as chlorpyrifos and Malathion were found in 18 % of the samples with residues, which were taken from all vegetable of the positive samples, 10.2 % were found contain residues exceeding the prescribed maximum residue limit. The average pesticide residue content across all the vegetable samples was ranging from 0.04 to 1.024 ppm.*

## Graphical Abstract




GC MS spectra of pesticide residues in the vegetable samples

**Keywords:** Pesticide Residues, Vegetable samples.

## INTRODUCTION

Pesticides are chemical substances used to kill insects and animals that destroy crops. They are characterized by pronounced persistence against chemical/biological degradation, high environmental mobility, strong tendency for bioaccumulation in human and animal tissues, and significant impacts on human health and the environment, even at extremely low concentrations [1]. Pesticides such as insecticides, herbicides, fungicides and acaroids are an abundant and diverse group of chemical compounds. Pesticides are widely applied during cultivation and postharvest storage to improve the quantities and quality of crops and food [2]. India is one of the largest agricultural pesticide consumers worldwide and is the second largest manufacturer of pesticides in Asia. There is a sequential rise in the productionand consumption of pesticides in India during last three decades. The consumption pattern of pesticides differs from rest of the world, as in Indi. In Andhra Pradesh, vegetable cultivation has increased in recent years because of greater market demand, higher returns, and an increased awareness among farmers. This has led to large stretches of vegetable growing areas with intensive management practices. Such intensive cultivation, coupled with the availing humid tropical climate, has resulted in increased pest and disease incidence. As the vegetables are grown in 449.2 ha only, the per capita pesticide consumption in the vegetable growing areas of Andhra Pradesh (3,586g) far exceeds the national average of 450 g [3].

The intensive cultivation of vegetables has gained momentum in recent years with excessive pesticide usage due to increased market demand. As the presence of pesticide residues in food produce is a serious concern and no data are available on the levels of pesticide residues in vegetables, a study was conducted to ascertain the presence of pesticide residues in major vegetables used locally in Vijayawada town of Andhra Pradesh at different locations.

## MATERIALS AND METHODS

**Sample Collection:** Vegetable samples of green chili, cabbage, Tomato and brinjal were chosen due to their commercial importance and potential consumption in the local area.

**Pesticides selection:** It was studied that which pesticides are now common in use were selected and use in high concentration. Standards were collected from agriculture department of Guntur. Standards were in powder form1% solution of each pesticide was prepared.

**Extraction and Analysis:** The multi residue extraction was done following a modified QuEChERS method [4], where the samples are cut into pieces and macerated with a mixer grinder. A 10g acerated sample is then weighed into a 100 mL centrifuge tube along with 50mL acetonitrile and shaken well for 5 min in a vortex shaker. The supernatant is transferred quantitatively to a second centrifuge tube containing 4 g anhydrous $MgSO_4$ and 1g NaCl. The tube was then shaken vigorously again for 1 min in a vortex shaker and centrifuged at 3,000 rpm for 10 min. A 10mL extract of this sample is added to a 15mL centrifuge tube that contains 1.2 g anhydrous $MgSO_4$ and 0.5 primary secondary amine, shaken vigorously for 10 min in the vortex shaker and centrifuged at 3,000 rpm for 5 min, 2mL extract sample is pipette out into a glass tube and the solvent is evaporated usinga Turbo Vap evaporator at 30°C using 10 psi $N_2$ gas over15 min. The residues are reconstituted using n-hexane for final GC and GC/MS analysis [5]. The detection and quantification of different pesticide compounds was carried out by injecting 1 µL of the extract into the gas chromatograph (GC-Shimadzu GC-2010) equipped with both an electron capture detector and a flame thermionic detector. The residue levels were estimated by comparing the peak areas of the samples to those of standards run under identical conditions. Any detected residues were confirmed using GC/MS (GC/MS-TQD Bruker's) to avoid the misinterpretation of any results.

## RESULTS AND DISCUSSION

Pesticides are widely used to increase the productivity of agricultural commodities and hence are essential component in modern agriculture. These chemicals are actually produced and/ or developed for agriculture pest control. Pesticides spray on vegetable crops is very common practice which not only kills insect/ pests but also stuck/ get inside the vegetables through minute pores thereby becoming its component. These are called pesticide residues that remain on the surface or inside of the vegetables and may become a great health hazard after consumption. Contamination of vegetables result from pesticide spray, as well as from improper handling, contaminated environment (air, soil or water) and from cross contamination processes.

