THE EFFECT OF HOUSEHOLD WASHING METHODS ON SELECTED PESTICIDE RESIDUE REDUCTION IN SELECTED CULTIVATED VEGETABLES

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CERTIFICATE I

Miss Sadhana Hariher Umrikar has satisfactorily prosecuted her course of research for a period of not less than two semesters and that the dissertation entitled " THE EFFECT OF HOUSEHOLD WASHING METHODS ON SELECTED PESTICIDE RESIDUE REDUCTION IN SELECTED CULTIVATED VEGETABLES " submitted by her, is the result of original work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the dissertation or part thereof has not been previously submitted by her for a degree of any University.

PARBHANI

31.5.86

DATED:

(Miss. S.M.Harode)
Guide

CERTIFICATE II

This is to certify that the dissertation entitled " THE EFFECT OF HOUSEHOLD WASHING METHODS ON SELECTED PESTICIDE RESIDUE REDUCTION IN SELECTED CULTIVATED VEGETABLES " submitted by Miss. Sadhana Hariher Umrikar to the Marathwada Agricultural University in partial fulfilment of the requirements for the degree of Master of Science (Home Science) in the subject of Home Management has been approved by the student's advisory committee after oral examination in collaboration with the external examiner.

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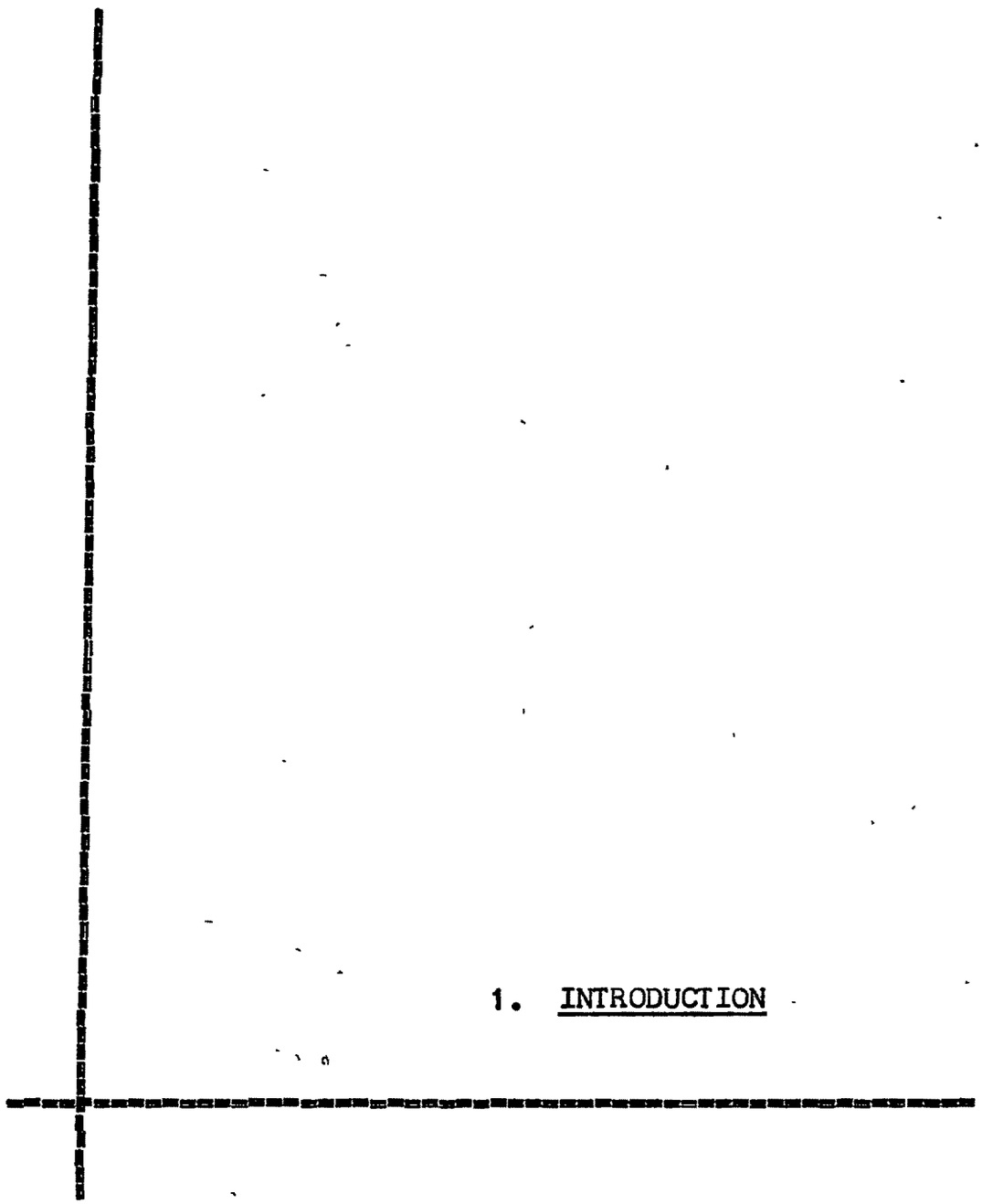

1. INTRODUCTION

1. INTRODUCTION

Vegetables play an important role in our daily diet. Being rich sources of vitamins and minerals, they are indispensable for growth and maintenance of human health. They add variety, colour and taste to meal, making it appealing, delicious and enjoyable.

The green revolution in the 20th century has increased the production of vegetables like other agricultural crops. The challenges in cultivation resulting due to infestation have been effectively dealt by the pesticides as emerging protective technology. Pesticides have thus gained world-wide acceptance in the productive technology. Prevention of 30 per cent losses in agricultural production proves its credibility (Rangaswami, 1970).

Pesticides, though reported in early 3000 B.C., have gained impetus in 1939, with the landmark of DDT, establishing strong hold for research in protection technology. Today, 900 synthetic pesticides have been enlisted in the world, for commercial purpose, while 120 are registered in India. Pesticides are grouped under chlorinated hydrocarbans, organophosphorus compounds, carbamate insecticides, plant originated-

and animal originated insecticides. Amongst these, DDT, BHC, endosulfan, malathion are commonly used in controlling vegetable pests.

Though protective to produce, the pesticides residue left on the surface and penetrated inside of the crop has became a global concern due to its effects, endangering human health (Munde, 1984). Over 10,000 people die every year in the third world countries due to pesticide poisoning and lakhs of others are prone to health hazards (Gupta, 1985). Metabolites of malathion can form antigen with body tissue protein, which leads to possibility of allergic tissue damage (Kay, 1973). The organophosphorus compounds ~~had~~ caused thousands of deaths by poisoning, while excessive levels of DDT and other chlorinated hydrocarbons affected the normal liver function. Cholesterol level, could impair the development and functioning of the nervous system. Besides, there is suspicion that high DDT residues may even cause abortion in pregnant women (Banerji, 1965). Excessive damage to the nerve can occur due to the organo-phosphorus insecticides (Jonson, 1970 and Jack lucas, 1978). Other harmful effects include damage to the psychological, neurological, cardiorespiratory and gastro-intestinal system (Jaek lucas, 1976).

Reviewing the emergence of fatal health problems, due to pesticide utilization, several countries have laid restrictions on their application. In India, promulgation of Insecticide Act in 1968, made provision for ceasing the market entry of the products containing pesticides above tolerance limit (Mujumdar et al.,1986). Tolerance limits were identified to denote the safe level of consumption (Verma, 1980).

To achieve the safe consumption level of pesticide residue, judicious use of pesticides by cultivators, requiring careful application, following instructions regarding concentrations, number and intervals of sprays, waiting period before marketing needs to be followed scrupulously. However, how many farmers are following these, is a matter of investigation. Many farmers have resorted to spraying more quantities on the crop, with the hope that, pests might get eliminated completely (Gupta, 1985).

The alarming situation challenging the healthy existence of ~~the~~ mankind, requires immediate conscious efforts at every level, including household. In the household, washing of the vegetables prior to consumption is a common practice. Different methods are implied depending upon the facilities available and cultural practices. Washing is believed to eliminate the

pesticides, though it may not bring the commodity under the safe level of consumption (Gupta, 1985 and Verma et al., 1985).

In the light of these facts, the different washing methods need to be tested for their efficacy. The results of the investigation can help the home-makers to adopt right vegetable washing process, as a step towards conscious efforts in bringing down the pesticide residue in family consumption for its welfare.

The study is therefore, undertaken with the following objectives-

1) To find out home-makers' vegetable washing methods and awareness of the effects of pesticide residue on human health.

2) To estimate the effect of the selected washing methods in reducing the selected pesticide residue on selected cultivated vegetables with different waiting periods.

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2. REVIEW OF LITERATURE

REVIEW OF LITERATURE

Management in the home is a part of Fabric of living. Its threads are interwoven because decisions for the use of resources are made, whether the family is at work or play (Gross and Crandall, 1960). Management is subject to the environmental conditions of household or Family and also has its effects (Ruth E Deacon, 1975).

A healthy, happy Family is one of the goal of every home maker. To achieve this goal a health conscious home maker strives to provide good nutritious food, with adequate amount of vegetables to satisfy the family, thus keeping within the budget and to avoid health problems too.

However the modern trend of pesticide spraying on the vegetable may have adverse effect on human health.

Available literature pertaining to this Study. is categorised under the following heads --

1. Initial deposits of insecticides on vegetables;
2. Residue reduction after washing;
3. Insecticide residue at different waiting periods.

