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## Nutritional Status of Red Amaranth as Influenced by Selected Pesticides

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**Abstract:** A study was undertaken in the Department of Biochemistry, Bangladesh Agricultural University, Mymensingh to evaluate the nutritional status of red amaranth as influenced by three selected pesticides at various dose levels. The results revealed that the level of moisture content ranged from 86.50 to 87.62% in different treatment groups. The highest amount was in T<sub>4</sub> where chlorpyrifos @ 0.66 a.i./ha was sprayed at 21 days after emergence and the lowest (86.5%) was in control group (T<sub>13</sub>) where no pesticide was applied. The dry matter percent was highest in control (13.50%) and slightly lower in treatment groups indicating no significant variation among them. The protein percent was from 5.02 to 5.24 in different treatment groups expressing little higher than the control plants (4.82%). Fat percentage ranged from 0.10 to 0.12 in treatment groups, which were very close to control value. Total sugar was highest (2.10) in T<sub>7</sub>, T<sub>9</sub> and T<sub>11</sub> and lowest in T<sub>6</sub> (carbofuran). Reducing sugar was 1.15% in T<sub>7</sub> (cypermethrin and chlorpyrifos) and 0.98 in T<sub>6</sub>, while non-reducing sugar seemed to be little higher (1.11%) in treatment groups compared to the control (0.88%). As a whole pesticide studied had very insignificant effect on protein, fat, ash, dry matter and moisture content of red amaranth. The carotene content was highest (10.24 mg 100 g<sup>-1</sup>) immediately after harvest in T<sub>1</sub> and lowest in T<sub>8</sub>. But the level of carotene decreased to 9.08 mg 100 g<sup>-1</sup> in T<sub>8</sub>, which was statistically insignificant. As far as vitamin C is concerned, the level was reasonably good in all the treatments as well as control plants immediately after harvest (38.52 mg - 40.41 mg). The level of vitamin C decreased in all the treatment and control plants after 20 minutes cooking (26.21-28.25 mg).

**Key words:** Red amaranth, Cypermethrin, Chlorpyrifos, Carbofuran, Carotene, Vitamin C

### INTRODUCTION

Red amaranth (*Amaranthus tricolor* L.) is a member of the family Amaranthaceae, in Bengali known as '*lal shak*'. It is originated in the Asia and is now widely grown as vegetables and ornamental crop throughout the tropics (Martin and Ruberte, 1979; Saunders and Becker, 1984). Red amaranth is one of the most important leafy vegetables in Bangladesh. It is tasty and nutritious. It can be grown throughout the year and can be harvested in a very short time. For vegetables and seed production, red amaranth is best grown in winter. It has been growing in Bangladesh both in winter and summer seasons.

The chief nutritive value of red amaranth lies in their content of  $\beta$ -carotene (precursor of vitamin A) and vitamin C. It contains carotene (11.94 mg), vitamin C (43 mg), calcium (374 mg), carbohydrate (5.0 g), protein (5.3 g), fat (0.1 g) and calories (43 K Cal.) 100 g<sup>-1</sup> of edible portion (Begum, 2000).

*Amaranthus spinosus* or *Amaranthus viridis* is thorny, pigweed and the leaves of which possess mucilaginous properties. The Negritos of the Philippines apply the bruised leaves directly to eczema, psoriasis, and

rashes with good results. The leaves make a good emollient preparation available in some of the philipino villages for insect bites, sunburn, and regular burns. In India the roots are used as a decoction for treating eczema and cobra bites and scorpion stings (Kirtikar and Basu, 1918; Colonel and Chopra, 1958).

Pesticides are chemicals that are utilised by farmers to protect their crops against pest infestation. Pesticides used in agriculture include insecticides, fungicides, herbicides etc. In vegetables production, insecticides are in some cases, used to control pests. They are directly applied to the crops. A part of it may be decomposed or degraded and some may still be present as residues in the vegetables even after their harvests. It is true that insecticides are toxic substances, but when used properly they constitute an important input in vegetable production in order to produce economically marketable products. However very little information are available on the level of nutritional status of leafy vegetables as influenced by pesticide. So considering this, a piece of work was under taken in order to see the effect of three selected pesticide on the nutritional status of red amaranth.

