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Research Article

QUANTITATIVE ANALYSIS OF MINERALS IN CERTAIN SPECIES OF AMARANTHUS

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ABSTRACT
Leaves as well as grains of *Amaranthus* are appreciated for its high nutritional qualities including high mineral content Study from the quantitative analysis of mineral, reveals that *A. hybridus* subsp. *hybridus* var. *hybridus* contain maximum amount of Sodium (Na) and Potasium (K), 29.11and 503mg/100gm dw Respectively. Iron (Fe) and Calcium (Ca) were observed in best amount in subsp. *hybridus* of *A. hybridus. A. palmeri* also contain, Magnesium (Mg) in maximum (282 mg/100 gm) amount. The comparative study showed that A. viridis has least amount of studied minerals except *A. spinosus* for Calcium (Ca) *i.e*. (103 mg/100 gm). *A. hybridus* subsp. *hybridus* var. *hybridus* and *A. palmeri* are vigorously growing plants in the desert area and both can serve as a good fodder.

INTRODUCTION
Amaranth (*Amaranthus* spp.) is a native of America. Its leaves as well as grains are appreciated for its high nutritional qualities including high mineral content. It belongs to the family Amaranthaceae which are herbaceous. Its an important pseudo cereal, broad leaved plant that produces small seeds on a Sorghum like head. It constitutes an important part of the diet in areas of Latin America, Africa and Asia (Teutonico and Knorr, 1985). Another potential nutritional advantage of the amaranth plant as a veritable source of plant protein and its rich source of vitamins and minerals. Minerals play important role in the life of livings. Iron and magnesium are necessary for chlorophyll formation. Magnesium is a constituent of the chlorophyll molecule but iron is not. Calcium plays a prominent role in absorption of other minerals form the soil. It also forms the cementing material for holding cells together throughout the plant and is the first substance laid down during the formation of new cell wall.

This crop is important and most widespread in India. It has been grown all over along the Himalayas, from Kashmir to Bhutan and also on South Indian hills. In the Kullu Valley (The Punjab) the grain is known as "*siriara"* or *scol"* and about 2000 acres are grown annually. In the upper Sutlez Valley, In Himachal Pradesh, the amaranth is called "*Tulsi"* and the border district of Kinnaur the local name is *"kalgi"* and *"dankhar"*. At present, it is also an important crop in the plains of India, especially in parts of Gujarat where it is known as *"rajgirah*". Isolated crop fields are also seen in the North Indian Plains, chiefly as a mixed crop vegetables, such as chillies, bringle, etc. In the North Indians plains, its common names are *"sil*" or *"chaulai*" (Singh, 1961). The aim of this study was to evaluate the availability of Ca, Mg, Na, K and Fe in the biomass of plant species.

MATERIALS AND METHODS
Biochemical Study
Important and locally available wild species of Amaranthus were studied for the quantitative estimation of Ca, Mg, Na, K and Fe in the dry weight biomass. For the study purpose, *A. hybridus* subsp. *cruentus* var. *paniculatus, A. viridis, A. palmeri, A. hybridus* subsp. *hybridus* var. *hybridus* and *A. spinosus* are selected. Among these one species namely, *A. hybridus* subsp. *cruentus* var. *paniculatus*, is cultivated and cultured in the pot for experiments.

Estimation of Minerals
A known amount of dried plant material was digested in mixture of HNO_3, H_2SO_4 and 60% $HClO_4$ in ratio of 4:1:1 (Trivedy and Goel, 1984) till the solution turned colourless. (Digest was diluted to 250 ml

and used for analysis of Ca, Mg, Na, K and Fe. Na and K were analysed by flamephotometerically, comparing with the standard curve prepared flamephotometrically by using NaCl and KCl as a standard salt for known ppm concentration. Fe was analysed by using atomic absorption spectrophotometer. Here standard curve was prepared with $FeSO_4$ as a known concentration with atomic absorption spectrophotometer. Ca and Mg were analysed titrimetrically.

Calcium

Reagents

(a) *Murixide indicator:* 0.2 gm of ammonium perpurate was mixed with 100 mg sodium chloride.