2.1 Initial deposits of insecticides on vegetables :

Penetration of pesticides into plant leaves has been ably reviewed by Hull (1970). In general, semi-lipophilic compounds tend to penetrate into leaves, because of the nature of the outer cuticle in most plants. Compounds whose polarity is increased on entry into plant tissues usually penetrate best. High temperature and atmospheric humidity favour penetration.

Because number of persistent insecticides are lipophilic and tend to accumulate in plant oils and waxes, they tend to stay within skin, peel or outer surface of the plants after penetration.

Wallies et al. (1955) asserted that comparatively residues of malathion was higher and remained longer on leafy vegetables than roots & tubers and other vegetables.

2.2 Residue reduction after washing

Washing is a process commonly applied to all vegetables and fruits. In this process the pesticide residue gets dissolved in the water and thus eliminated to some extent through drained water. A significant amount of residues have been found to persist even after washing. Washing may not bring the commodity under the safe level of consumption (Jacob, 1981 and Gupta, 1985).

Smith et al. (1955) ascertained that washing for 30 and 60 seconds reduced 3.4 ppm initial deposits of malathion to 0.5 and 0.2 ppm respectively. Further they recorded that washing removed 80 to 100 per cent malathion from lettuce.

Wallies et al. (1957) discerned that washing removed 92-100 per cent residues from Okra, summer squash and parsley. Further, it was confirmed that one minute washing reduced 15.20 ppm initial deposits of malathion to mere traces in Okra. According to Pekka and Maila (1964) washing of tomatoes removed 99 per cent malathion with an initial deposits of 12.8 ppm. Singh and Lal (1966) reported a reduction of 86.2 per cent malathion content in tomatoes after 9 minutes washing. Sharma et al. (1966) found that washing eliminated 72 to 78 per cent of malathion residue from cauliflower head.

In washing, Elkins, Lamb and Cook (1968) stated effective (96 per cent) removal of malathion residues from beans. Elkins et al. (1971) opined that a home style cold water washing did not cause any significant change in the level or malathion residues in tomatoes.

Deshmukh et al. (1972) also illustrated that by washing with slightly rubbing, the initial deposits

of 1.41 ppm endosulfan on tomatoes was reduced to only 39 per cent, while 14 days old residue was removed upto 18 per cent only. According to them, this may be due to quick penetration of endosulfan inside the fruits and vegetables leaving very little quantity on surface, which is removed by washing and rubbing.

Nath et al. (1974) confirmed that 30 seconds wash removed 35-49 per cent endosulfan residue from ladies finger. Malathion residues of different concentrations were studied by Nath et al. (1975). The results indicated decrease of 89.15 and 99.48 per cent in lower and higher concentrations respectively. Similarly in case of lower and higher doses of endosulfan treated cauliflower. Awasthi et al. (1975) described 46.5 and 12.5 per cent elimination by washing respectively in lower and higher dosage. By washing endosulfan treated Okra, for 30 seconds. The removal of endosulfan residues from bhendi fruits varied from 35-49 per cent after washing according to Nath et al. (1975). According to Kushawah and Pal (1978), washing of tomatoes by rubbing with hands for about 2 minutes, under tap decreased the initial deposits of 5.915 ppm of endosulfan to 67.93 per cent. Verma (1979), by washing red tomatoes, concluded that the initial deposits of endosulfan were lowered from 2.71 to 0.75 ppm.

According to Kathpal (1980) washing of cauliflower leaves and curds for a minute removed endosulfan residue to the extent of 29.10 per cent.

Nath, Srivastava (1981) noted that the initial deposits of malathion on bittergurd were reduced after washing to 4.87 and 10.16 ppm respectively from 16.80 and 30.91 ppm of 0.05 and 0.01 concentration.

Verma et al. (1981) observed that washing and boiling of brinjal did not bring down the endosulfan residues below the tolerance limit. Verma and Jacob (1985) revealed that the initial deposits of 10.0 ppm (0.07 per cent concentration) of endosulfan on the cauliflower was reduced to 4.6 ppm after washing.

2.3 Insecticide residue at different waiting periods

Waiting period is important aspect in insecticide utilisation to bring down the residue below the tolerance limit. High temperature and atmospheric humidity favour the penetration and tend to accumulate after penetration (Hull, 1970). Waiting period is determined by several factors such as initial deposits, rate of dissipation and tolerance limit (Kathpal, 1980). A sharp decline in the residue level after the post harvest periods may be due to hot tropical solar radiation, temperature, wind, rains and humidity (Mujumdar et al., 1984 and Gupta, 1985).

Wallies et al. (1955) witnessed above 8 ppm residue on leafy vegetables for 3 days and even longer when no rainfall occurred and further persisting to 14 days on parsely. The safe waiting period for the cauliflower inferred by Lal (1971), Gupta and Kapoor (1971) was about 12 and 5 days respectively for higher and lower dose concentration of malathion. Hameed and Lal (1977) found that malathion residues on cabbage, cauliflower and Knol-Khol took 6-9 and 10-12 days respectively to dissipate below the tolerance limit (at the rate of 600 g./hectare and 1200 g/hectare). Kawadia and Gupta (1977) recorded that after 6 days of waiting period 26.74 ppm, initial deposits of malathion on tomatoes declined to below the tolerance limit.

Sharma (1979) concluded that a week's waiting period was required for tomatoes treated with higher dosage of endosulfam. Kathpal (1980) observed that 3-7 days waiting period was required to bring safe consumption level of endosulfan on cauliflower and tomatoes respectively. Further, ladies finger denoted excessive levels of endosulfan residue.

One day waiting period for malathion at recommended dosage brought the residue to tolerance limit, for

brinjal, bhindi, peas, tomatoes and mustard with the exception of peas (cowpea) which took more than 7 days was affirmed by Kathpal (1980). The study of Murthi et al. (1982) determined 9.35 and 14.0 days waiting period to reach the endosulfan residue below the tolerance limit (0.05 and 0.10 cm), while Lalitha et al. (1984) expressed complete dissipation of endosulfan residue in tomatoes and brinjal after 7 and 10 days respectively. Dikshit et al. (1984) evidenced declining of endosulfan residue in 62 days from potatoes to 1.10 and 2.18 ppm and below the tolerance limit after 92 days of an initial deposits of 2.64 and 4.00 ppm (.0.3 and 0.5ppm) respectively.

3. MATERIALS AND METHODS

MATERIALS AND METHODS

The study was undertaken to assess the"Effect of household washing methods on Selected pesticide residue reduction in selected,cultivated vegetables". Awareness of homemakers regarding presence of pesticides and their methods of vegetable washing,initial, pesticide deposits in vegetables , residue reduction after washing, pesticide residue at different waiting periods were the various factors of study.

An account of materials used and methods employed in the present study is detailed under following heads.

3.1 Collection of information regarding common vegetable washing methods and awareness of harmful pesticide residue effects among the homemakers.

3.2 Estimation of pesticide residue in vegetables cultivated using specific treatments.

3.3 Statistical analysis.

3.1 Colledtion of information regarding common vegetable washing methods and awareness of harmful pesticides residue effect among the homemakers.

A total of 100 homemakers from Parbhani city were surveyed randomly by personal interview method with the help of pretested questionnaire (Appendix I). Data

regarding homemakers vegetable washing methods and awareness of the harmful effects of pesticides residue on human health was collected. It was consolidated and tabulated for further interpretation.

3.2 Estimation of pesticides residue in vegetables cultivated using specific treatment

The experiment was carried out partially in the Department of Home Management, College of Home Science and in the pesticide research centre, Department of Entomology, College of Agriculture, Marathwada Agricultural University, Parbhani.

The details of the procedures followed in the experiment are briefed under the following heads-

1) Selection and cultivation of the vegetables.
2) Selection, preparation and application of insecticides on selected vegetables.
3) Collection of samples at different waiting periods.
4) Selection and standardization of washing methods.
5) Selection and standardization of cooking methods.
6) Experimental procedure.
7) Estimation of the residue by Gas chromatograph.

3.2.1 Selection and cultivation of the vegetables

Vegetables such as brinjal, cabbage being commonly susceptible to infestation and hence commonly sprayed

with pesticides were selected for this study. The seedlings of those vegetables obtained from Department of Horticulture of Marathwada Agricultural University were raised in G x 10 feet plots, each in triplicate, in the kitchen garden area of Home Science College. Control plot was also maintained for each vegetable.

3.2.2 Selection, preparation and application of the insecticides on vegetables

The commercial insecticides namely endosulfan 35 EC and malathion 50 EC being commonly advised and practiced to protect the vegetables against infestations were selected for field application. Spray solutions of 0.05 per cent concentrations were prepared in water and applied to the crops at fruiting stage, having sufficient number of fruits, using hand compression sprayer.

3.2.3 Collection of samples at different waiting periods

The samples of cabbage and brinjals were randomly drawn from each treated and controlled plot after selected waiting periods i.e. 1, 3, 5 and 7th day of application. They were labelled and stored in polythene bags in the deep freezer for further analysis.

3.2.4 Selection and standardization of washing methods

Washing by holding under the running cold and hot water tap, dipping in cold water and dipping in warm

water were the methods selected for washing vegetables, on the basis of survey.

The washing under tap was standardized for its pressure (at 0.7 pound/sq" pressure) and time. Dipping method were standardized for the size of the vessel, volume of the water, immersion period, temperature and the size and weight of the vegetable (Appendix II), number of frequencies of washings were fixed.

3.2.5 Experimental procedure

3.2.5.1 Washing of vegetables

Sample of selected vegetables, each 50 g. in weight was washed in the following three methods-

1) Washing each vegetable four times by holding under the running cold tap water for ½ minute.

2) Washing each vegetable four times by holding under the running warm tap water.

3) Dipping with light rub in cold water for 1, 2. and 3 minutes.