## MATERIALS AND METHODS

The experiment was conducted by growing the plant in pot in roof condition at the experimental site of Karim Bhaban 2nd floor roof. BAU, Mymensingh during the period from April to July, 2002. Proximate analysis of plant sample performed in the Biochemistry Laboratory, Department of Biochemistry, BAU, Bangladesh.

Pesticides were collected from the local market of Mymensingh.

**Materials and operations under taken:** The experiment was conducted at the site of Department of Biochemistry. Geographically the experimental area is located at 24°75' N latitude and 90°50' E longitudes having an altitude of 18 m. The soil was collected from Karim Bhaban area, BAU, Mymensingh and air dried for several days. The soil samples were collected from 15-30 cm depth of the experimental field before first opening of the soil. The soil was silty loam type.

The experimental area is situated under sub tropical climate, characterized by three distinct seasons the monsoon the rainy season (May to October), the winter or dry season (November to February) and the pre monsoon or hot season (March to April). Red amaranth is a short growing (2 Months) vegetables crop. It can be grown in all the three seasons in Bangladesh. The winter climate condition of Bangladesh is more favourable for red amaranth cultivation. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications.

The crop used in this study was red amaranth. The seeds were collected from Mymensingh Nuton Bazar, Mymensingh. The seeds were healthy, vigorous, plummy, well matured and free from mixture of other crop seeds and extraneous materials.

Medium size pots (0.049 m<sup>2</sup>) were used in this experiment. Each pot was filled with 10 kg of the sun-dried soil. Plant propagates, inert materials, visible insects and pests were removed from the soil.

**Detail of treatments:** There were twelve different treatments of pesticide to reduce hairy caterpillar infestation in red amaranth which were evaluated against control having no pesticide treatment. The treatment included in the study were as follows:

- T<sub>1</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (2.8µg g<sup>-1</sup> each pot)  
T<sub>2</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1.5 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (4.2µg g<sup>-1</sup> each pot)

- T<sub>3</sub> = Application of chlorpyrifos (trade name: lorsban 15 G) @ 0.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (2.4µg g<sup>-1</sup> each pot)  
T<sub>4</sub> = Application of chlorpyrifos (trade name: lorsban 15 G) @ 0.66 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (3.23µg g<sup>-1</sup> each pot)  
T<sub>5</sub> = Application of carbofuran (trade name: furadan 5 G) @ 1.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (7.35µg g<sup>-1</sup> each pot)  
T<sub>6</sub> = Application of carbofuran (trade name: furadan 5 G) @ 2.0 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (9.8µg g<sup>-1</sup> each pot)  
T<sub>7</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (2.8µg g<sup>-1</sup> each pot) and chlorpyrifos (trade name: lorsban 15 G) @ 0.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (2.4µg g<sup>-1</sup> each pot)  
T<sub>8</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1.5 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (4.2µg g<sup>-1</sup> each pot) and chlorpyrifos (trade name: lorsban 15 G) @ 0.66 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (3.23µg g<sup>-1</sup> each pot)  
T<sub>9</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (2.8µg g<sup>-1</sup> each pot) and carbofuran (trade name: furadan 5 G) @ 1.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (7.35µg g<sup>-1</sup> each pot)  
T<sub>10</sub> = Application of cypermethrin (trade name: basathrin 10 EC) @ 1.5 mL L<sup>-1</sup> of water at 21 days after emergence (DAE) (4.2µg g<sup>-1</sup> each pot) and carbofuran (trade name: furadan 5 G) @ 2.0 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (9.8µg g<sup>-1</sup> each pot)  
T<sub>11</sub> = Application of chlorpyrifos (trade name: lorsban 15 G) @ 0.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (2.8µg g<sup>-1</sup> each pot) and carbofuran (trade name: furadan 5 G) @ 1.5 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (7.3µg g<sup>-1</sup> each pot)  
T<sub>12</sub> = Application of chlorpyrifos (trade name: lorsban 15 G) @ 0.66 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (3.23µg g<sup>-1</sup> each pot) and carbofuran (trade name: furadan 5 G) @ 2.0 kg a.i ha<sup>-1</sup> at 21 days after emergence (DAE) (9.8 µg g<sup>-1</sup> each pot)  
T<sub>13</sub> = Control (without pesticide)

**Application of insecticide:** Cypermethrin (basathrin 10 EC) was applied by mixing with water. The mixture within the spray tank was shaken well and sprayed covering the whole plant. Chlorpyrifos (lorsban 15 G) and carbofuran (furadan 5 G) were directly applied by mixing with the soil surrounding the plant.