(b) *EDTA 0.1 M solution:* 50 ml of digest was taken out and pH of this set to 9 with NaOH, 2 ml of NaOH (1N) and a pinch of murixide indicator was added to this. A pink colour was developed. The solution was titrated against EDTA, until pink colour changed into purple. The volume of EDTA used was recorded.

Calculation

Where X = Amount of EDTA used.

Magnesium

Reagents

(a) EDTA – 1 M solution

(b) Buffer solution

(i) 16.99 g NH_4Cl was dissolved in 143 ml concentrated NH_4OH.

(ii) 1.179 gm disodium EDTA and 0.078 gm $MgSO_4$ were dissolved in 50 ml of distilled water.

(i) And (ii) were mixed. Resultant was used as buffer solution.

(c) Erichrome black T: 0.4 gm erichrome black T was used as an indicator .50 ml of digest was taken in flask. The pH of the digest was adjusted to 9 by using NaOH solution, 2 ml buffer solution and 100-200 mg erichrome black T indicator was added to the digest. Solution turned to wine red. This was titrated against EDTA solution, till the colour was changed to blue. The volume of EDTA used was noted. Where Y = EDTA used in titration, and N = EDTA used in calcium determinations.

RESULTS

Observations of quantitative analysis of mineral reveals, The *A. hybridus* subsp. *hybridus* var. *hybridus* contain maximum amount of Sodium (Na) and Potasium (K), 29.11and 503mg/100gm dw respectively, followed by *A. hybridus* subsp. *cruentus* var. *paniculatus*. Iron (Fe) and Calcium (Ca) were observed in best amount in subsp. *hybridus* of *A. hybridus* followed by *A. palmeri. A. palmeri* also contain, Magnesium (Mg) in maximum (282 mg/100 gm) amount. The comparative study showed that A. viridis has least amount of studied minerals except *A. spinosus* for Calcium (Ca) *i.e*. (103 mg/100 gm). *A. hybridus* subsp. *hybridus* var. *hybridus* and *A. palmeri* are vigorously growing plants in the desert area and both can serve as a good fodder.

Table-1: Mineral content (mg/100g dw) in studied species of *Amaranthus.*

S. No.	Name of plant	Ca	Mg	Na	K	Fe
1.	*A. hybridus* subsp. *cruentus* var. *paniculatus*	142	241	24. 09	261	9. 10
2.	*A. viridis* L.	122	193	6. 70	213	8. 80
3.	*A. palmeri* Wats	165	282	22. 23	251	13. 10
4.	*A. hybridus* subsp. *hybridus* var. *hybridus*	178	231	29. 11	503	13. 70
5.	*A. spinosus* L.	103	213	10. 89	218	11. 10

DISCUSION

In present investigations mineral contents viz; Ca, Mg, Na, K and Fe were estimated in mg/100g dry matter in different species of the Genus *Amaranthus*. Khader and Rama (2003) studied the macro-mineral contents of two varieties of *Amaranthus* species; two varieties of *Hibiscus* species; *Portulaca olerecea* and Palak and observed that Ca, Mg and P contents were in variable amounts at different stages of maturity and in different varieties. Gajewska (2002) reported the levels (mg/100g) of minerals in amaranth as follow: 204-223 Ca; 712-792P; 8. 3-9.7 Fe; 200-235 Mg; 2.9-3.1 Zn; 1.03-1.38 Cu; 3.78-4.54 Mn; 6.30-8.42 Na; 318-337 K; 0.040-0.055 Cr; 0.185-0.292 Ni; and 0.045-0.051 Co. The contents of Cadmium ranged from 5-9 mg/100g and lead 27-35 mg/100g in examined products of amaranth. Our results are somewhat different from those of Gajewska (2002) and slight variations were found that Ca was 103-178, Mg 193-282, Na 6.70-29.11, K 213-503 and Fe 8.80-13.70. Work of Freiberger *et al*., (1998) who analysed the leaves of seven plant species for minerals, amino acid and fatty acid contents. The species were *Ximenia americana*, *Amaranthus viridis*, *Corchorus tridens*, *Hibiscus sabdariffa*, *Maerua crassifolia*, *Moringa oleifera* and *Leptadenia hastata*. *Ximenia americana* contained large amount of calcium. Large quantities of iron were present in *Amaranthus viridis*. However, our observations show that *A. viridis* contain 8.80 mg/100g of Fe. *A. spinosus* and *Adansonia digitata* leaves contained the highest level of iron (38.4 mg/100g and 30.6 mg/100g dw, respectively) observed by Barminas *et al.,* (1998). In present investigation 11.10 mg/100g of iron was found in *A. spinosus*.

