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Studies on the antioxidants and antinutriens content of leafy vegetables cultivated at Dhapa, a Municipal Solid waste landfilling site in Kolkata, West Bengal, India

Dr.Paramita Barman[1], Dr. Tapan Kumar Pal[2], Dr. Minati Sen[3]

[1]Assistant Professor, Dept. of Food & Nutrition, Barrackpore Rastraguru Surendranath College, WBSU.
[2]Assistant Professor, Dept. of Biotechnology, BIT College, Hadia,
[3]Professor (Retd.), Dept. of Home Science, C.U.

Abstract:
The impact of Municipal Solid Waste (MSW) landfilling on vegetation in terms of nutritional quality is still under investigation. The main objectives of this study are to assess the antinutrients and antioxidants content of the leafy vegetables grown on Dhapa landfilled ground (DLG) and also to compare these nutritional qualities with the same leafy vegetables collected from other than landfilled ground i.e. Normal ground (NG). From the analysis it was observed that both antinutrients and antioxidants content of the leafy vegetables vary significantly ($P<0.01$) in between places except oxalate and tannin content ($P>0.05$). Furthermore, Phytate content, Antioxidant contents (Total Phenol, Flavonoid & Ascorbic acid) as well as Total Antioxidant Activity (reflected by FRAP Assay & DPPH Radical Scavenging Assay) of the samples of DLG were found to be significantly higher ($P<0.001$) than the samples of NG.

Keywords: Dhapa Landfilled Ground, Solid Waste, Leafy Vegetables, Antinutrients, Antioxidants, Total Antioxidant Activity.

Introduction:

Dhapa Landfilled Ground (DLG), Kolkata, West Bengal, being one of the largest open waste dumping grounds all over the World, is presently famous for the cultivation of vegetables. More than 40% of consumed vegetables at Kolkata are coming from EKW site. It is the continuing trend to dump the Municipal Solid Waste of the city of Kolkata in East Kolkata Wetland (EKW) sites since the middle of the 19th AD. By the process of dumping of Solid wastes of Kolkata in EKW sites, landfilled areas were developed which are popularly known as "**Dhapa**". In recent years 800 hectares of area at Dhapa which were landfilled previously by MSW is being utilized by the farmers to grow vegetables and crops **(Ghosh, 2005).** Vegetables are one of the major constituents of our daily diet which not only rich in vitamins minerals and fibre but also have some antioxidant properties by which they can able to prevent the detrimental effects of free radicals in our body.

Antioxidant compounds like phenolic compounds, flavonoids, ascorbic acids etc. scavenge the available free radicals produced in our body and thus inhibit the oxidative damages which may otherwise lead to

degenerative diseases. On the other hand Antinutrients are the compounds that may hinder the bioavailability of some most essential nutrients in the living system. But the reactivity of antinutrients with the bio-molecules such as polysaccharides, proteins, and metal ions has important nutritional and physiological consequences **(Schofield et al., 2001).**

Nutritional quality of the vegetables entirely depends on the composition of soil used for vegetation. As Municipal solid wastes (MSW) of the city of Kolkata are generally dumped at Dhapa sites it is quite obvious that it has some effects on the quality of vegetables grown over there. In this context the present study gives detail reports on the effect of solid waste on Antioxidants and Antinutrients content of the leafy vegetables cultivated in Dhapa, Kolkata, West Bengal.

Materials & Methods :

MATERIALS USED:

All the chemicals, reagents, & solvents used in this study are of AR/ GR grade and obtained from E. Merck, SRL, & Hi Media.

COLLECTION AND IDENTIFICATION OF SAMPLES:

The samples were collected throughout the year from five selected locations of Dhapa land-filled ground (designated as DLG1,DLG2, DLG3, DLG4, & DLG5) and also from five selected locations of Normal ground (designated as NG1, NG2, NG3, NG4, & NG5) in sterile zip lock plastic bags and preserved in ice bag during transportation from land to the laboratory. Herbarium sheets of the selected vegetable samples were prepared and identified & classified by a plant taxonomist of Botanical Survey of India, Shibpur, Howrah. The details of each plant species are elaborated in Table 1.