4) Dipping with light rub in 42 ^{o}C warm water for 1, 2 and 3 minutes.

3.2.5.2 Extraction process

The samples were chopped uniformly in 1-1.½ cm size with steel knife and weighed 50 g. from each

treatment and controlled plot, with selected waiting periods. They were put in properly labelled, wide mouthed 250 ml. beakers.

Extracts of malathion and endosulfan were blended in mixer with 100 ml acetone for 3-4 minutes. The extract was filtered through funnel using cotton wool. The filtrate was transferred to the separatory funnel. The filtrate was washed with petroleum ether and chloroform respectively. Fifty ml each for endosulfan and malathion was used. The filtrate of petroleum ether and chloroform were stored in deep freeze.

3.2.5.3 Cleanup process

The extracts petroleum ether and chloroform were passed through chromatography column. Petroleum ether and chloroform elutes were collected and reduced to 10 ml clean extracts were stored in refrigerator after labelling for further analysis.

3.2.6 Estimation of residue by Gas chromatography

The endosulfan residues were estimated by Gas chromatography method. Column, injection part and ECD temperatures were 185, 200 and 210 ^{o}C respectively. RT was 7.82 min. malathion residues were estimated as per the procedure described by Jain et al. (1974).

Recovery ranged from 75 to 83 per cent. (Jain, H.K., Pandey, S.Y., Agnihotri, N.P. and Dewan, R.S. 1974. Rapid estimation of organophosphorus pesticides)

3.3 Statistical analysis

The X^2 test was applied to determined the association between two variables.

Formula -

$$\frac{(O-E)^2}{E}$$

where - O - observed frequency

E - Expected frequency

4. RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The present investigation was undertaken to study the"Effect of Household washing methods on Selected Presicide residue ~~vegetables~~ reduction in selected vegetables."

T he various aspects dealt include common vegetable washing methods adopted by homemakers, awareness of homemakers, regarding the harmful effects of pesticides residue,residue reduction in diffierent waiting periods in selected vegetables. The Data obtained was tabulated, statistically analysed and presented under the following heads.

4.1 General information.

4.2 Homemakers' vegetable washing methods and awareness regarding the effects of pesticide residue on human health.

4.3 Estimation of the effect of the selected household washing methods in reducing the selected pesticides residue on selected, cultivated vegetables with different waiting periods.

4.1 General information.

General information about the homemakers' age,education , income,size and type of family is given in Table 1.

Table 1: General information of the homamakers

Sr. No.	General information	Families	
		Frequency	Percentage
1	Age		
	20-30	27	27.0
	30-40	38	38.0
	40-50	25	25.0
	50-60	10	10.0
2	Literacy level		
	Illiterate	9	9.0
	Primary school	14	14.0
	Middle school	15	15.0
	High school	38	38.0
	College- Graduate	22	22.0
	Post graduate	2	2.0
3	Monthly income (Rs)		
	0-600	-	-
	601-1200	15	15.0
	1201-1800	39	39.0
	1801-2400	27	27.0
	2401-3000	16	16.0
	3001 and above	3	3.0
4	Size of the family		
	0-2	11	11.0
	3-4	35	35.0
	4-5	28	28.0
	5-6	20	20.0
	7 and above	6	6.0
5	Type of the family		
	Nuclear	82	82.0
	Extended	6	6.0
	Joint	12	12.0

As seen in Table 1, maximum (38 %) housewives were in the age group of 30-40 years and minimum (10 %) in the age group of 50-60 years. Close number of homamakers (27 and 25) were noted in the age group of 20 to 30 and 40 to 50 years.

Majority (38 %) of the housewives were high school educated, followed by graduates (22 %). Only 20 per cent housewives were post-graduates while 9 per cent were illiterates.

As seen, no families had monthly income below Rs 600. Maximum (39 %) families were within the range of Rs 1200-1800, followed by Rs 1801-2400. Only 3 per cent of the families were having Rs 3000 and above income.

It is also revealed from the Table 1 that most (55 %) families were small in size having 3-4 members. Only 6 per cent families had 7 and above members.

It is also observed from the Table 1 that maximum (82 %) families were nuclear. Joint and extended families were 12 and 6 per cent respectively.

4.2 Homemakers' vegetable washing methods and awareness regarding the harmful effects of pesticides residue on human health

4.2.1 Household vegetable purchasing practices

4.2.2 Household vegetable consumption pattern

4.2.3 Household vegetable washing practices

4.2.4 Homemakers' awareness regarding pesticides use and their harmful effects on health

4.2.1 Household vegetable purchasing practices

Table 2: Household vegetable purchasing practices

Sr. No.	Purchasing pattern	Number of families (N=100)
1	Daily	45
2	Every 2 days	37
3	Every 3 days	18

From above Table 2, it is informed that, maximum families (45 %) purchased vegetables daily, while 37 and 18 per cent bought once in every 2 and 3 days respectively.

Table 3: Personnel involved in household vegetable purchasing

Sr. No.	Vegetable buyer	Number of families (N=100)
1	Husband	53
2	Housewife	35
3	Other members	9
4	Servants	3

From the Table 3, it is illustrated that in maximum (53 %) families, husbands shouldered the responsibility of vegetable purchases, followed by next highest percentage of (35 %) housewives. In 9 per cent families, the vegetable purchases were done by other members and in only 3 per cent families servants were assigned this duty.

Table 4: Sources of household vegetable marketing

Sr. No.	Sources	Number of families (N=100)
1	Main vegetable market	85
2	Vendors	12
3	Petty shops	2
4	Weekly bazar	1

Above table depicted that the main vegetable market was the major source of purchase for the majority (85 %) of the families, while vendors were approached by 12 per cent, only 2 per cent families purchased vegetables from nearby petty shops and 1 per cent from weekly bazar. It was felt that the main vegetable market was in the main shopping

area, where other purchases were possible easily by the majority of the families. Marketing in weekly bazar only by 1 per cent may be attributed to the lack of variety and unsatisfactory quality of the vegetables and other far products, far off from main shopping centre and presence of the low class consumers.

Table 5: Monthly household expenditure on vegetables

Sr. No.	Monthly expenditure on vegetables (Rs)	Number of families (N=100)
1	30-40	13
2	41-50	27
3	51-60	12
4	More than 60	48

From the above Table 5, it is expressed that majority of the families (48 %) spent more than Rs 60/ month on vegetables. On the other hand, Rs. 31-40 was incurred by 13 per cent families; while, 27 and 12 per cent families spent Rs 41-50 and Rs 51-60 on vegetables, respectively.

4.2.2 Household vegetable consumption pattern

Table 6: Vegetable consumption pattern of the families

Sr. No.	Vegetables consumed	Every day	Frequently	Sometimes
1	Leafy vegetables	55	45	-
2	Roots and tubers	30	70	-
3	Other vegetables	-	25	75

It is revealed from the above Table 6 that, 55 and 30 per cent families consumed leafy vegetables and roots and tubers every day respectively. Frequent consumption of leafy vegetables and roots and tubers were observed among 70 and 45 per cent families respectively. Though every day consumption of other vegetables was nil, 25 per cent families reported it frequently and 75 per cent sometimes. On the whole, it is discovered that the consumption of the vegetables was poor.

Table 7: Per day vegetable requirement of the families

Sr. No.	Vegetables	Requirement in kg			
		1/4	1/2	3/4	1
1	Leafy vegetables	55	-	45	-
2	Roots and tubers	-	60	-	40
3	Others	-	75	-	25

From the above Table 7, it is evident that majority (55 %) of the families per day consumption of leafy vegetables was 1/4 kg while 45 per cent required 3/4 kg. Roots and tubers required in 1/2 kg quantity by 60 per cent families and 1 kg by 40 per cent families. Per day requirement of the other vegetables was 1/2 kg for 75 per cent families and 1 kg for 25 per cent families.

Table 8: Types of vegetables consumed per day

Sr. No.	Type of vegetables	Vegetable consumption	
		In Morning	In Evening
1	Leafy vegetables	55	45
2	Roots and tubers	40	60
3	Other vegetables	25	75

It is observed from the Table 8 that 55 per cent of the families consumed leafy vegetables in the morning meals and 45 per cent in the evening. The consumption of roots and tubers was more in the evening as depicted by 60 per cent families, whereas 40 per cent had it in the morning. Other vegetables were consumed in the morning by 25 per cent of the families and in the evening by 75 per cent.

4.2.2.1 Homemakers' rational for the vegetable consumption

All the families homemakers expressed the necessity of vegetables in their daily diet. The various justifications given included relishing by the family members (5.3 %), bringing variety in the diet (59 %), indispensable source of nutrients (64%) and keeping healthy (14 %). Need of the regular vegetable consumption was felt by 9 per cent families as they were advised by doctors and health visitors.

4.2.3 Household vegetable washing practices

From Table 9, it is ascertained that majority (49%) of the families washed the vegetables under the running water (tap) while 17 per cent families washed the vegetables by immersing in water and therein picking them up before draining the water off.

Table 9: Vegetable washing practices

Sr. No.	Vegetable washing practices	Number of families (N=100)
1	Washing methods	
	a) Holding under running water	49
	b) Dipping in cold water and drawing off the water	34
	c) Immersing in water & taking out	17
2	Number of washes used	
	a) Leafy vegetables	
	Once	2
	Twice	30
	Thrice	10
	Four times	4
	b) Roots and tubers	
	Once	10
	Twice	18
	Thrice	2
	Four times	-
	c) Other vegetables	
	Once	8
	Twice	14
	Thrice	
	Four times	
3	Type of water used for washing	
	i) Cold water	82
	ii) Warm water	18
4	i) Before cutting	50
	ii) After cutting	24
	iii) Both before and after cutting	26
5	Time allotted for dipping in water in minutes	
	i) 1/2	46
	ii) 1	6
	iii) 2	34
	iv) 3	3
	v) 4	2
	vi) 5	9

In case of education and washing methods, the association was significant giving high value (13.24) of Chi-square as compared to the table value of Chi-square (5.99) at given degrees of freedom and choosen level of significance. Hence it can be revealed that two variables, washing methods and education level of house wives are positively associated with each other. Higher the education lever more the awareness regarding washing methods.