The procedure for the estimation of moisture content, dry matter, ash, crude protein, fat and carotene were those of A.O.A.C. Vitamin C was determined by the Indophenol-xylene extraction method (Pepkowitz, 1943; Robinson and Stotz, 1945). Total sugar was determined colorimetrically by the anthrone method (Jayaraman, 1981). Reducing sugar was determined by Dinitrosalicylic acid method (Miller, 1972).

## RESULT AND DISCUSSION

The results on the nutritional status of red amaranth (*Amaranthus tricolor*) as influenced by three selected pesticides namely cypermethrin (basathrin 10EC), chlorpyrifos (lorsban 15 G) and carbofuran (furadan 5 G) at various dose levels have been presented according to following sub heading.

### The effect of the selected pesticides on the proximate composition of red amaranth:

It appears from the data presented in Table 1 that the level of moisture content ranged from 86.50 to 87.62% in different treatment groups, the highest amount was in  $T_4$  treatment and lowest was in control group ( $T_{13}$ ). It was 86.50%. There was no significant variation among different treatment groups in respect to moisture content. However, there was a little increase in the moisture content as compared to the control group. It can be mentioned here that the leaves of plants in control group were mostly damaged by insect like hairy caterpillar (Plate 1). Whereas the treated plants produced much more fresh leaves (Plates 2, 3 and 4) than those of the control plants. This might be one of the reasons for the little variation in the level of moisture between control and treatment groups. Begum (2000) studied with red amaranth and observed that the moisture percentage in control plant was 88%. In case of dry matter the result was little different. The percent dry matter content was higher (13.50%) in control ( $T_{13}$ ) group whereas it was slight lower in different treatment groups like  $T_1$ ,  $T_2$ ,  $T_3$ ,  $T_4$ ,  $T_5$ ,  $T_6$ ,  $T_7$ ,  $T_8$ ,  $T_9$ ,  $T_{10}$ ,  $T_{11}$  and  $T_{12}$ , respectively. However there was no significant variation among the different treatment groups as far as dry matter in concerned (Table 1). It was revealed from the results that dry matter values in different treatment groups ranged from 12.38 to 12.54%. Oliveira and De Carvalho (1975) reported that the dry matter content of amaranth leaves ranged from 17.4 to 38.3%. As far as ash content is concerned there was no effect of pesticides as revealed from Table 1, the values ranged from 1.3 ( $T_3$ ) to 1.39% ( $T_2$ ) in different treatment groups. In control group ( $T_{13}$ ) it was 1.45%. Begum (2000) also studied the ash level of red amaranth and found 1.6% ash in the leaf samples. Our



Plate 2: External appearance of red amaranth.  $T_{13}R_1$ = Untreated plant,  $T_1R_1$ = Treated with cypermethrin @ 1 ml  $l^{-1}$  of water,  $T_2R_1$ = Treated with cypermethrin @ 1.5 ml  $l^{-1}$  of water, Pesticides applied on 21 days after emergence (DAE)



Plate 3: External appearance of red amaranth.  $T_{13}R_3$ = Untreated plant,  $T_3R_3$ = Treated with chlorpyrifos @ 0.5 kg a.i  $ha^{-1}$ ,  $T_4R_3$ = Treated with chlorpyrifos @ 0.66 kg a.i  $ha^{-1}$ , Pesticides applied on 21 days after emergence (DAE)

results showed little decrease in the treatment group as compared to the value reported by Begum. This variation might be due to some other factors like climate, soil condition, weather, fertilizer and the age of the plants etc.