Table 1 : Vegetables collected for the study and pats used for proximate analysis.

English name	Species name	Family name	Local name	Parts used	Status
Red Amaranth (RA)	Amaranthus blitum L.	Amaranthaceae	Lal shaakh	Leaves with adjoining stem	Cultivated
Green Amaranth (GA)	Amaranthus tricolor L.	Amaranthaceae	Natey Shaakh	Leaves with adjoining stem	Cultivated
Bottle Gourd Leaves (BGL)	Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Lau shaakh	Leaves with adjoining stem	Cultivated
Ceylon Spinach (CSP)	Basella alba L.	Basellaceae	Pui shaakh	Leaves with adjoining stem	Cultivated

Spinach (SP)	Spinacia oleracea L.	Amaranthaceae	Palang shaakh	Leaves with adjoining stem	Cultivated

PREPARATION OF SAMPLE EXTRACT:

i.<u>For Anti-Nutrients Assay</u>

- **For Oxalate (Baker, 1952)**

Appropriate amount of cleaned & dried grounded plant samples were extracted in 2N HCl with mechanical shaking for about 2 hours, then centrifuged and filtered with Whatmaan No. 40 filter paper and the filtrate was taken for oxalate estimation.

- **For Phytate (Thompson & Erdman, 1982)**

Appropriate amount of cleaned & dried grounded plant samples were extracted in 3% TCA with mechanical shaking for about 30 minutes, then centrifuged and supernatant was taken for phytate estimation.

- **For Tannin (Schanderi, 1970)**

Appropriate amount of cleaned & dried grounded plant samples were boiled with distilled water for 30 minutes and cooled, then centrifuged and filtered with whatmaan No. 1 filter paper and the filtrate was taken for tannin estimation.

ii.<u>For Antioxidant Assay:-</u>

Cleaned vegetables, dried with paper towel was made into a paste and appropriate amount of each paste sample was extracted with -

- 6 % metaphosphoric acid for vitamin C estimation (**Joseph *et al*., 1944**) and
- 80% methanol and left it overnight, then centrifuged at 10,000 rpm for 15 min and the supernatants were decanted into polypropylene tubes and filtered hrough Whatman No.1 filter paper. The clear extracts were analyzed both for determination of phenolic contents and antioxidant activity (**Zhang and Hamauzu, 2004)** .

ANALYSIS:

(A) <u>Antinutrients content</u> :

- **Determination of Oxalate content:**

Briefly, the determination was as previously described by **Baker, 1952** with some modifications. The sample extract was weighed after taking in a beaker and boiled for 15 mins. This was then adjusted to previous volume with distilled water and volume was made upto 100ml with 2N HCl. The mixture was shaken well and filtered (whatman 40). To the 25 ml of filterate , 5 ml of phosphoric tungstate reagentwas added & mixed well & once or twkept overnight . Next day the mixture was centrifuged for 10 minutes at 3000 rpm and filtered (whatman 40) . 20 ml of clear solution was then taken to a 50 ml centrifuge tube and 2-3 drops of methyl red was added & neutralized with ammonia. Then 5 ml of Calcium chloride

reagentwas added to it and stirred with a fine glass rod and kept tube overnight in a refrigerator at 5 - 7 ^{0} C. Next day the mixture was again centrifuged for 10 minutes at 3000 rpm and filtered (whatman 40) .The ppt was then dissolved in distilled water followed by 5 ml of 2N sulphuric acid. Then the mixture was placed in a water bath over 80 ^{0} C for 2 minutes and titrated the oxalic acid with N/100 potassium permanganate solution to a faint pink colour which persisted for about 30 s after which the burette reading was taken. The oxalate content was evaluated from the titre value.