The present study was undertaken to evaluate the pesticide residues from market samples of Vijayawada, a commercial city in Andhra Pradesh, the pesticide compounds in collected vegetable samples were identified by comparing their retention time with respect to their technical grade reference standards. In the present research we choose six locations in Vijayawada city, these locations are Raithu bazaars, Market areas located in the municipality boundaries.

Results that are obtained from samples analysis through GC/MS is given table 1 and in figure 1, corresponding GC MS spectra given in figure 2. In this study, a distinct pattern of pesticide use is discernable from the maximum number of samples containing different pesticide residues. Accordingly, Chlorpyrifos and Malathion compounds were mainly used for green chilly and cabbage; Endosulfan was used for all vegetables.

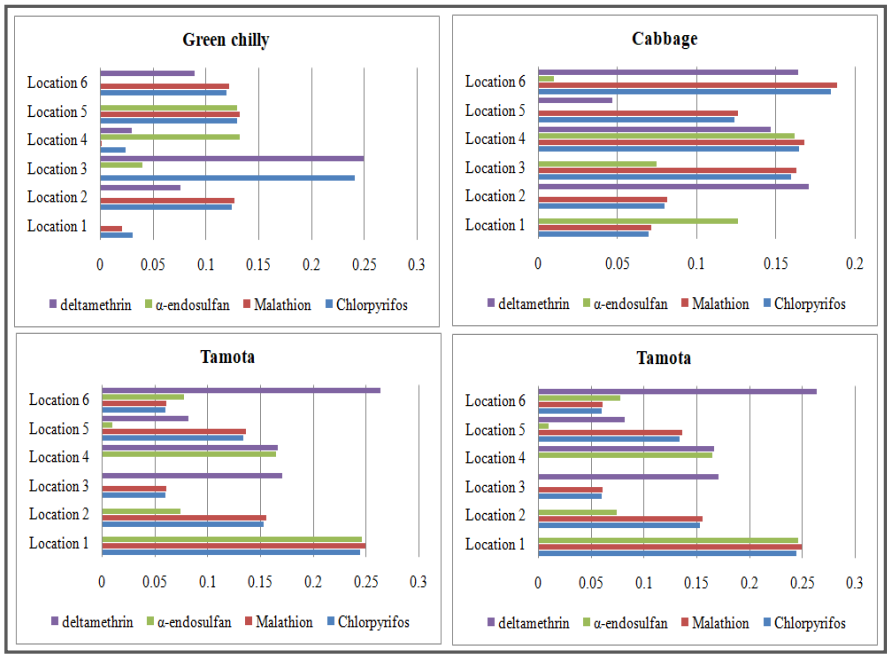



**Figure 1.** Vegetable samples with residue of pesticides in graphical representation.

Although these vegetables are organically grown but our findings given in table 1 showed that these vegetables had trace amounts of residues which may be due to the reason that the retailers contaminate these vegetables by washing with same water which they use for washing heavily sprayed vegetables. The other possible reason for contamination of organic vegetables may be growing these vegetables on the soil contaminated from previous crop. This is also in conformity with Hill [**6**] who proposed that the fruits are usually mixed in the lots in trade, the residue data from these composite samples were therefore, potentially misleading.