Plate 4: External appearance of red amaranth.  $T_{13}R_3$ = Untreated plant,  $T_5R_2$ = Treated with chlorpyrifos @ 0.5 kg a.i ha<sup>-1</sup>,  $T_6R_2$ = Treated with chlorpyrifos @ 0.66 kg a.i ha<sup>-1</sup>, Pesticides applied on 21 days after emergence (DAE)

The level of protein, fat, total sugar, reducing sugar and non-reducing sugar content have also been shown in Table 1. The level of protein ranged from 5.02 ( $T_3$ ) to 5.24% ( $T_6$ ) in different treatment groups. In control group ( $T_{13}$ ) it was 4.82%. It is evident that red amaranth contains about 5% protein. BAN-HRDB (2002) obtained 5.3% protein in red amaranth which is very close to our findings. It appears from Table 1 that protein level was slightly higher in all the treatment groups ( $T_1$ ,  $T_2$ ,  $T_3$ ,  $T_4$ ,  $T_5$ ,  $T_6$ ,  $T_7$ ,  $T_8$ ,  $T_9$ ,  $T_{10}$ ,  $T_{11}$  and  $T_{12}$ ) as compared to the control group which might be due to freshness of leafy plants (Plates 2, 3 and 4) as influenced by different pesticides. Similar was the situation with the level of fat

percentage. It ranged from 0.1 to 0.12% in treatment groups. However in control group it was 0.10%. Haque (1985) conducted a study with red amaranth and observed 0.10% of fat contained there in. Total sugar were highest (2.10%) in  $T_7$ ,  $T_9$ ,  $T_{11}$  and lowest (1.8%) in the  $T_6$  (carbofuran). From the Table 1, it was observed that total sugar contents in the edible portion of the treated plants was comparatively higher than that of the control plant.

Reducing sugar was 1.15% in  $T_7$  (cypermethrin and chlorpyrifos) and 0.98% in the  $T_6$  (carbofuran). The reducing sugar content in the edible portion of the treated plants was comparatively higher than the control plant. The percent content of non-reducing sugar were higher (1.11%) in  $T_9$  and  $T_{11}$  and lowest (0.82%) in the  $T_6$ . It was also observed that the non-reducing sugar content in the edible portion of the treated plants was comparatively higher than that of the control (0.88%) plant.

The results further indicate that the application of different pesticides and their levels had significant effect on percent content of total, reducing and non-reducing sugars in edible portion of red amaranth. Application of higher levels of all the three pesticides reduced total and reducing sugars while only carbofuran had reverse effect on non reducing sugar content of red amaranth. The effect of the pesticides studied had positive but insignificant effect on protein, fat, ash, dry matter and moisture content of red amaranth.

**The level of carotene content in red amaranth:** The results presented in Fig. 1 show that the highest carotene content (10.24 mg 100 g<sup>-1</sup>) in the leaf of red amaranth

Table 1: Effect of selected pesticides after three days of application on the nutritional qualities in edible portion of red amaranth