The overall redox reaction is:

$2MnO_4^- + 5C_2O_4^{2} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

- **Determination of Phytate content:**

Total phytate content of the extract was determined according to the supernatant difference method of **Thompson & Erdman (1982).**Sample extract (10 ml) was mixed with 4 ml $FeCl_3$ solution and heated in a boiling water bath for 45 mins. If the supernatant is no clear after 30 mins, add one or two drops of 3% Sodium sulphate in 3% TCA and continue heating.It was then Centrifuged for 10 – 15 mins and carefully decant the clear supernatant. After that precipitate was washed twice by dispensing well in 20 – 25ml of 3% TCA and heated in boiling water bath for 5 – 10 mins and centrifuged. The process of washing with water repeated. The precipitate was then dispersed in 27ml of water and 3 ml of 1.5N NAOH with mixing and the volume was made upto approximately 30ml with water and allowed to heat in boiling water bath for 30mins. It was then filtered hot through a moderately retentive paper Whatman No.2. The precipitate was washed with 6 – 70ml hot water and the filtrate was discarded. Then the precipitate from the paper was dissolved with 40ml 3.2N HNO_3 into a 100ml volumetric flask and the volume was made upto the mark. 5ml aliquot was transferred to another 100ml volumetric flask and diluted to approximately 70ml. 20ml of 1.5M KSCN was added to it and diluted to the volume. Finally read at 480nm of wavelength. Standard curve was prepared by using $Fe(NO)_3$. The (µg) iron present in the standard curve was found out and phytate P was calculated as per the equation.

Phytate P present in the sample = µg of Fe x 15 / Weight of the sample (g)

- **Determination of Tannin content:**

Tannin content in the plant extract (extracted in boiled water) was determined as described by (**Schanderi, 1970**) , using tannic acid as the standard. The extract solution (1 ml) was mixed with the Folin denis reagent (5ml) and super saturated solution of Na2CO3(10 ml) and volume made upto 100ml by distilled water. After 30 minutes of incubation at room temperature, the absorbance of the reaction compound at 700 nm was measured spectrophotometer (Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer) The overall tannin content was expressed as mg of tannic acid equivalents / gm dry weight .

(B) Antioxidants content:

- **Determination of Total Phenols :**

Total phenol content in the plant extract (extracted in 80% methanol, kept overnight) was determined as described by **Singlaton and Rossi (1965)** , using gallic acid as the standard. The extract solution in 80% methanol (1 ml, 50 mg ml-1) was mixed with the FC reagent (10%, 1 ml) and an aqueous solution of Na2CO3(7.5% , 0.8 ml) and volume made upto 10ml by distilled water. After 30 minutes of incubation at

room temperature, the absorbance of the reaction compound at 765 nm was measured spectrophotometer (Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer) The overall phenol content was expressed as mg of gallic acid equivalents (GAE)/ gm dry weight.

- **Estimation of Total Flavonoids:**

Total flavonoid content of the extract was determined according to a modified colorimetric method of **Bao , Cay et al. (2005).** Sample extract (1 ml, 50 mg ml-1) was mixed with 0.15ml of a 5% NaNO2 solution. After 6 minutes , 0.15ml of 10% AlCl3.H2O solution was added. After 6 minutes, 2 ml of 4% Sodium hydroxide was added and volume made upto 10ml by distilled water. The solution was mixed well and kept for 15 min. The increase in absorbance was measured at 510 nm using a UV-Visible spectrophotometer(Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer) The total flavonoid content was calculated using standard quercetin calibration curve. The results were expressed as micrograms of quercetin equivalents (QE) per gram dry weight of the sample.

- **Estimation of Ascorbic Acids:**

Ascorbic acid content in the plant extract was determined as described by **Joseph *et al*.,(1944)** using ascorbic acid as the standard (1mg/ml). The extract solution (2 ml) was mixed with equal amount of acetate buffer (ph 4.0) and dye (sodium salt of 2,6 dichlorophenol indophenol)solution in the separating funnel. The content was mixed well and 10ml xylene was added . This was then mixed well and allowed to stand for 6 seconds for separating the layers and then the water layer was removed and the colour in xylene was measured in a spectrophotometer (Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer) at 500 nm.