Leafy, roots and tubers and other vegetables were washed twice by 30,18 and 14 per cent families respectively. On the other hand, it was performed thrice by 10,2 and 2 per cent families respectively for leafy, roots and tubers and other vegetables. Two, 10 and 18 per cent families washed the leafy vegetables, roots and tubers and other vegetables once only. Generally, the frequency of washing was noted to be more in rainy seasons to the extent of 4 and 5 times by 6 and 2 percent families. Most (83 %) of the families lightly rubbed the vegetables slightly whenever vegetables were much soiled.

Majority(82%) of the families washed vegetables in cold water, while few(18%) of them used warm water(specially for cauliflower).

Most of the families (18 %) who were washing the vegetables with warm water, uses warm water throughout the year, irrespective of season by only one family.

Most of the families (50 %) washed the vegetables before cutting though 24 and 26 per cent of the families washed the vegetables after cutting and both before and after cutting respectively.

Washing vegetables before cutting was practiced by homemakers, for making vegetables free from dust (50 %) habituated from childhood (12 %), learned from others (20 %) and for retention of nutrients was expressed by 30 per cent families.

Washing vegetables after cutting was justified for various reasons, such as habituated from beginning (24 %), colour preservation (4 %), flavour reduction (6 %) and easy to cut (11 %).

For thorough cleaning, vegetable washing was done both the times by 26 per cent families.

Forty six and 34 per cent families immersed vegetables in water for half a minute and 2 minutes respectively. Very few of the families 6, 3 and 2 per cent immersed the vegetable in water for 1, 3 and 4 minutes respectively.

It was surprising to find that 9 percent of the families were immersing vegetables for 5 minutes. Two percent of the families were using potassium permangnate for washing only leafy vegetables.

4.2.3.1 Homemakers' rationale for vegetable washing

The reasons for washing the vegetables given by the homemakers were removal of mud(77%),removal of pesticides (42%) to make free from micro- organisms (27%) ,increasing the turgidity (22%) and to make them fresh and appealing (6%).

4.2.4 Homemakers' awareness regarding pesticides use and their harmful effects on health

It was found that,all the homemakers were aware that the farmers used pesticides on vegetables to control the pest infestation except one.

Ninety eight per cent families were aware that, pesticides above tolerance limit were harmful to the human health, while only 2 percent were ignorant about it.

To know the association between increasing age and increasing awareness,Chi-square test was applied (C.V.= 0.48, T.V. 3.84),which resulted into non-significant association.Hence it can be revealed that with the increase in age the awareness did not increase simultaneously.

Similar results were observed in case of education and awareness of harmful effects of pesticides. The observed value of X^2 was smaller(0.089) than table value at 5(3.84) per cent level of significance,which concluded that education and awareness of pesticide residue was were independent .

From the Table 10, it is revealed that the only harmful effects known to the families enlisted were acute poisoning (66%), deaths(26%),destrution of vital organs like Kidney and heart(12%), occupational fatalities (6%) signs of impaired nerves (6%). and abortion in pregnant women(4%).

Most of the families (66%) believed that their marketed vegetables contained pesticidies above tolerance limit,though 36% per cent families were unaware of it. Incidence of above tolerance pesticides limit were experienced in somem marketed vegetables.

It is also noted from the Table 10 that,most of the families were suggesting to wash the vegetables many times before cooking. It was startlingg to note that 2 per cent homemakers suggesting not to consum the vegetables at all.

Table 10: Homemakers awareness of harmful effects of pesticide on human health

Sr. No.	Particulars	Number of families (N=100)
	I) Harmful effects	
1	Acute poisoning	66
2	Deaths	26
3	Destruction of vital organs like kidney and heart	12
4	Occupational fatalities	6
5	Signs of impaired nerve	6
6	Abortion in pregnant women	4
	II) Suggestions	
1	Not to consume	2
2	To educate the farmers	12
3	To educate women to take group action	12
4	To wash thoroughly	66
5	To grow vegetables	24
6	To use safest pesticide	4
7	To wash vegetables by farmers before selling	2
8	To follow all precautionery measures and observe proper waiting periods	1

Solutions suggested by the homemakers to avoid such dangers are vegetables should be washed thoroughly (2 %) by the farmers before selling (2 %), use of safest pesticides (1 %) and following all precautionary measures and observing proper waiting periods (4 %).

4.3 Estimation of the effect of the selected household washing methods in reducing the selected pesticides residue on selected, cultivated vegetables with different waiting periods

The results are detailed under the following heads.

4.3.1 The effect of washing methods on the pesticide residue reduction in cultivated vegetables.

4.3.2 The effect of washing methods at different waiting periods on pesticide residue reduction in cultivated vegetables.

4.3.3 Ranking of the selected washing methods with regard to pesticide reduction.

4.3.1 The effect of washing methods on the pesticide residue reduction in cultivated vegetables

Table 11 denotes the results of the number of washes of four washing methods in the endosulfan reduction in cabbage at different waiting periods.

Table 11: Effect of various washing methods in the endosulfan reduction in cabbage at different waiting periods

Methods of washing	Initial deposits at different waiting periods				Reduction of residue after each wash at different waiting periods				Difference in the reduction of residue each wash in percentage			
	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day
I) Holding under running cold water (tap)	7.345	3.034	0.105	0.089								
1) First (½ min.)					5.134* (31)	2.939* (4)	0.101 (4)	0.072 (20)	31	4	4	20
2) Second (1/2 min.)					4.348* (41)	2.214* (28)	0.075 (29)	0.022 (76)	10	24	25	55
3) Second (1/2 min.)					2.248* (70)	1.538 (50)	0.022 (80)	0.010 (89)	29	22	51	13
4) Fourth (1/2 min.)					1.790 (76)	0.085 (98)	N.D.	N.D.	6*	48	N.D.	N.D.
II) Holding under running warm tap water (42 °C)												
1) First (1/2 min.)					4.903* (34)	2.534* (17)	0.089 (16)	0.060 (33)	34	17	16	33
2) Second (1/2 min.)					4.183* (45)	1.639 (46)	0.032 (70)	0.048 (47)	11	25	54	14
3) Third (1/2 min.)					2.098* (72)	1.085 (65)	0.015 (86)	0.015 (84)	27	19	16	37
4) Fourth (1/2 min.)					0.345 (96)	N.D.	N.D.	N.D.	24	N.D.	N.D.	N.D.
III) Dipping in cold water with eight rub	7.345	3.034	0.105	0.089								
1) First (1 min.)					7.034* (5)	2.385* (22)	0.085 (20)	0.067 (25)	5	22	20	25
2) Second (2 min.)					5.323* (28)	1.929 (37)	0.053 (50)	0.042 (53)	23*	18	30	28
3) Third (3 min.)					3.345* (55)	1.545 (90)	N.D.	0.025 (72)	27	80	N.D.	19
IV) Dipping in warm water with eight rub (42°C)												
1) First (1 min.)					5.348* (28)	2.234* (27)	0.083 (21)	0.051 (43)	28	27	21	43
2) Second (1 min.)					4.923* (33)	1.818 (41)	0.032 (70)	0.037 (59)	5	14	49	16
3) Third (3 min.)					3.121* (58)	1.435 (53)	N.D.	0.017 (81)	25	12	N.D.	22

T.L = 2 Pm

Figures in parentheses indicate percentage * indicates [illegible]

The initial endosulfan deposit on cabbage was reduced to 5.134 ppm from 7.345 ppm at one day waiting period when washed once for a half minute under cold running tap water, which was further reduced to 4.346ppm, 2.245 ppm and 1.790 ppm in the 2nd, 3rd, 4th washes each of half a minute respectively. The elimination of residue was increased with each additional wash denoting 31, 41, 70, 76 per cent ~~ppm~~. The initial above tolerance was brought down to below tolerance only after the 4th wash. The difference in the reduction of residue at each waiting period was 31, 10, 29 and 6 per cent.

At the three days waiting period, the initial above tolerance residue of endosulfan was reduced to 1.538 below tolerance limit from 3.034ppm in the third wash only.

The differences in the residue reduction were 4, 24, 22 and 48 per cent only. The initial residue levels at 5th and 7th day waiting periods were below tolerance limit 0.105 ppm and 0.089 ppm respectively, reduced to non-detectable levels in the fourth wash of cold running water.

In holding under running warm tap water (42 ^{o}C) the initial endosulfan deposit of 7.345 ppm on cabbage was reduced to 4.903 ppm, 4.103 ppm, 2.098 ppm and

0.345 ppm with each additional wash respectively, bringing it to below tolerance only at the end of 4th wash. The difference in reduction at the end of each washing stage was 34, 11, 27 and 24 per cent respectively.

Further the 3rd day waiting period initial deposit 3.034 ppm was decreased to below tolerance limit to 1.639 ppm at the end of the second wash and non-detectable level at the 4th wash.

The initial below tolerance level of residue at 5th and 7th day waiting periods were also reduced to non-detectable levels only at the 4th wash.

