



## LEVELS OF PESTICIDE RESIDUE IN CABBAGE (*Brassica oleracea var. capitata*)

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**ABSTRACT** : Vegetables are an essential component of nutritionally balanced diet. Among vegetables cabbage is widely grown in India and it suffers from severe infestation due to insect pests like cabbage looper, cabbage worm and cabbage aphids. To control the pests various pesticides are used, which may be found as remnants on cabbage heads and during processing its disintegrated products remain in the food chain. These pesticide residues, if present in excess, may act as a health hazard to the consumers and may cause chronic diseases. Therefore, an attempt has been made to estimate pesticide residue levels before and after application of food processing practices like washing and cooking in water. The present study indicated considerable amount of reduction in pesticide after washing and cooking in a sample grown under controlled condition. Washing of cabbage samples with water reduced 45.84% of Endosulfan residues but cooking was found to be more effective as it reduced 66.6% of Endosulfan residues.

**Keywords** : Cabbage, processing, pesticide residue, washing, cooking

Vegetables play a very important role in making a diet balanced as they provide vital elements to the human body. They are rich sources of nutrients like carbohydrate, vitamins and minerals. These are essential for growth and maintenance of healthy body. Among vegetables, cabbage is widely grown in India and it suffers from severe infestations due to insect pests like cabbage looper, cabbage worm, and cabbage aphids. To control the pests various pesticides are used. On harvesting these pesticide remnants are found on the vegetables in residual form and during processing its disintegrated products remain in the food chain. These pesticide residues, if present in excess, may act as a health hazard to the consumers and may cause chronic diseases. Therefore, an attempt has been made to estimate pesticide residue levels in cabbage which were grown under controlled condition before and after application of food processing practices like washing and cooking in water to enable the consumer to optimize cooking practices in order to minimize pesticide residue in cooked food.

### MATERIALS AND METHODS

Golden Acre variety of cabbage crop was grown on the experimental field of Lady Irwin College in the year 2007. Pesticide (Endosulfan) was applied on the experimental field at the rate of 500g ai/ha in each replicate while one plot was kept as control to get cabbage samples without pesticide. Mature cabbage heads were harvested and samples were randomly selected.

### Preparation of stock solution

Endosulfan (20g) was weighed (analytical grade, 98.7%) and dissolved in dry and distilled acetone in a volumetric flask and made up to 10 ml to obtain 2000µg/ml stock solution. Suitable aliquots were diluted with hexane to get the solution of 20µg/ml. From this solution different aliquots were taken to obtain the desired working concentration. All the solutions were stored in refrigerator for further use.

### Residue analysis for field samples

Cabbage samples were selected from each treatment replicate including the control. Approximately 1000g of sample was collected and thoroughly mixed and sub sample of 50g was taken for further processing.

### Washing of cabbage

A portion of cabbage samples as already collected for residue study from each replicate was used for this study. Samples (50g) were chopped into small pieces and then washed in a dish under running tap water for 3 minutes (2×150 ml).

### Cooking of cabbage

A portion of cabbage samples after washing, already collected for residue study from each replicate was used for this study. 50 g chopped washed cabbage samples were cooked with water in a pan covered with a lid for 10 minutes till it was properly cooked.

### Extraction and cleanup of samples

50 g cabbage samples were taken and blended in a mixer blender for 2 minutes at high speed with 100 ml

n-hexane:isopropanol (8:2). The contents were then transferred to conical flask. The remains in the jar were rinsed twice with n-hexane:isopropanol solution and transferred into the flasks. The flasks were shaken in a mechanical shaker for 30 minutes. The supernatant liquid was then filtered under suction through Whatman No 1 filter paper using Buchner funnel. Finally the contents in the conical flasks were filtered using the same filtering assembly. The above filtrates were taken in a separating funnel and 100ml distilled water was added to it. The separating funnel was shaken vigorously with intermittent release of pressure. The contents were allowed to stand and hexane layer was collected by passing through 5g anhydrous sodium sulphate. The aqueous layer was discarded and acetone was added to the organic layer in order to make it a hexane acetone solution in the ratio of 9:1. Dacro G 60 activated charcoal (20mg) was added to it and the solution was filtered through Whatman No 1 filter paper after shaking. The solvent was evaporated on a rotavapour and the residue was dissolved in hexane acetone (9:1) prior to GC analysis.

#### Estimation of residues

The estimation of residues was carried out by gas chromatograph (GC) equipped with <sup>63</sup>Ni electron capture detector (ECD) Megabore column (ov-5, 25m × 0.53 μm id). The operating parameters of the instrument used as follows: oven temperature 210°C, injection temperature 280°C, detector temperature 330°C and flow rate of nitrogen was 20ml/min. Injection volume was 3μl.

Recovery experiment was carried out to establish the reliability and validity of analytical method and to know the efficiency of extraction and clean up procedures.

## RESULTS AND DISCUSSION

Recovery data showed that retention time of *alpha* and *beta* Endosulfan was 3.243 and 6.010 minutes, respectively and the ratio of alpha and beta Endosulfan was 7:3. The recoveries from Endosulfan treated samples ranged between 94 to 98%. Fig. 1 depicts the peaks of different cabbage samples like washed, cooked, untreated and unprocessed cabbage samples. From the chromatogram (Fig. 1) it was quite clear that both *alpha* and *beta* Endosulfan had prominent sharp peaks. The peaks found in case of cabbage samples were without any interfering peaks and were sharp.