The ascorbic acid content was calculated as..

$$= \frac{0.1 \times \dfrac{\text{Blank- Sample}}{\text{Blank- Standard}}}{\text{Amount of the sample taken}} \times 100 \quad \text{(mg/gm fresh weight)}$$

(C) Determination of total antioxidant activity of the extract :

- **Determination of Ferric Reducing/Antioxidant Power assay (FRAP) :**

FRAP assay was carried out according to the method of **Benzie and Strain (1999)**. FRAP reagent was prepared from acetate buffer (1.6 g sodium acetate and 8 ml acetic acid make up to 500 ml) (pH 3.6), 10 mM TPTZ solution in 40 mM HCL and 20 mM iron (III) chloride solution in proportion of 10:1:1 (v/v) respectively. The FRAP reagent was prepared fresh daily and was warmed to 37^{o}C in oven prior to use. A total of 50 µl samples extract were added to 1.5 ml of the FRAP reagent and mixed well. The absorbance was measured at 593 nm using using microplate reader spectrophotometers (Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer) after 4 mins. Samples were measured in three replicates.

FRAP value of Sample (µM) = (Change in absorbance of sample from 0 to 4 minute / Change in absorbance of standardfrom 0 to 4 minute) X FRAP value of standard {Ascorbic Acid (M.W. 176.13) 1000 µ} **Note: FRAP value of Ascobic acid is 2**

- **Determination of free radical scavenging using DPPH method:**

Antioxidant activity was determined by the 2,2,-di- phenyl-2- picryl-hydrazyl (DPPH) method of **Zhang and Hamauzu (2004)** with some modifications. The concentration of the methanol (80%) extracts of fresh vegetable was adjusted to 10 mg/ml (on dry basis), which was chosen as an appropriate concentration for assessing antioxidant activity after preliminary studies of the different concentrations. An aliquot of 2 ml of 0.1 mM DPPH radical in methanol was added to a test tube with 0.1 ml of vegetable extract, at 10 mg/ml volume made upto 4ml by methanol (80%). Instead of methanolic extract of vegetables, pure methanol was used as control. The reaction mixture was vortex mixed and let to stand at room temperature in the dark for 30 min before the decrease in absorbance at 517 nm was measured at spectrophotometer (Perkin Elmer, Lambda 25, UV/VIS Spectrophotometer). Samples were measured in three replicates.
Percentage of DPPH scavenging activity was calculated as % inhibition of DPPH = [Abs control –Abs sample / Abs control] x 100.
The EC_{50} value was calculated according to the experimental data by using the Origin 7.

STATISTICAL ANALYSIS:

Each experiment was repeated three times for each sample collected from selected fields of DLG (i.e. DP1, DP2, DP3, DP4, & DP5) and NG (i.e. NG1, NG2, NG3, NG4, & NG5). The results are presented with their means, and standard error. The statistical analysis was done using ANOVA with the help of the software SPSS 16.0.

Results:

Table 2: Mean ± SE of **Antinutrient contents** of selected leafy vegetables collected from five different locations of Dhapa Land-filled Ground (DLG) & Normal Ground (NG)

SAMPLES	**PHYTATE CONTENT (µg/ gm DW) N = 15**		**OXALATE CONTENT (mg/gm DW) N = 15**		**TANNIN CONTENT (mg/ gm DW) N = 15**	
	DLG	**NG**	**DLG**	**NG**	**DLG**	**NG**
Red Amaranth **(RA)**	12.611 ± 0.158	12.252± 0.158	52.700 ± 0.483	52.847 ± 0.483	12.308 ± 0.146	12.592 ± 0.146
Green Amaranth **(GA)**	11.567 ± 0.158	11.361 ± 0.158	58.673 ± 0.483	57.573 ± 0.483	13.658 ± 0.146	13.442 ± 0.146
Bottle Gourd Leaves **(BGL)**	4.755 ± 0.158	4.566 ± 0.158	2.127 ± 0.483	2.120 ± 0.483	9.033 ± 0.146	8.975 ± 0.146
Ceylon Spinach **(CSP)**	13.827 ± 0.158	13.214 ± 0.158	57.420 ± 0.483	56.733 ± 0.483	10.925 ± 0.146	10.683 ± 0.146
Spinach **(SP)**	7.446 ± 0.158	6.960 ± 0.158	63.687 ± 0.483	62.760 ± 0.483	8.442 ± 0.146	8.475 ± 0.146

