A Comparative Study on the Nutritional and Anti-Nutritional Characters of Species of *Amaranthus* L. (Amaranthaceae)

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Amaranthus belongs to the family Amaranthaceae and is widely distributed in tropical countries. The genus comprises over 70 species of which 15 are consumed as vegetables. The present study concerns with the estimation of nutritional and anti nutritional components of four *Amaranthus* species, namely, *A. cruentus, A. spinosus*, *A. tricolor* and *A. viridis* collected from Thiruvananthapuram district, is the southern part of Kerala. The evaluated parameters were protein, carbohydrate, ascorbic acid, phenol, flavanoid, moisture and oxalate. The protein content ranged between 4.8-9.7 mg/g. High protein content was detected in *A. spinosus*. *A. cruentus* was characterized by presence of rich carbohydrate (23.6 mg/g). The carbohydrate and phenol content of genus ranged between 5.2-23.6 mg/g and 5.1-11 mg/g respectively. Highest flavanoid content was observed in *A.spinosus* and it ranged between 0.0029-0.005 mg/g. Ascorbic acid content and moisture was high in *A.viridis* and it ranged between 14-25 mg/g and 40-65%, respectively. The anti nutritional factor oxalate was found to be highest in *A. cruentus* and *A. tricolor* (15-14.09 mg/g) whereas it was comparatively very low in *A. spinosus* and *A. viridis*. The nutritional factors namely, carbohydrate, protein and ascorbic acid were markedly high as per the Recommended Dietary Allowances (1974). This study suggested the cultivation and consumption of *A. spinosus* and *A. viridis* which are not commonly used.

Key Words: *Amaranthus*, Nutrients, Anti-nutrients

Introduction

Many of the local vegetables are under-exploited because of inadequate scientific knowledge of their nutritional potentials. Vegetables are the indispensible constituents of human diets they supply the body minerals, vitamins and hormone precursors in addition to protein and energy.

The genus Amaranthus is a leafy vegetable and also a grain type of the family Amaranthaceae distributed widely in the tropics and sub tropics and it comprised of 60-75 species (Allen, 1964) out of which 15 occur in Indian subcontinent. *Amaranthus* is very palatable and well suited for human nutritional needs. *Amaranthus* is a tender annual growing to a height of 2-8 feet. The leaves are oval or oblong and some species are having purple colored lamina. The flowers are unisexual and developed on branched flowering clusters.

Though various researchers reported the compositional evaluation and functional properties of edible species of wild species of *Amaranthus*, studies related with the nutritional properties of wild species are scanty. Present investigation was to assess many of the potentials of nutritional and anti-nutritional properties of four *Amaranthus* species *viz, A. cruentus, A. spinosus, A. tricolor* and *A.viridis.* Among these *A.cruentus* is grain type A. *tricolor* is the common vegetable and *A. spinosus* and *A.viridis* are weeds. The evaluated parameters in this study are protein, carbohydrate, ascorbic acid, phenol, flavanoid, moisture and oxalate.

Materials and Methods

The leaves were collected from Thiruvananthapuram. Estimation of protein, ascorbic acid, moisture and oxalate were done immediately after collection. Leaves were then dried and ground. The leaf powder was analyzed for carbohydrate content. The powder subjected to extraction (10 mg: 150 ml) with methanol using soxhelet apparatus. Estimation of phenol and flavanoid were made from the dried extracts.

Protein estimation of the leaves was done by the method of Lowry *et al.*, (1951). The method suggested by Hedge and Holfreiter (1962) was used for the estimation of carbohydrate. Ascorbic acid content of the fresh leaves were determined by the titration with 2, 6 dichloro phenol indophenols.(Harris and Ray, 1935). Moisture percentage was estimated by drying in a hot air oven and calculation was done by the formula W–D/DX100 (AOAC, 1984). Total phenol was estimated by Folins Ciocalteau assay (Singleton *et al.*, 1999). Flavanoid extraction and estimation was done according to Zhishen *et al.* (1999) Extraction and estimation of total oxalate was done by the procedure described by AOAC (1984). The proximate analysis of the above

Table 1.

Parameters	*A. cruentus*	*A. spinosus*	*A. tricolor*	*A. viridis*
Protein (mg/g)	6.70	9.74	5.00	4.80
Carbohydrate (mg/g)	23.6	5.22	7.25	8.16
Ascorbic Acid (mg/g)	15.00	24.95	18.40	14.32
Phenol (mg/g)	9.25	5.1	9.50	11.00
Flavanoid (mg/g)	0.43	0.50	0.31	0.29
Moisture (%)	60	79	76	85
Oxalate (mg/g)	15.01	8.05	14.75	5.72

mentioned results were summarized in Table1.

Result and Discussion

It is evident that all the four species were rich in ascorbic acid. Ascorbic acid is necessary for healthy teeth, gums and bones and is essential for the proper functioning of adrenal and thyroid glands. It has also antioxidant properties. Ascorbic acid in the leaves varied from 14.32-24.95 mg/100g. *A. spinosus* is a weedy species possessed high amount of ascorbic acid (24.95) compared to the cultivated species, *A. tricolor* (18.4). According to the food and nutrition board (1974), the Recommended Dietary Allowances of ascorbic acid (vitamin C) for infants, children and adults are 40, 45 and 60 mg per day. Akubugwo *et al.* (2007) reported that ascorbic acid content in the *A. hybridus* leaves as 25.40 mg/100 mg. Shukla *et al*. (2003) reported variable quantity of ascorbic acid from foliage cuttings vegetable amaranth.