Dipping the cabbage in cold water with light rubbing for a minute helped to bring down the residue to 7.034 ppm, 5.323 ppm and 3.34 ppm, from the initial deposit of 7.345 ppm on one day waiting period. Though there is reduction in the amount of residue, it had not come down below tolerance limit. However, at the 3rd day waiting period, the above tolerance residue limit 3.034 ppm was lowered down to consumption limit, 1.929 ppm at the end of 2nd wash only. The difference in residue reduction at each was found to be steadily increasing.

The below tolerance endosulfan deposits on 5th and 7th waiting days were further reduced to non-

detectable level and 0.025 ppm respectively by the end of the 3rd wash.

Dipping cabbage in warm water with slight rubbing also reduced initial deposit of 7.345 ppm at one day waiting period to 3.121 ppm, which still remained above tolerance limit only, though there was difference in the residue reduction 28, 5 and 25 per cent at the end of 2nd and 3rd wash. Again, the above tolerance deposit 3.034 ppm at third day waiting period was reduced to 2.234 ppm, 1.818 ppm and 1.435 ppm, with each additional dip, thus achieving safe consumption level, at the end of 2nd wash. It is observed that the below tolerance residue at the end of the 5th day was at non-detectable level at the 3rd dip while, 7th day waiting period, it was 0.017 ppm only.

It is obvious from the Table 11 that with increase in the waiting period, the initial above tolerance level of endosulfan on cabbage was decreased to safer consumption level, only at the end of 5th day. As seen from the Table 12 washing brinjal under running cold tap water the initial residue of endosulfan at 1 day waiting period 5.235 ppm was lowered to 4.635 ppm, 3.192 ppm, 2.567 ppm and 2.345 ppm in 1, 2, 3, 4 washes respectively. It remained at above tolerance limit though there was 56 per cent reduction.

Table12 : Effect of Various washing methods in the reduction of endosulfan on brinjal at different waiting periods

Methods of washing and number of washes	Initial deposits at different waiting periods				Reduction of residue after each wash at different waiting periods				Difference between each wash in percentage			
	1st day	2nd day	3rd day	4th day	1st day	2nd day	3rd day	4th day	1st day	2nd day	3rd day	4th day
I) Holding under running cold water (tap)	5.234*	2.382*	0.224	0.056								
1) First (1/2 min.)					4.632* (12)	2.134* (11)	0.102 (55)	0.032 (43)	12	11	55	43
2) Second (1/2 min.)					3.192* (40)	1.24 (53)	0.052 (77)	0.024 (58)	28	42	22	15
3) Third (1/2 min.)					2.567* (51)	0.532 (78)	0.021 (91)	0.012 (79)	11	25	14	21
4) Fourth (1/2 min.)					2.345* (56)	0.345 (86)	N.D.	N.D.	5	8	-	-
II) Holding under running hot water (42 °C)(tap)												
1) First (1/2 min.)					4.101* (22)	2.122* (11)	0.102 (55)	0.032 (43)	22	11	55	43
2) Second (1/2 min.)					2.738* (48)	1.902 (21)	0.052 (77)	0.024 (51)	26	10	22	14
3) Third (1/2 min.)					2.124* (60)	0.134 (95)	0.021 (91)	0.012	12	74	14	3
4) Fourth (1/2 min.)					1.992 (62)	0.088 (97)	N.D.		2	2	-	-
III) Dipping in cold water with light rubbing	5.235	2.382	0.224	0.056								
1) First (1 min.)					4.632* (12)	2.009* (16)	0.132 (42)	0.042 (29)	12	16	42	25
2) Second (2 min.)					4.349* (13)	1.542 (36)	0.122 (46)	0.099 (30)	1	20	4	5
3) Third (3 min.)					2.890* (45)	1.101	0.089 (61)	N.D.	32	18	15	N.D.
IV) Dipping in warm water												
1) First (1 min.)					4.325* (18)	1.532 (36)	0.122 (46)	0.022 (61)	18	36	46	61
2) Second(2 min.)					3.752* (29)	1.329 (45)	0.102 (55)	0.012 (79)	11	9	9	18
3) Third (3 min.)					2.922* (45)	0.982 (59)	0.072 (68)	N.D.	16	14	13	N.D.

TL : 2 ppm

Figures in parenthesis indicate percentage * indicates ATL

The 3rd day waiting period initial value 2.382 ppm was reduced to 2.134 ppm and 1.124 ppm in the first and second wash respectively. The reduction of 53 per cent reduction in the second wash brought the residue below the tolerance limit. At the end of 4th wash 86 per cent residue loss was observed. Washing at 5th and 7th day waiting period further reduced the below tolerance ppm level to 0.021 ppm and 0.012 ppm respectively in the third wash. Washing under running warm tap water lowered the initial residue 5.235 ppm to 1.992 ppm in the 4th wash, eliminating 62 per cent residue thus bringing it to safer consumption level. The above tolerance residue at 3rd washing day was reduced to safe consumption level at the end of second wash, eliminating 21 per cent residue. The lower residue levels at 5th and 7th day waiting period were further reduced to non-detectable levels respectively at the end of 4th wash.

When the brinjal was washed by dipping it cold water with light rub at 1 day waiting period, residue 5.235 ppm was decreased to 4.632 ppm, 4.349 ppm and 2.89 ppm at 1st, 2nd and 3rd wash respectively. Though by this method 45 per cent of the initial residue was washed off, it still remained at above tolerance level.

Washing on 3rd day waiting period the residue 2.382 ppm was decreased to 2.009 ppm at the first wash,

thus not making it for safe consumption. The total loss at the end of third was 54 per cent. Washing at 5th and 7th day waiting period resulted in further reduction in the initial below tolerance levels which was non-detectable at 3rd wash on the 7th day.

Brinjal when dipped in warm water on 1st waiting day was found to reduce the initial deposit 5.235 ppm to 4.325 ppm, 3.752 ppm and 2.922 ppm levels, keeping it at above tolerance limit at the end of all the three washes. Washing at 3rd day waiting period the initial residue 2.382 ppm was reduced to below tolerance limit 1.532 ppm after first wash only.

Fifty nine per cent residue loss was observed at the end of the third wash. The 5th and 7th day initial residues on brinjal were found to be below tolerance limit (0.224 ppm and 0.056 ppm) which were further reduced to 0.072 and nil respectively.

It is evident from the Table 12 that the initial above tolerance residue 5.234 ppm on 1st waiting day was reduced to below tolerance level on 5th day denoting 0.224 ppm.

Table No. 13 describes the effect of the washing methods in the reduction of malathion on cabbage at

Table 13: Effect of various washing methods in the malathion reduction in cabbage at different waiting periods

Methods of washing	Initial deposits at different waiting periods				Reduction of residue after each wash at different waiting periods				Difference in the reduction of eresidue between each wash in percentage			
	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day
I) Holding under running cold tap water	7.789*	3.459*	0.066	0.022								
1) First (1/2 min.)					6.834* (13)	2.734* (21)	0.042 (36)	0.010 (55)	13	21	36	55
2) Second (1/2 min.)					5.232* (33)	1.635 (53)	0.022 (66)	N.D.	20	32	30	N.D.
3) Third (1/2 min.)					3.192* (60)	0.345 (90)	0.002 (97)	N.D.	27	37	31	N.D.
4) Fourth (1/2 min.)					2.567* (68)	0.055 (98)	N.D.	N.D.	8	8	N.D.	N.D.
II) Holding under running warm tap water (42 °C)												
1) First (1/2 min.)					6.345* (19)	2.134* (36)	0.031 (54)	0.003 (87)	19	38	54	87
2) Second (1/2 min.)					4.892* (38)	1.464 (58)	0.012 (82)	N.D.	19	20	28	N.D.
3) Third (1/2 min.)					2.242* (72)	0.219 (94)	N.D.	N.D.	34	36	N.D.	N.D.
4) Fourth (1/2 min.)					1.654 (79)	N.D.	N.D.	N.D.	7	N.D.	N.D.	N.D.
III) Dipping in cold water with light rubbing												
1) First (1 min.)					7.634* (2)	3.145* (9)	0.052 (22)	0.017 (23)	2	9	22	23
2) Second (2 min.)					7.129* (9)	2.545* (27)	0.032 (52)	0.008 (64)	7	18	30	41
3) Third (3 min.)					5.464* (30)	1.924 (45)	0.017 (75)	N.D.	21	18	23	N.D.
IV) Dipping in warm water with light rubbing												
1) First (1 min.)					7.134* (8)	2.942* (15)	0.045 (32)	0.014 (37)	8	15	32	37
2) Second (2 min.)					6.345* (19)	2.504* (28)	0.025 (62)	0.005 (78)	11	13	30	
3) Third (3 min.)					5.123* (34)	1.345 (56)	0.004 (94)	N.D.	16	20	37	N.D.

TL = 2ppm

Figures in parentheses indicate percentage. * Indicates ATL

different waiting periods. By holding cabbage under cold tap water the initial pesticide 7.789 ppm was reduced to 6.834 ppm, 5.232 ppm, 3.192 ppm and 2.567 ppm in 1st, 2nd 3rd and 4th wash respectively. The total reduction was 68 per cent though the residue persisted at above tolerance limit. Washing cabbage at 3rd day waiting period with initial residue of 3.459 ppm deleted 53 per cent residue after 2nd wash bringing it to the below consumption limit. Further washes lead to 90 and 98 per cent reduction in the initial residue. The initial residues on 5th and 7th day where below tolerance limit which were further reduced to non-detectable levels in the 3rd and 2nd wash respectively. Washing cabbage by holding under running warm tap water brought reduction of 19, 38, 72 and 79 per cent from 7.789 ppm initial malathion residue at one day waiting period. The above tolerance content was reduced to below tolerance level in the 4th wash, eliminating 79 per cent of the total residue.