The samples' bearing same or no superscripts does not differ significantly (P>0.05) by Least Significant Difference (LSD) test.

- **Comparison of Phytate content among different vegetable samples (µg /gm DW):**
  CSP ^{d}> RA ^{a} > GA ^{b} > SP ^{e}> BGL
- **Comparison of Oxalate content among different vegetable samples (mg /gm DW): SP ^{d} > GA ^{b} = CSP ^{b} > RA ^{a} > BGL ^{c}**

- **Comparison of Tannin content among different vegetable samples (mg/gm DW) : GA [b] > RA [a] > CSP [d] > BGL [c] > SP [e]**

Table 2.1: Analysis Of Variance (ANOVA) – ANTINUTRIENTS CONTENT

CATEGORY	SIGNIFICANCE		
	PHYTATE	OXALATE	TANNIN
Between Samples	**0.000 (S)**	**0.000 (S)**	**0.000 (S)**
Between Places	**0.000 (S)**	**0.160 (NS)**	**0.162 (NS)**
Between Samples within locations	**0.612(NS)**	**0.609 (NS)**	**0.133 (NS)**
Error	--	--	--

Table 3: Mean ± SE of **Antioxidant contents** of selected leafy vegetables collected from five different locations of Dhapa Land-filled Ground (DLG) & Normal Ground (NG)

SAMPLES	ASCORBIC ACID CONTENT (mg% FW) N = 15		TOTAL PHENOL CONTENT (mg GAE/gm DW) N = 15		FLAVONOID CONTENT (mg QE/gm DW) N = 15	
	DLG	NG	DLG	NG	DLG	NG
Red Amaranth **(RA)**	70.679 ± 0.100	70.473 ± 0.100	182.720 ± 1.423	122.267 ± 1.423	70.433 ± 1.039	37.133 ± 1.039
Green Amaranth **(GA)**	47.649 ± 0.100	47.465 ± 0.100	101.680 ± 1.423	53.747 ± 1.423	60.700 ± 1.039	37.600 ± 1.039
Bottle Gourd Leaves **(BGL)**	BDL	BDL	227.027 ± 1.423	134.520 ± 1.423	86.133 ± 1.039	54.367 ± 1.039
Ceylon Spinach **(CSP)**	50.966 ± 0.100	50.953 ± 0.100	125.227 ± 1.423	53.907 ± 1.423	35.000 ± 1.039	25.067 ± 1.039
Spinach **(SP)**	28.068 ± 0.100	27.635 ± 0.100	93.187 ± 1.423	47.733 ± 1.423	76.333 ± 1.039	33.000 ± 1.039

BDL= Below Detection Level;

The samples' bearing same or no superscripts does not differ significantly (P>0.05) by Least Significant Difference (LSD) test.

- **Comparison of Ascorbic Acid content among different vegetable samples (mg%) : RA [a] > CSP [c] > GA [b] > SP [d]**
- **Comparison of Total Phenol content among different vegetable samples (mg GAE/gm DW) : BGL [c] > RA [a] > CSP [d] > GA [b] > SP [e]**
- **Comparison of Flavonoid content among different vegetable samples (mg QE/gm DW) : BGL [c] > SP [a] = RA [a] > GA [b] > CSP [d]**