Leaves analysis of *Amaranthus viridis* in respect of protein and amino acids was found favourably to that of WHO standards. It also contained considerable amount of the two fatty acids that are essential to humans (linoleic and α-linoleic) and a number of minerals including Fe, Mg, Ca and Zn. (Sena *et al.,* 1998). *A. viridis* leaves were also rich in beta carotene (3290 mg/100g) (Nordeide *et al*., 1996). Yadav and Sehgal (1995) analysed the processed leaves of *Spinach oleracea* and *Amaranthus tricolor* for total and extractable calcium and zinc content. The Ca and Zn content of these leave varied from 1320 to 2120 and 11.70 to 12.60 mg/100g DM and the percentage HCl-extractability was 77.82 to 81.92 and 85.16 to 86.15 respectively.

Rajyalakshmi and Geervani (1994) analysed proximate composition, vitamins and minerals of 25 food comprising cereals, millets, legumes, tubers and miscellaneous foods which are consumed by tribals of Andhra Pradesh (India) . The major findings of the study were as follows: protein content of cereal and millet ranged from 6.8 to 11.8g/100g and that of legumes from 20 to 23.8 g 100g. The uncommon legume, Judumulu (*Vigna* sp.) grown by the tribals had the protein content of 22g/100g. A wild legume, *Mucuna pruriens*, had the highest protein content of 27.9g/100g. Mineral contents of the food showed greater variations. Among the miscellaneous food analysed, rajkeera seed (*Amaranthus paniculatus*) had protein content of 22g/100g. Vetter (1994) found the contents of minerals in *Amaranthus hypochondriacus* seed are similar to those of wheat and (except a few elements P and K) pea. The habitats of plants especially the soil conditions effect importantly on minerals and the total amino acid content and mainly the rate of essential amino acids (lysine, arginine etc.) are higher than those in seeds of wheat and maize and this fact create the importance of cultivation and utilization of this plant. In the present investigation the amount of protein ranges from 31.87 mg/100g to 66.98 mg/100g.

Green leafy vegetables particularly *Amaranthus spinosus* which is locally available throughout India and many other countries is a rich source of iron, vitamin A and vitamin C (Devadas and Saroja, 1979). The experiments were undertaken to study the bioavailability of iron in diets consisting of maize flour and amaranth leaves (*A. spinosus*) in different proportions, diets made up of maize flour and amaranth leaves and of maize alone with or without supplemented iron (30 µg/g of diet) were fed to albino rats and their effect on serum content, total iron binding capacity, unsaturated iron binding capacity and per cent saturated serum transferrin was studied. The study revealed that iron bioavailability was maximum when diet containing 50% maize and 50% fresh amaranth leaves was to fed to the albino rats. Further supplementation with iron (30 µg/g diet) and even with vitamin C (100µg/g of diet) did not improve the bioavailability of iron (Prakash and Zaidi, 2000). In the investigated species of *Amaranthus* the iron was

found to be 8.8 to 13.7 mg/100g. Mineral analysis were done by several workers on grain amaranths. Becker *et al.,* (1981) , Martin and Telek (1979) , Sanchez-Marroquin *et al.,* (1980) and Teutonico and Knorr (1985) reported that K, Fe, Mg and Ca exists in significant concentration in *A. hypocondriacus* leaves. Vegetable amaranth has been rated equal to or superior in taste to spinach and is considerably higher in calcium, iron and phosphorus (Makus, 1984).

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