Washing on third day removed 58 per cent loss in the 2nd wash brought the residue to safe consumption level while the 4th wash resulted in non-detectable residue. The below tolerance level 0.066 ppm and 0.022 ppm residue at 5th and 7th day waiting period

non-dectable after 3rd and 2nd wash respectively, 82 and 87 per cent residue respectively.

Dipping cabbage in cold water with light rub wash reduced the initial level 7.789 ppm to 7.634 ppm and 7.129 ppm and 5.464 ppm in the 1st, 2nd and 3rd wash respectively denoting only 30 per cent reduction of the residue which was above tolerance limit. The 3rd day waiting period reduced the residue to 9, 27 and 45 per cent in 1st, 2nd and 3rd wash respectively thus lowering it to below tolerance level.

The waiting period residue 0.066 ppm on 5th day was further reduced to 0.017 ppm, while 7th day 0.022 ppm to non-detectable level after 3rd wash. Washing cabbage by dipping in warm water, with light rub reduced the residue to 7.134 ppm, 6.345 ppm and 5.123 ppm in 3 washes denoting all above the tolerance level. At the 3rd day waiting period the same reduced wash 15, 28 and 56 per cent residue was noted. The 3rd wash showed residue below tolerance level. The original residue of 5th and 7th day waiting period was further reduced to 94 and 78 per cent in 3rd and 2nd wash respectively, indicating non-detectable level and in the third wash at 7th day waiting period.

From Table 14 the effect of washing methods in the reduction of malathion residue on brinjal at different

Table 14: Effect of various washing methods in the reduction of malathion on brinjal at different waiting periods

Methods of washing	Initial deposits at different waiting periods				Reduction of residue after each wash at different waiting period				Difference between each wash in percentage			
	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day	1st day	3rd day	5th day	7th day
I) Holding under running cold water (tap)	5.632*	2.998*	0.071	0.033								
1) First (1/2 min.)					4.343* (23)	2.189* (27)	0.043 (40)	0.024 (28)	23	27	40	28
2) Second (1/2 min.)					3.421* (40)	1.542 (49)	0.022 (69)	0.014 (58)	17	22	29	30
3) Third (1/2 min.)					2.742* (52)	0.344 (89)	0.005 (93)	N.D.	12	40	24	N.D.
4) Fourth (1/2 min.)					2.123* (63)	0.045 (99)	N.D.	N.D.	11	10	N.D.	N.D.
II) Holding under running tap water (42 °C)												
1) First (1/2 min.)					9.122* (27)	1.927 (36)	0.05 (30)	0.020 (40)	27	36	30	40
2) Second (1/2 min.)					3.024* (46)	1.349 (55)	0.045 (37)	0.012 (64)	19	19	7	24
3) Third (1/2 min.)					1.985 (65)	0.303 (90)	0.015 (79)	N.D.	19	35	42	N.D.
4) Fourth (1/2 min.)					1.321 (77)	N.D.	N.D.	N.D.	12	N.D.	N.D.	N.D.
III) Dipping in cold water with light rubbing												
1) First (1 min.)					5.213* (8)	2.240* (26)	0.051 (28)	0.030 (9)	8	26	28	9
2) Second (2 min.)					4.582* (19)	1.752 (42)	0.039 (51)	0.017 (49)	11	16	23	40
3) Third (3 min.)					3.222* (43)	1.123 (63)	0.020 (72)	0.005 (85)	24	21	21	36
IV) Dipping in warm water with light rubbing												
1) First (1 min.)					5.102* (10)	2.102* (30)	0.050 (30)	0.025 (25)	10	30	30	25
2) Second (2 min.)					4.500* (21)	1.622 (46)	0.030 (58)	0.012 (64)	11	16	28	39
3) Third (3 min.)					3.200* (44)	0.542 (82)	N.D.	N.D.	23	36	N.D.	N.D.

TL: 2 PPM Figures in parentheses indicate percentage * Indicates ATL

waiting periods is explained. Washing brinjal under running cold water reduced from the initial 5.632 ppm to 4.343 ppm, 3.421 ppm, 2.742 ppm and 2.123 ppm in 1st, 2nd, 3rd and 4th washes. There was elimination from 23 to 63 per cent residue from 1st to 4th wash, though the residue remained at above tolerance limit. Brinjal washing at 3rd day waiting period eliminated initial residue 2.998 ppm to 2.189 ppm in 1st wash which was subsequently reduced to below tolerance limit 1.542 ppm in the 2nd wash. The total reduction at the end of 4th wash was 99 per cent denoting 0.045 ppm residue. Initial residue on 5th and 7th day waiting period was below tolerance limit, which was further reduced to the non-detectable level in the 4th and 3rd wash respectively.

When brinjal was washed under running warm tap water (42 ^{o}C) the initial malathion residue 5.632 ppm on 3rd waiting day was reduced to 4.122 (27 per cent) ppm and 3.024 (46 per cent) ppm. The first wash resulted in 65 per cent loss which subsequently resulted in below tolerance level loss. Above tolerance limit residue 2.998 ppm on 3rd waiting day was eliminated 36 per cent in 1st wash reaching the below tolerance level 1.927 ppm and finally at non-detectable level in the 4th wash. The residue level

on 5th and 7th day waiting period were already below tolerance limit, which denoted non-detectable level in the 4th and 3rd wash respectively finally reducing 79 per cent and 64 per cent residue. By dipping brinjal in cold water 5.632 ppm initial residue of malathion was on one day waiting period reduced by 8, 19 and 43 per cent in 1st, 2nd and 3rd wash, showing the persistence of the residue above tolerance level. Analysis on 3rd day waiting period reported the reduction of initial 2.998 ppm to 2.240 ppm eliminating 26 per cent residue. After second wash reduced residue level was below tolerance. The waiting period of 5 and 7 day further reduced the below tolerance residue 72 and 85 per cent respectively in third wash.

Brinjal washing by dipping in warm water denoted loss of 44 per cent residue in the initial 5.632 ppm residue level at one day waiting period. The loss did not help to bring the residue to safe consumption level. The second wash on brinjal at three day waiting period reduced 46 per cent of the initial tolerance level 2.992 ppm residue 1.622 ppm which was below tolerance level. The 5th and 7th day waiting period brought to non-detectable levels after 3 washes.

~~The~~ Table 14 revealed that the initial deposit of 5.632 ppm was gradually reduced at 3rd, 5th and 7th day waiting period subsequently reaching below tolerance level on 5th day waiting period.

4.3.2 The effect of washing methods at different waiting periods on pesticide residue reduction in cultivated vegetables

It is seen from the Table 15 that the selected vegetables, brinjal and cabbage were treated with 0.05 per cent endosulfan and malathion pesticides and the efficacy of various washing methods at different waiting periods, in lowering down the residue to safe consumption level was recorded. As indicated from the Table 15, cabbage residue at one day waiting period was lowered to safe consumption level by 4th wash of the first method, holding under running cold tap water, whereas in case of brinjal the residue remained at above tolerance limit at the end of last wash also. At one day waiting period 4th wash of the running warm tap water reduced the residue on both cabbage and brinjal to safe tolerance level, on the other hand dipping in cold and warm water with light rub did not help in decreasing residue on cabbage and brinjal to the safe level of consumption.

Table 15: Effect of the selected washing methods at different waiting periods on lowering the selected pesticide residue level to safe consumption level

Washing methods	ENDOSULFAN (0.05 %)								MALATHION (0.05%)							
	Waiting of periods								Waiting of periods							
	1st day		3rd day		5th day		7th day		1st day		3rd day		5th day		7th day	
	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B
Initial values	7.345	5.325	3.034	2.382	0.705	0.224	0.089	0.056	7.789	5.632	3.459	2.998	0.066	0.071	0.022	0.033
I) Holding under running cold tap water																
1) First wash (1/2 min.)	ATL	ATL	ATL	ATL	BTL	BTL	BTL	BTL	ATL	ATL	ATL	ATL	BTL	BTL	BTL	BTL
2) Second wash (1/2 ")	ATL	ATL	ATL	1.124 (53)					ATL	ATL	1.635 (53)	1.542 (49)				
3) Third wash (1/2 min.)	ATL	ATL	1.538 (50)						ATL	ATL						
4) Fourth wash (1/2 min.)	1.798 (76)	ATL							ATL	ATL						
II) Holding under running warm tap water (42 °C)																
1) First wash (1/2 min.)	ATL	ATL	ATL	ATL	BTL	BTL	BTL	BTL	ATL	ATL	ATL	1.927 (36)				
2) Second wash (1/2 min.)	ATL	ATL	1.639 (46)	1.902 (21)					ATL	ATL	1.464 (58)					
3) Third wash (1/2 min.)	ATL	ATL							ATL	1.985 (65)						
4) Fourth wash (1/2 min.)	0.345 (96)	1.992 (62)							1.654 (79)							
III) Dipping in cold water with light rub																
1) First wash (1 min.)	ATL	ATL	ATL	ATL	BTL	BTL	BTL	BTL	ATL	ATL	ATL	ATL	BTL	BTL	BTL	BTL
2) Second wash (2 min.)	ATL	ATL	1.929 (37)	1.542 (36)					ATL	ATL	ATL	1.752 (42)				
3) Third wash (3 min.)	ATL	ATL							ATL	ATL	1.924 (45)					
IV) Dipping in warm water with light rub																
1) First wash (2 min.)	ATL	ATL	ATL	1.532	BTL	BTL	BTL	BTL	BTL	ATL	ATL	ATL	BTL	BTL	BTL	BTL
2) Second wash (2 min.)	ATL	BTL	1.818 (41)						ATL	ATL	ATL	1.622 (46)				
3) Third wash (3 min.)	ATL	ATL							ATL	ATL	1.545 (56)					