Table 3.1: Analysis Of Variance (ANOVA) – ANTIOXIDANT CONTENT

CATEGORY	SIGNIFICANCE		
	ASCORBIC ACID	TOTAL PHENOL	FLAVONOID
Between Samples	**0.000 (S)**	**0.000 (S)**	**0.000 (S)**

Between Places	**0.009 (S)**	**0.000 (S)**	**0.000 (S)**
Between Samples within locations	**0.268 (NS)**	**0.000 (S)**	**0.000 (S)**
Error	--	--	--

Table 4: Mean ± SE of **Total Antioxidant activity** of selected leafy vegetables collected from five different locations of Dhapa Land-filled Ground (DLG) & Normal Ground (NG)

SAMPLES	**DPPH RADICAL SCAVENGING ASSAY (IC 50 VALUE µg/ml, DW) N = 15**		**FRAP ASSAY (mM/100gm DW) N = 15**	
	DLG	**NG**	**DLG**	**NG**
Red Amaranth **(RA)**	357.657 ± 19.435	587.313 ± 19.435	8.302 ± 0.136	6.065 ± 0.136
Green Amaranth **(GA)**	402.913 ± 19.435	714.159 ± 19.435	5.340 ± 0.136	3.642 ± 0.136
Bottle Gourd Leaves **(BGL)**	522.739 ± 19.435	739.136 ± 19.435	8.999 ± 0.136	5.721 ± 0.136
Ceylon Spinach **(CSP)**	3402.364 ± 19.435	2213.508 ± 19.435	2.915 ± 0.136	1.858 ± 0.136
Spinach **(SP)**	1932.278 ± 19.435	3206.472 ± 19.435	3.969 ± 0.136	2.493 ± 0.136

The samples' bearing same or no superscripts does not differ significantly (P>0.05) by Least Significant Difference (LSD) test.

- **Comparison of Total Antioxidant Activity among different vegetable samples by DPPH Radical Scavenging Assay : RA ^{a} > GA ^{b} > BGL ^{c} > SP ^{e} > CSP ^{d}**
- **Comparison of Total Antioxidant content among different vegetable samples by FRAP Assay : BGL ^{a} = RA ^{a} > GA ^{b} > SP ^{d} > CSP ^{c}**

Table 4.1: Analysis Of Variance (ANOVA) - TOTAL ANTIOXIDANT ACTIVITY

CATEGORY	**SIGNIFICANCE**	
	DPPH RADICAL SCAVENGING ASSAY	**FRAP ASSAY**
Between Samples	**0.000 (S)**	**0.000 (S)**
Between Places	**0.000 (S)**	**0.000 (S)**
Between Samples within locations	**0.000 (S)**	**0.000 (S)**
Error	--	--

Discussions :

TABLE 2 & 2.1 : ANTINUTRIENTS CONTENT

- **Phytate**

Phytate content shows significant differences between places and found to be significantly higher in all samples of DLG ($p<0.001$). They also vary significantly between samples ($p<0.001$). Significantly highest amount of phytate was found in Ceylon Spinach and lowest in Bottle Gourd Leaves irrespective of the locations ($p<0.005$).

- **Oxalate**

Vegetables of DLG & NG does not differ significantly ($P>0.05$) in terms of **Oxalate** content, but vary significantly between samples ($p<0.001$) except Green Amaranth - Ceylon Spinach ($P= 0.032$). Significantly highest amount of oxalate was found in Spinach and lowest in Bottle Gourd Leaves irrespective of the locations ($p<0.005$).

- **Tannin**

Tannin content shows no significant differences ($P > 0.05$) between places, but they vary significantly from sample to sample ($P<0.001$). Significantly highest amount of tannin was found in Green Amaranth and lowest in Spinach irrespective of the locations ($p<0.005$).

So from the present study it can be stated that garbage farming not at all affect the antinutrients level of the vegetables produced over there except Phytate. Furthermore, it may be mentioned that after extensive literature survey, no documented data regarding antinutrients content of vegetables grown on DLG are available by which the present data could be compared.