**Table 1: Average of Endosulfan residue in cabbage samples before and after processing.**

Samples	Residue level of <i>alpha</i> Endosulfan (μg/g)	Residue level of <i>beta</i> Endosulfan (μg/g)	Total Endosulfan ( <i>alpha</i> + <i>beta</i> ) residues (μg/g)
Without processing	0.008	0.016	0.024
After washing	0.004 (50%)*	0.009 (43.75%)*	0.013 (45.84%)*
After boiling	0.003 (62.5%)*	0.005 (68.75%)*	0.008 (66.6%)*

\* % decrease in residue level

#### Without processing :

Average of Endosulfan residue in cabbage samples before and after processing in the samples (Table 1) shows that when treated samples of cabbage were analyzed for Endosulfan, both *alpha* and *beta* Endosulfan were present in the samples. Residue of *alpha* Endosulfan ranged from 0.001 to 0.018μg/g; *beta* Endosulfan was found little more persistent ranging from 0.003 to 0.02μg/g. Total Endosulfan residues accounted the persistence from 0.005 to 0.042μg/g. Although the ratio of *beta* Endosulfan was less in technical material but the residues found in samples were higher than *alpha* isomer indicating it to be a more persistent isomer. Average alpha and beta Endosulfan residue without processing was 0.008 and 0.016 μg/g, respectively and total Endosulfan residue value was 0.024μg/g.

#### After washing :

Washing of cabbage with water which was treated with Endosulfan, reduced the initial deposits from 0.024μg/g to 0.013μg/g showing a reduction of 45.84% (Table 1). However Dinabandhoo and Sharma (1) reported that when cauliflower curds were washed under running tap water for 2 minutes 70% of Endosulfan residues were reduced. Nagesh and Verma (3) reported a reduction of only 38.0 % for chlorpyrifos residue in cabbage by water washing. After washing residue level of *alpha* and *beta* Endosulfan in washed cabbage ranged between 0.001 to 0.009μg/g and 0.002 to 0.040μg/g, respectively. Total residue of Endosulfan after washing ranged between 0.005 to 0.040μg/g.

#### After cooking :

Cooking of Endosulfan treated cabbage samples in water for 10 minutes reduced the initial deposits after washing from 0.013μg/g to 0.008μg/g showing a reduction of 61.5% (Table 1). *Alpha* and *beta* Endosulfan persistence after cooking ranged between

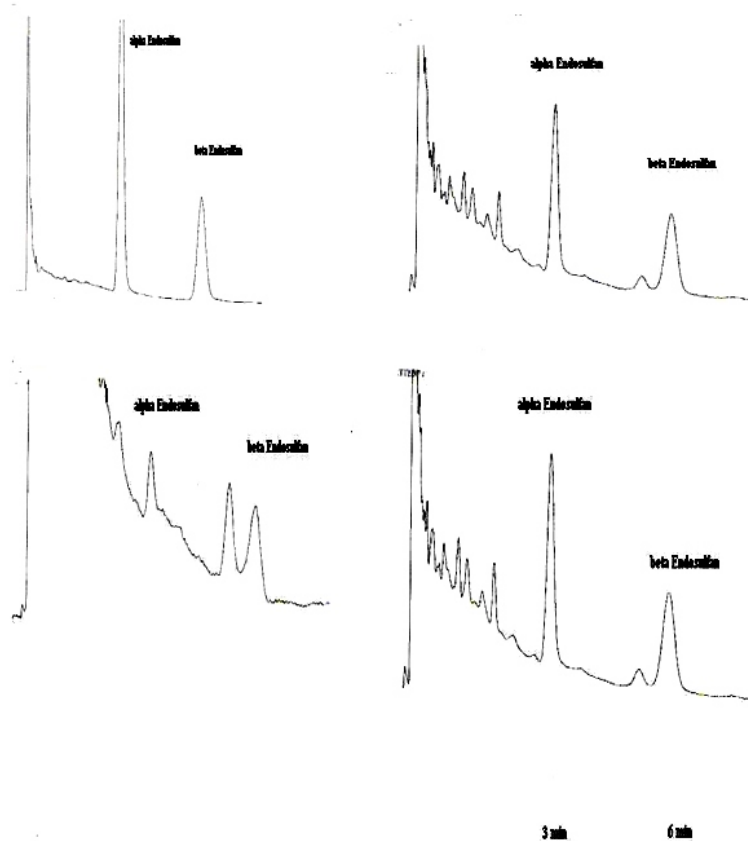


Figure 1 : Peaks of *alpha* and *beta* Endosulfan in washed, cooked, untreated and unprocessed cabbage.

0.001 to 0.009 $\mu$ g/g and 0.001 to 0.016 $\mu$ g/g, respectively, while in case of total Endosulfan persistence ranged between 0.003 to 0.025 $\mu$ g/g. Cabbage consumption after cooking is healthier than washing with water as it reduces 62.5% and 68.7% of *alpha* and *beta* Endosulfan, respectively. Similar results as reported by Dinabandhoo and Sharma (1) concluded that in cauliflower curds Endosulfan residue reduction after washing was 70% whereas after cooking 75% reduction of Endosulfan was seen. Elkins (2) reported that 98% of carbaryl was removed in tomato puree and ketchup after cooking.

In the present research work considerable amount of reduction in pesticide after washing and cooking was observed under controlled condition of sowing, pesticide application and harvesting. This indicates that with effective washing and cooking procedures pesticide residue decreases at consumption level for better health.

### Acknowledgement

The authors are grateful to the Head, Division of Agrichemicals, IARI, New Delhi for providing support and facilities to undertake the investigation.

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**Citation :** Goomer S., Upadhyay R., Das A. and Singh S.B. (2014). Levels of pesticide residue in cabbage (*Brassica oleracea var. capitata*). *HortFlora Res. Spectrum*, 3(1) : 88-90.