ATL : 2ppm

Figures in parentheses indicate percentage. * indicates ATL

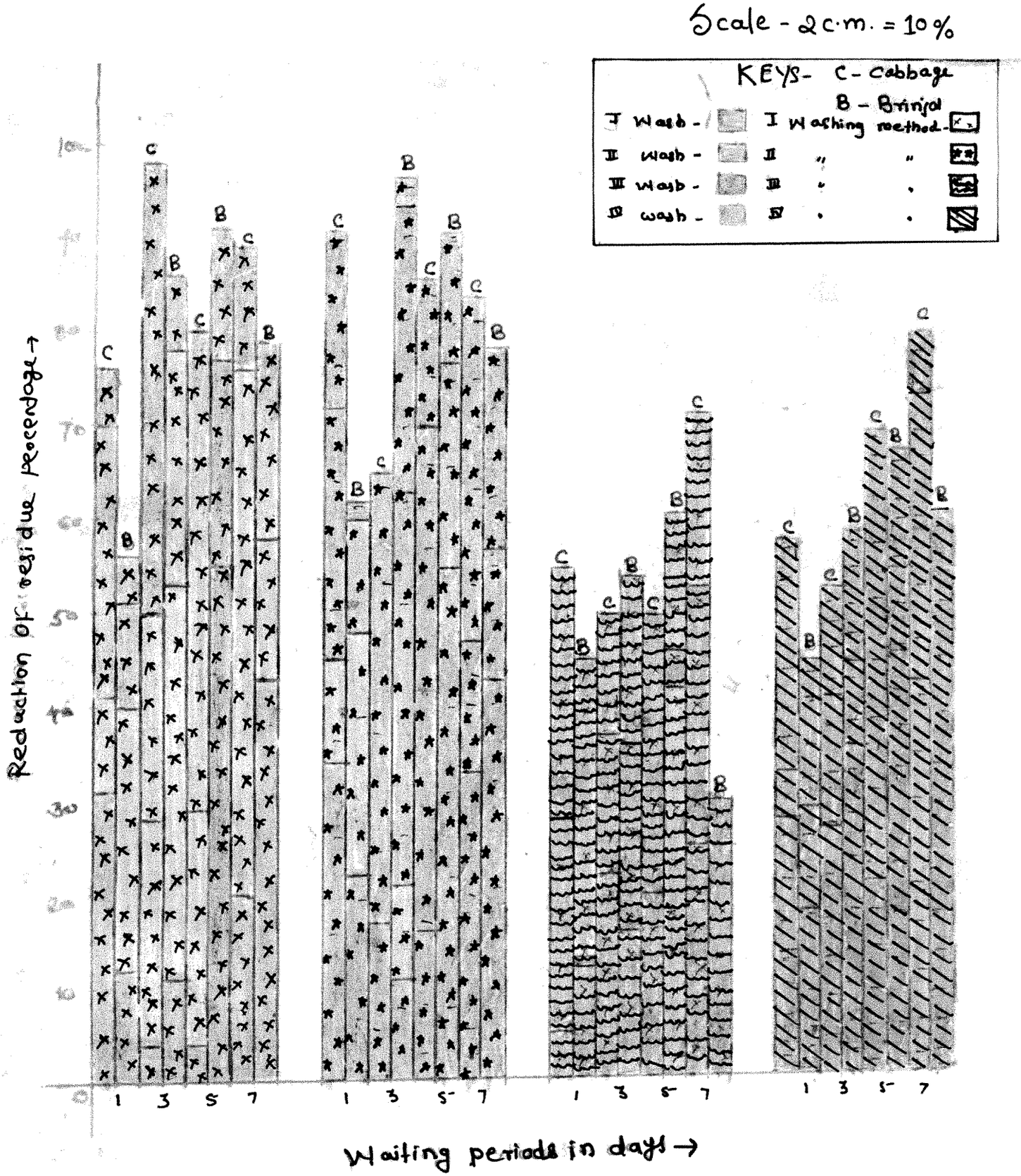

Figure 1

Effects of various washing methods in the endosulfan reduction in cabbage & brinjal at different waiting periods.

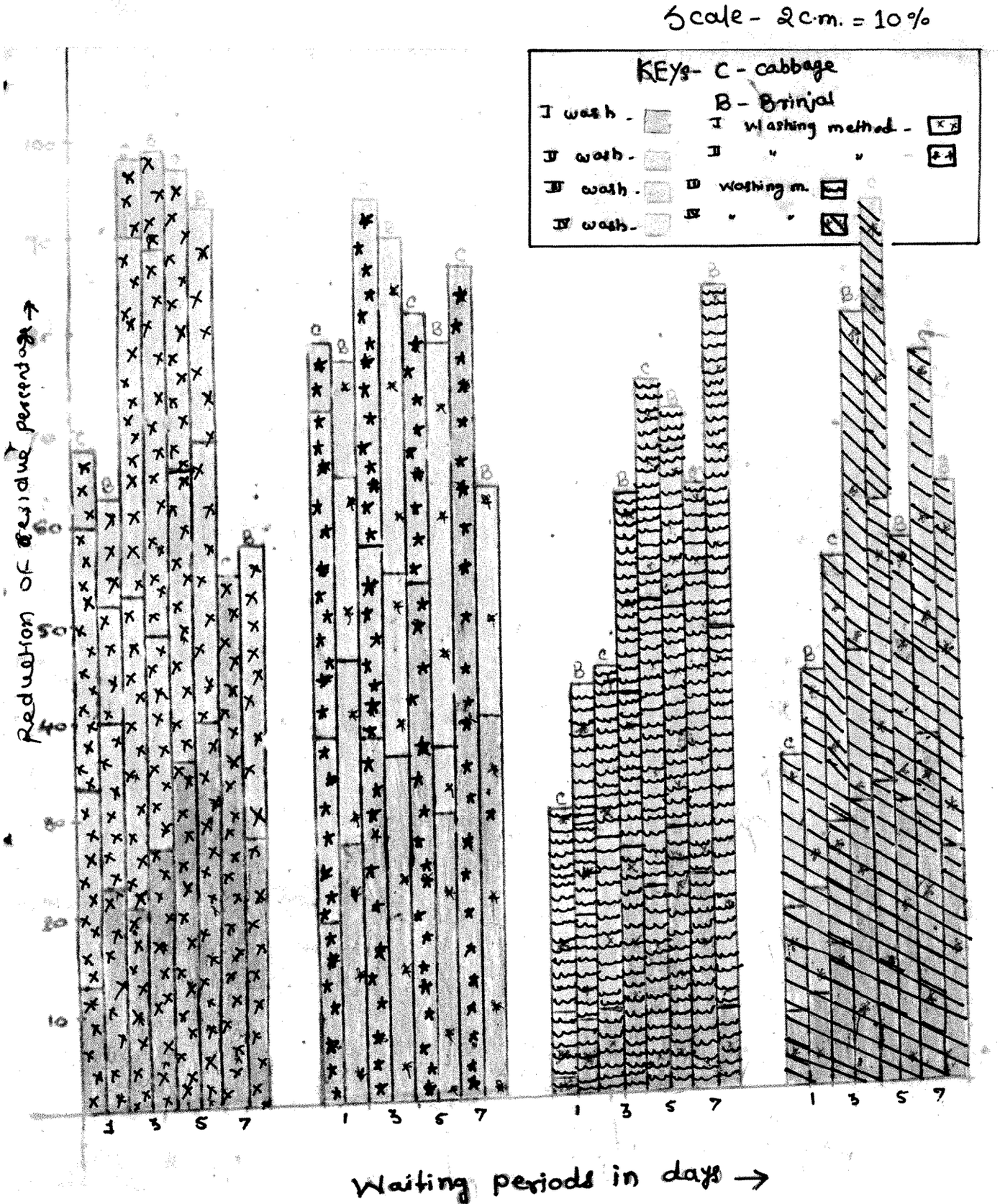

Figure 2

Effect of various washing methods in the ~~In~~ Malation reduction in cabbage & brinjal at different waiting periods.

At the end of third day of the waiting period, the third wash for the cabbage and the second wash for the brinjal in the first method was found to be effective in reducing the residue to the harmless consumption level. Similarly two times washing of cabbage and brinjal under running warm water was recorded to be more effective.

Two times washing of cabbage by dipping in cold water as well as warm water with light rub achieved the desired levels, while in respect to brinjal safe levels obtained by second and first wash by third and 4th method.

The Table 15 also denotes the effect of washing methods, at various waiting periods in the reduction of malathion residue on cabbage and brinjal. As observed, washing of both cabbage and brinjal under running cold tap water, dipping in cold and warm method were noted to be not effective at one day waiting period. At the 5th day of the waiting period in both the vegetables residue was decreased to safer consumption level.

4.3.3 Ranking of the selected washing methods with regard to pesticide reduction

On the basis of the efficacy indicated (Table 15) in reducing the pesticide residue to safe consumption level, the selected washing methods were ranked and presented in Table 16.

As observed, washing under running warm tap water secured 1st rank as both endosulfan (0.05 %) and malathion (0.05 %) residue on cabbage and brinjal were reduced to safe consumption level in the 4th and 2nd wash at both 1st and 3rd waiting day and whereas for brinjal, the corresponding figures were 4th and 2nd, 3rd and 1st wash respectively.

Washing under running cold tap water was ranked 2nd as at 1st and 3rd waiting day in cabbage, endosulfan was decreased to safer level in 4th and 3rd wash and malathion in 2nd wash at 3rd waiting day, with no desired level in 1st day waiting period. In brinjal, the reduction of both endosulfan and malathion to the safe level was observed only in the 3rd waiting day, in the 3rd and 2nd wash respectively.