TABLE 3 & 3.1 : ANTIOXIDANTS CONTENT

- **Ascorbic acid**

Data reveals that the **Ascorbic acid** content of samples of DLG were found to be significantly higher as compared with the samples of NG ($P<0.01$) and also vary significantly between samples ($P<0.001$). Significantly highest amount of Ascorbic acid was found in Red Amaranth and lowest in Spinach irrespective of the locations ($p<0.005$).

- **Total Phenol**

Total Phenol content was significantly higher (1.6 fold) in DLG **(137.42 mg GAE/gm DW)** as compared with NG **(84.588 mg GAE/gm DW)** ($P<0.001$) and varies significantly from sample to sample ($P<0.001$). Significantly highest amount of polyphenol was found in Bottle Gourd Leaves and lowest in Spinach irrespective of the locations ($p<0.005$).

- **Flavonoid**

From the data it has been observed that significantly higher (1.68 fold) amount of **Flavonoid** was present in all samples of DLG **(58.367 mg QE/gm DW)** in comparison to the same samples of NG **(34.750mg QE/gm DW)** ($P<0.001$). Flavonoid content also varies significantly ($P<0.01$) between samples, except in between Red Amaranth & Spinach ($P= 0.397$). Significantly highest amount of flavonoid was found in Bottle Gourd Leaves and lowest in Ceylon Spinach irrespective of the locations ($p<0.005$).

TABLE 4 & 4.1 : TOTAL ANTIOXIDANT ACTIVITY

- **DPPH Radical Scavenging Assay**

All the samples of DLG show significantly higher **Antioxidant activity** ($P<0.001$) by **DPPH Radical Scavenging Assay**. By this method it has been observed that Red Amaranth possesses significantly higher Antioxidant activity ($P<0.05$) as compared with others.

- **FRAP Assay**

Total Antioxidant content by **FRAP Assay** was found to be significantly higher in all the samples of DLG as compared with NG and also varies significantly between samples (P<0.001), except RA- BGL (P= 0.198). FRAP Assay showed significantly higher Antioxidant activity (P<0.05) in both Bottle Gourd Leaves & Bottle Gourd Leaves

Antioxidant contents (Total Phenol, Flavonoid & Ascorbic acid) as well as Total Antioxidant Activity (reflected by FRAP Assay & DPPH Radical Scavenging Assay) of DLG samples were found to be significantly higher (P<0.001) than NG samples. From the data it was also observed that Red Amaranth, Green Amaranth & Bottle Gourd Leaves had significantly higher (P<0.001) antioxidant activity as compared to other vegetable samples irrespective of the locations. The probable reason behind the differences in results with respect to antinutrients & antioxidants content between DLG & NG samples may be due to the different soil composition. But, there were no earlier studies available to relate the effects of solid waste landfilling on the antioxidant activity of the vegetables grown on it.

Conclusions :

The present work deals with the evaluation of antinutrients and antioxidants content of selected leafy vegetables cultivated on solid waste dumping ground of Kolkata i.e. Dhapa Landfilled Ground (DLG) as well as from Normal Ground (NG).

From this study it can be concluded that Oxalate & Tannin contents were almost similar in all vegetables irrespective of the locations. But the amount of Phytate was found to be significantly higher (P<0.01) in all the samples of DLG as compared to the same samples of NG (Normal Ground).

Difference in Antioxidant contents of DLG samples as compared to NG samples was another prominent finding of this study. . It is highlighted for the first time that Antioxidant contents (Total Phenol, Flavonoid & Ascorbic acid) as well as Total Antioxidant Activity (reflected by FRAP Assay & DPPH Radical Scavenging Assay) of DLG sample were significantly higher (P<0.001) than NG samples. From the data it was also observed that Red Amaranth, Green Amaranth & Bottle Gourd Leaves possess significantly higher (P<0.001) antioxidant activity as compared to other vegetable samples irrespective of the locations. The probable reason behind the differences in results between DLG & NG samples may be due to the different soil composition as reflected by the continuous deposition of MSW into the soil.

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