Treatments	Name of pesticides	Moisture (%)	Dry matter (%)	Ash (%)	Protein (%)	Fat (%)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
$T_1$	Cypermethrin @ 1mL L <sup>-1</sup> of water	87.53	12.47	1.37	5.13	0.12	2.06ab	1.09b	0.97bc
$T_2$	Cypermethrin @ 1.5 mL L <sup>-1</sup> of water	87.46	12.54	1.39	5.09	0.12	1.98abc	0.99c	0.99bc
$T_3$	Chlorpyrifos @ 0.5 kg a.i ha <sup>-1</sup>	87.61	12.39	1.30	5.02	0.11	2.01abc	1.03c	0.98bc
$T_4$	Chlorpyrifos @ 0.66 kg a.i ha <sup>-1</sup>	87.62	12.38	1.36	5.06	0.11	1.97abc	0.98c	0.99bc
$T_5$	Carbofuran @ 1.5 kg a.i ha <sup>-1</sup>	87.55	12.45	1.32	5.13	0.11	1.93bc	0.99c	0.94cde
$T_6$	Carbofuran @ 2.0 kg a.i ha <sup>-1</sup>	87.52	12.48	1.35	5.24	0.11	1.80d	0.98c	0.82f
$T_7$	Cypermethrin @ 1 mL L <sup>-1</sup> of water and chlorpyrifos @ 0.5 kg a.i ha <sup>-1</sup>	87.50	12.50	1.37	5.13	0.11	2.10a	1.15a	0.95bcd
$T_8$	Cypermethrin @ 1.5 mL L <sup>-1</sup> of water and chlorpyrifos @ 0.66 kg a.i ha <sup>-1</sup>	87.53	12.47	1.34	5.19	0.11	1.89cd	0.98c	0.91de
$T_9$	Cypermethrin @ 1 mL L <sup>-1</sup> of water and carbofuran @ 1.5 kg a.i ha <sup>-1</sup>	87.49	12.51	1.36	5.05	0.12	2.10a	0.99c	1.11a
$T_{10}$	Cypermethrin @ 1 mL L <sup>-1</sup> of water and carbofuran @ 2.0 kg a.i ha <sup>-1</sup>	87.47	12.53	1.38	5.03	0.11	1.95bc	0.99c	0.96bcd
$T_{11}$	Chlorpyrifos @ 0.5 kg a.i ha <sup>-1</sup> and carbofuran @ 1.5 kg a.i ha <sup>-1</sup>	87.51	12.49	1.32	5.09	0.12	2.10a	0.99c	1.11a
$T_{12}$	Chlorpyrifos @ 0.66 kg a.i ha <sup>-1</sup> and carbofuran @ 2.0 kg a.i ha <sup>-1</sup>	87.52	12.48	1.38	5.06	0.11	1.99abc	0.98c	1.01b
$T_{13}$	Control (without pesticides)	86.50	13.50	1.45	4.82	0.10	1.78d	0.90c	0.88e
CV (%)		3.59	3.61	3.41	2.89	3.01	3.56	2.70d	3.13
LSD (0.01)		NS	NS	NS	NS	NS	0.119	0.053	0.053

Figures followed by common letters are not significantly in the same column  
Pesticides applied on 21 days after emergence (DAE)

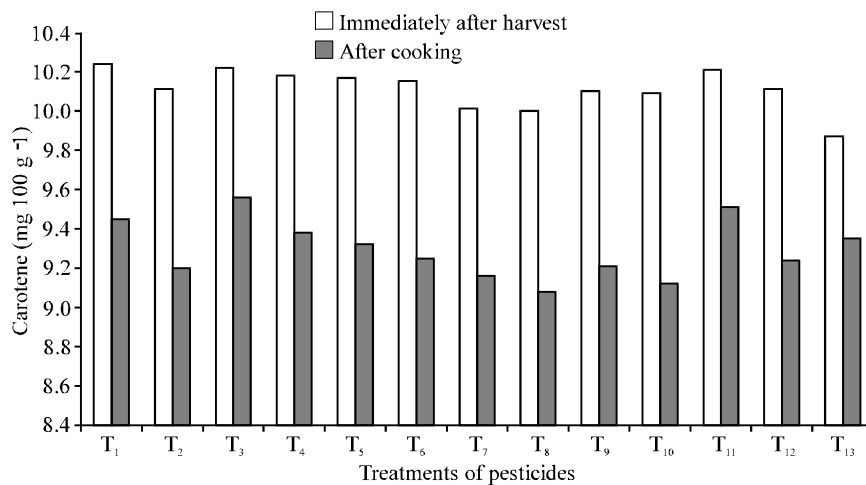


Fig. 1: Effect of selected pesticides after three days of application on the level of carotene content in the leaf of red amaranth immediately after harvest and after cooking

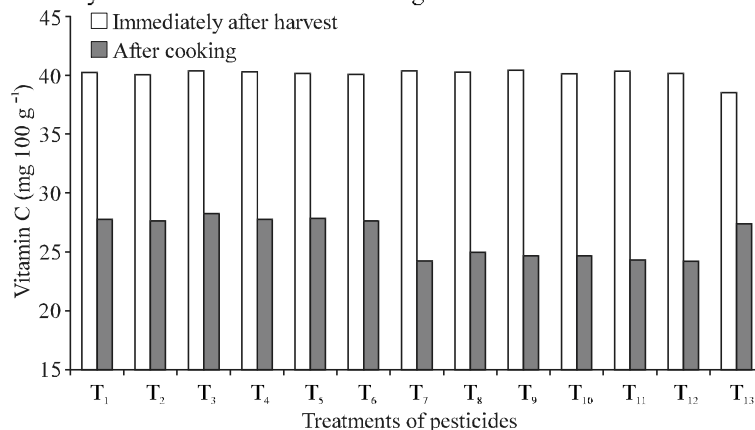


Fig. 2: Effect of selected pesticides after three days of application on the level of vitamin C content in red amaranth immediately after harvest and after cooking