Both washing by dipping in warm water (42 ^{o}C) and cold water with light rub were depicting similar

Table 16: Ranking of the selected washing methods at different waiting periods on the basis of their effectiveness in the reduction of selected pesticide residue to safe consumption level

Washing methods		Waiting period and number of washes				Remark	Waiting period and number of washes				Remark
		1st day	3rd day	5th day	7th day		1st day	3rd day	5th day	7th day	
Initial deposits	C	ATL (7.345)	ATL (3.034)	BTL (0.105)	BTL (0.089)		ATL (7.789)	ATL (3.459)	BTL (0.066)	BTL (0.022)	
	B	ATL (5.325)	ATL (2.382)	BTL (0.224)	BTL (0.056)		ATL (5.632)	ATL (2.998)	BTL (0.071)	BTL (0.033)	
I Method	C	4	3	-	-	2	None	2	-	-	2
	B	None	2	-	-		None	2	-	-	
II Method	C	4	2	-	-	1	4	2	-	-	1
	B	4	2	-	-	-	3	1	-	-	-
III Method	C	None	2	-	-	3	None	3	-	-	3
	B	None	2	-	-	-	None	2	-	-	-
IV Method	C	None	2	-	-	-	None	3	-	-	3+
	B	None	1	-	-	3+	None	2	-	-	-

ATL – Above tolerance limit

BTL – Below tolerance limit

results in residue losses not achieving safe consumption level of both pesticides used on both vegetables at one day waiting period while on 3rd day waiting period, both endosulfan and malathion residue on cabbage and brinjal were lowered down, in both the methods by 2nd and 2nd and 3rd and 2nd wash respectively. Hence they were at par and were 3rd in the rank. However, the percentage of pesticide residue elimination was more in dipping in warm water method which was indicated by 3 + rank.

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5. SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

The study entitled "Effect of household washing methods on selected pesticides residue reduction in selected, cultivated vegetables was undertaken with the following objectives.

(1) To find out homemakers vegetable washing methods and awareness of the effects of pesticide residue on human health.

(2) To estimate the effect of the selected washing methods in reducing the selected vegetables with different waiting periods.

To find out the washing methods and awareness of pesticide residue effects, a survey of 100 homemakers from Parbhani city was personally interviewed. Information regarding household vegetable consumption and purchasing practices and awareness of harmful effects of pesticide on human health was collected, the data consolidated was analysed statistically.

Estimation of the effects of washing methods in residue reduction was done by conducting field and laboratory experiment. Cabbage and brinjal vegetables were cultivated each in 6 x 10 feet plot, each in triplicate along with controls.

Endosulfan 35 EC and malathion 50 EC of each of 0.05 per cent concentrations were sprayed at

fruiting stage. Each treatment and control samples were drawn at 1, 3, 5 and 7 days of application.

The above samples, 50 g in weight, were washed by the selected washing methods which included four times holding under cold tap water and warm water each for 1/2 minute, dipping with light rub in cold and warm water each for 1, 2 and 3 minutes.

The washed samples were cut and 50 g each were blended with 100 ml acetone. The filtered extracts were washed with petroleum ether and chloroform for endosulfan and malathion respectively. The extracts of petroleum ether and chloroform were passed through chromatography column to collect elutes, reduced to 10 ml.

Most (45%) of the families purchased the vegetables daily- In maximum (53%) families husbands purchased the vegetables. Majority (85%) of the families purchased vegetables from main market. Majority (48%) of the families spent more than 60 Rs/month on vegetables. Vegetables were mostly washed by holding under running cold water. Most (50%) of the families washed the vegetables before cutting. Maximum (98%) families were aware that pesticides above tolerance limit were harmful to the human health.

In cabbage, endosulfan residue at one day waiting period was lowered to safe level of consumption by 4th wash holding under running cold tap water (76%). At one day waiting period, 4th wash under running warm water (tap) reduced to 96 and 62 per cent for endosulfan residue in both brinjal and cabbage respectively, bringing it to the safe level of consumption. At the end of 3rd day waiting period third wash for cabbage (50%) and second wash for brinjal (53%) in the first method was effective in reducing the residue to bringing the harmless consumption level. Two times washing of cabbage by dipping in cold and warm water with light rub reduced the residue to below tolerance limie (37 and 31 %). On third day, while in respect to brinjal, safe levels were obtained when twice washed by dipping in cold and once in warm water with light rub. Washing of both cabbage and brinjal under running cold tap water, dipping in cold and warm water were ineffective in reducing malathion residue at one day waiting period. The initial residue on 5th and 7th day waiting periods in both vegetables denoted safe consumption level residues for both the insecticides. With the additional wash the residue reduction was increasing in all the methods.

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APPENDICES

APPENDIX I

Interview Schedule

Questionnaire to elicit the information regarding the vegetable washing practices of selected families in Parbhani town

A) General information

i) Full name of the housewife

ii) Address

iii) Occupation of the family members

Sr. No.	Name	Age	Education	Occupation	INCOME		
					Regular	Irregular	Total

I) Household vegetable purchasing practices

i) Do you buy vegetables daily/every 2 days/ every 3 days ?

ii) Who buys the vegetables ?

1) Husband
2) Housewife
3) Other members
4) Servants

iii) Where from you buy the vegetables?

1) Main vegetable market
2) Vendor
3) Small shop
4) Weekly bazar

Continued

iv) What is the monthly expenditure on vegetables ?

1) Rs 30-40
2) Rs 41-50
3) Rs 51-60
4) Rs 61 and above

v) Household vegetable consumption pattern.

Sr. No.	Vegetables	Every day	Frequently	Sometimes
1	Leafy vegetables			
2	Roots and tubers			
3	Others			

vi) How much quantity is required per day

Sr. No.	Vegetables	Requirement in kg			
		1/4	1/2	3/4	1.00
1	Leafy vegetables				
2	Roots and tubers				
3	Others				

vii) Do you take vegetables both the times ?

Yes/No

If yes, state which are

Sr. No.	Vegetables	In morning	In evening
1	Leafy vegetables		
2	Roots and tubers		
3	Others		

Continued

viii) Do you think that vegetables are necessary in your daily diet ?

Yes/No

If yes, give reasons-

i) They are liked by the family members
ii) Vegetables bring variety in meal
iii) Vegetables are important source of nutrients
iv) They keep doctor away
v) Doctor/health visitors advice for the regular consumption
vi) Vegetables are rich sources of vitamins, some of which can not be obtained from any food sources
vii) It helps to keep the person healthy and away from the disease.

II) Household vegetable washing practices

i) How do you wash the vegetables ?

a) Keeping in the hand and holding under running cold tap water

b) Dipping in cold water and draining off the water

c) Immersing in water and taking out

ii) Generally you repeat the process

Sr. No.	Repetation	Leafy vegetables	Roots & tubers	Others
1	Twice			
2	Thrice			
3	Four times			

Continued

iii) Throughout the season/year, do you wash them in cool/warm water. Yes/No

iv) Whether warm water wash is used only in rainy/winter season

Yes/No

v) When do you wash the vegetables- before cutting
after cutting
Both before & after cutting

If you wash the vegetables before cutting give reasons:

1) To make free from dust
2) Habituated from childhood
3) Learned from others
4) To retain nutrients that get lost in water.

If you wash the vegetables after cutting give reasons-

1) Habituated from the beginning
2) To preserve the colour
3) Easy to cut when unwashed and dry

If you wash the vegetables both before and after cutting give the reasons-

1) For thorough cleaning
2) Because of habit

vi) Approximately how long it takes to wash the vegetables - (i.e. time immersed in water)

1. 1/2 min.
2. 1 min.
3. 2 min.
4. 3 min.
5. 4 min.
6. 5 min.

Continued

vii) Do you use potassium permangnate to wash the vegetables in rainy/all seasons ?

Yes/No

viii) If it is used, whether for all vegetables/ only leafy vegetables

ix) For what purpose do you wash the vegetables?

1) To remove mud and dust
2) To remove pesticides sprayed over it
3) To make free from micro-organisms
4) To increase the turgidity
5) To make them fresh and appealing

III) Homemakers awareness regarding pesticides use and their harmful effects on health.

i) Which harmful effects of pesticides known to you?

1) Abortion in pregnant women
2) Acute pesticide poisoning
3) Occupational fatalities
4) Signs of impaired nerve and muscle functioning
5) Destruction of vital organs like kidney & lungs
6) Can cause the deaths by poisoning (if excessive level of them)

ii) Do you think that many of the vegetables you purchased have pesticide residue above the tolerance limit or in large quantity which is harmful to your health.

Yes/No

Continued

iii) If yes, do you suggest solutions to avoid abovesaid harmful effects

1) Not to consume

2) To educate the farmers to prevent its use

3) To educate the women consumers to take group action for consumers legal protection

4) To wash vegetables many times before cooking

5) To grow vegetables at home

6) To wash vegetables by the farmers before selling the vegetables

7) To use of safest pesticides

8) To follow all precautionary measures by observing proper waiting periods

9) Any other.

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APPENDIX II

Standardization of washing methods

Sr. No.	Particulars	Amount
1	Weight of the sample	50 g
2	Time of washing (cold/warm)	4 times for 1/2 min.
3	Number of washings	4
4	Dipping with light rub in cold water	½, 1, 2, 3 min.
5	Dipping with light rub in warm water	1, 2, 3 min.
6	Temperature of water	42 ^{o}C
7	Volume of water	250 ml
8	~~Number~~ Duration of washings	3