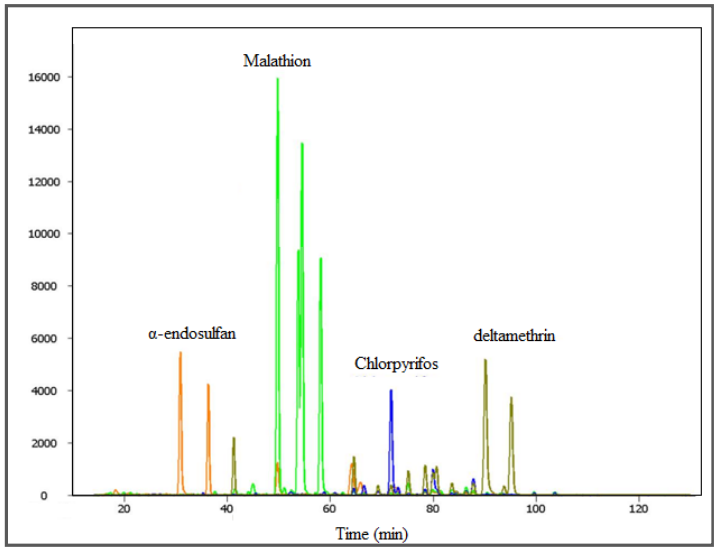



**Figure 2.** GC MS spectra of pesticide residues in the vegetable samples.

**Table 1**.Concentration ranges of pesticide residues in fruit and vegetable samples analyzed

| Vegetables | Markets Location | Pesticides ppmkg$^{-1}$ | | | |
|---|---|---|---|---|---|
| | | Chlorpyrifos | Malathion | α-Endosulfan | Deltamethrin |
| Green chilly | Location 1 | 0.031 | 0.021 | BDL | BDL |
| | Location 2 | 0.125 | 0.1275 | BDL | 0.076 |
| | Location 3 | 0.241 | BDL | 0.04 | 0.25 |
| | Location 4 | 0.024 | 0.002 | 0.132 | 0.03 |
| | Location 5 | 0.13 | 0.1326 | 0.13 | BDL |
| | Location 6 | 0.12 | 0.1224 | BDL | 0.09 |
| Cabbage | Location 1 | 0.07 | 0.0714 | 0.126 | BDL |
| | Location 2 | 0.08 | 0.0816 | BDL | 0.171 |
| | Location 3 | 0.16 | 0.1632 | 0.075 | BDL |
| | Location 4 | 0.165 | 0.1683 | 0.162 | 0.147 |
| | Location 5 | 0.124 | 0.12648 | BDL | 0.047 |
| | Location 6 | 0.185 | 0.1887 | 0.01 | 0.164 |
| Tomato | Location 1 | 0.245 | 0.2499 | 0.246 | BDL |
| | Location 2 | 0.153 | 0.15606 | 0.075 | BDL |
| | Location 3 | 0.06 | 0.0612 | BDL | 0.171 |
| | Location 4 | BDL | BDL | 0.165 | 0.167 |
| | Location 5 | 0.134 | 0.13668 | 0.01 | 0.082 |
| | Location 6 | 0.06 | 0.0612 | 0.078 | 0.264 |
| Brinjal | Location 1 | 0.161 | 0.16422 | 0.137 | 0.075 |
| | Location 2 | 0.01 | 0.0102 | 0.152 | 0.031 |
| | Location 3 | BDL | 0.024 | BDL | 0.17 |
| | Location 4 | BDL | 0.001 | 0.13 | BDL |
| | Location 5 | BDL | 0.006 | 0.015 | BDL |
| | Location 6 | 0.01 | 0.0102 | 0.021 | 0.041 |

Majority of the samples violated MRLs [7] and these results are in conformity with the findings of earlier study [8] in which vegetable samples of Vijayawada market were taken and most of the samples were found contaminated with multiple pesticide residues. The persistent nature of different pesticides, mishandling, environmental pollution and presence of pesticide residues in vegetables has now become a global concern. Organophosphorus, organochlorine along with mixture of different pesticides in fruits and vegetables were also reported all over the world by many researchers [9].

## APPLICATION

This study recommends that vegetables may be thoroughly washed prior to use and water may be changed after each vegetable wash or washing of vegetables may be done under running tap water in order to minimize pesticide contamination ratio.

## CONCLUSION

It was concluded that pesticide spray is most common practice in Vijayawada surrounding agricultural formers and single vegetable was found with more than one pesticide with residual level above mentioned MRLs. Present study recommends that vegetable may be thoroughly washed prior to use and water may be changed after each vegetable wash or washing of vegetables may be done under running tap water in order to minimize pesticide contamination ratio. The comparison of results with their respective MRLs have led to an insight which suggests that majority of vegetables had residual levels far above the MRLs, hence were unfit for human consumption. It was further observed that same water was being used for washing of different vegetables which increased the contamination ratio.

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