immediately after harvest was in T<sub>1</sub> (cypermethrin) and lowest content (10.00 mg 100 g<sup>-1</sup>) was in T<sub>8</sub> (cypermethrin and chlorpyrifos). From the Figure it was observed that level of carotene in treated plants was comparatively higher than the control plant (9.87 mg 100 g<sup>-1</sup>). Begum (2000) observed that the level of carotene in red amaranth plant was 11.94 mg 100 g<sup>-1</sup> which is very close to our findings.

After 20 min of cooking the highest (9.56 mg 100 g<sup>-1</sup>) content of carotene in red amaranth was in T<sub>3</sub> (chlorpyrifos) and the lowest level was (9.08 mg 100 g<sup>-1</sup>) in T<sub>8</sub> (cypermethrin and chlorpyrifos). From the Figure it was also observed that the level of carotene content in the plants of T<sub>1</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>11</sub> treatments were little higher than the control plant where no pesticide was sprayed. But the plants of T<sub>2</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>, T<sub>9</sub>, T<sub>10</sub> and T<sub>12</sub> treatments showed lower level of carotene than the

control plants. Inconsistency of these data might be due to some technical mistakes. According to Ishaque (1976) during cooking the losses of carotene in palong shak, puishak, kalmi shak, pat shak, helencha shak and mistikumra shak were 14.99, 16.47, 12.47, 14.52, 31.38 and 16.66, respectively. The range of loss was from 12.47 to 31.38%. The findings of the present study are in agreement with the report of Ishaque that carotene content decreases due to cooking. Leung *et al.* (1972) reported that the leaves of dasheen (*Colocasia* spp.) containing 5.533 µg carotene equivalent, retained 4.695 µg after cooking. The values are also in fair agreement with the results of the present investigation. If we look critically in Fig. 1 it appears that in case of the control (T<sub>13</sub>) percent loss of carotene is little less after cooking perhaps because of its heat stability. The loss of carotene in other treatment groups might be due to some indirect effect of pesticides.



**Effect of different pesticides on vitamin C content of red amaranth:** The Fig. 2 showed the effect of selected pesticides on the level of vitamin C. The highest level of vitamin C content in the red amaranth immediately after harvest was 40.41 mg 100 g<sup>-1</sup> in T<sub>9</sub> (cypermethrin and carbofuran) and lowest (40.01 mg 100 g<sup>-1</sup>) in T<sub>2</sub> (cypermethrin). The amount of vitamin C in edible portion of the treated red amaranth plants were seemed to be similar to T<sub>13</sub> (control) plant (38.52 mg 100 g<sup>-1</sup>) as appeared in the table and also in Fig. 2. Haque (1985) reported that the amount of vitamin C in red amaranth control plant was 43 mg 100 g<sup>-1</sup> which is in agreement with our findings.

After 20 minutes of cooking the highest level of vitamin C content in the red amaranth was 28.25 mg 100 g<sup>-1</sup> in T<sub>3</sub> (chlorpyrifos) and lowest level of vitamin C content was 26.21 mg 100 g<sup>-1</sup> in T<sub>12</sub> (chlorpyrifos and carbofuran). It is evident from the Figure that 20 minutes cooking caused a drastic loss of vitamin C. This is because of heat lability of vitamin C. Ahmed and Makherjee (1957) reported that in most of the cases boiling of vegetable for 10 minutes caused a loss in vitamin C by 14 to 86% and for 20 minutes by 25 to 95%. Kibe and Mahapatra (1965) also reported 52.5% loss of ascorbic acid due to cooking in leafy vegetable. Oke (1967) in his experiment with Nigerian vegetables found 22 to 78% loss of the vitamin C due to cooking.

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