Phenol content in the leaves show a wide range of 5-11 mg/100 g. Phenolics are well known for their diverse physiological properties, anti-carcinogenic, anti-inflammatory and antioxidant activities. (Rice Evans *et al.*, 1997) the presence of phenol content in *A. viridis* leaves is much higher than the other three species (11 mg/100 g). Phenol content was lowest in the weedy species *A. spinosus*. Presence of high phenol content in *A.viridis* points out the significance in the use of carcinogenic properties.

Flavanoid content of the four species ranged between 0.29-0.50 mg/100 g dry weight. Highest content of flavanoid was observed in *A.spinosus* (0.50 mg) where as the cultivated species *A. tricolor* possessed only 0.31 mg and the least value 0.29 mg was detected in *A.viridis*. Akubugwo *et al*. (2008) estimated the flavanoid content in *A. hybridus* as 0.83 mg/100 g. According to Michelle *et al.* (2008) *Urtica dioica* leaves (wild) possess 0.89 mg/100 g as quercetin equivalents.

The protein content was highest in the leaves of *A. spinosus* (9.74 mg/g) and the lowest in *A. viridis* (4.8 mg/g). *A. cruentus* and *A. tricolor* were 6.7 and 5 mg/gm respectively. Protein content in the present stud was lower than that reported by Prakash and Pal (1991), Mnkeni *et al*. (2007) and Akubugwo *et al*., (2007). Shukla *et al.* (2003) reported the protein content in the cultivars of *A. tricolor* as 1.95-3.06 g/100 g. Low-level protein content observed in the present study due to the differences and variation in agro-climatic changes. Singh *et al*. (2000) suggested this in their study on the nutritional composition of leafy vegetables and herbs.

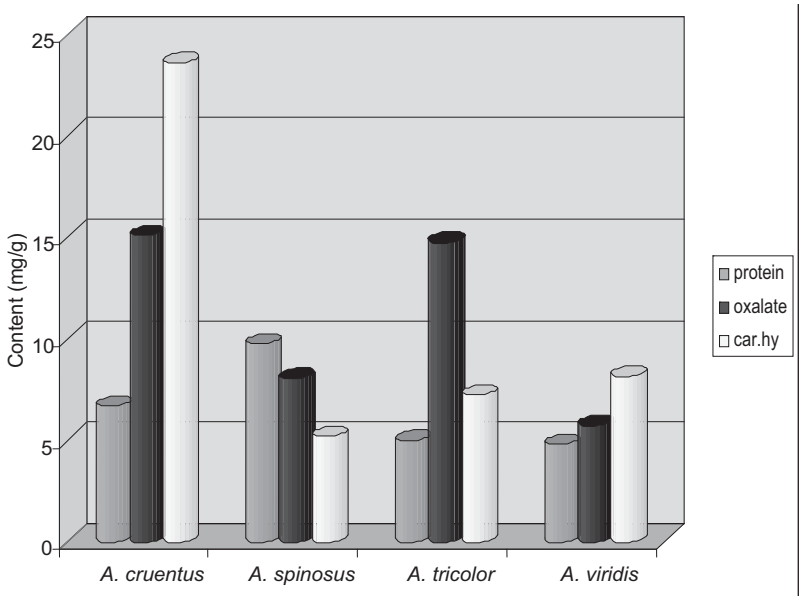

Fig. 1: Representation of carbohydrate, protein and oxalate

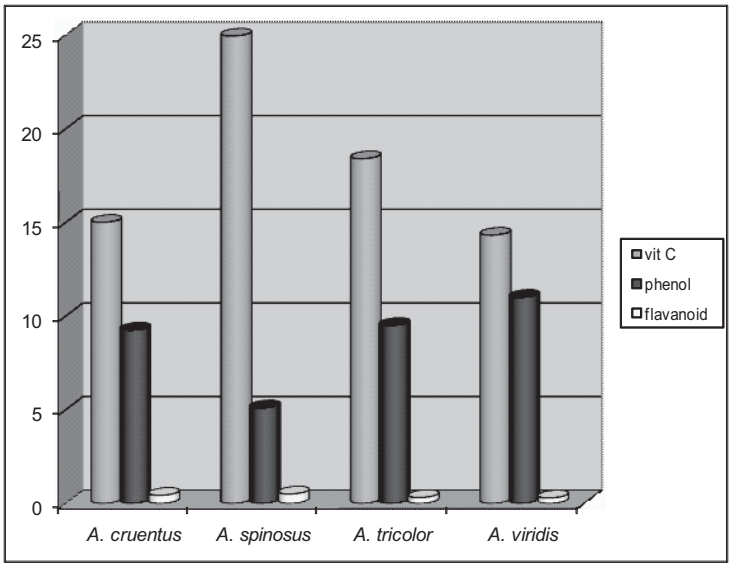

Fig. 2: Representation of vitamin C, phenol and flavanoid (mg/100 g)

A wide range of variation 95.22-23.6 mg/g) was observed in the quantity of carbohydrate. High quantity was found out in the *A. cruentus* the grain type amaranth. The leafy vegetable *A. tricolor* had 7.25 mg. The weedy species *A. spinosus* and *A. viridis* possessed 5.22 and 8.16 respectively.

Moisture content in the leaves ranged between 60-85%. Maximum moisture was observed in *A. viridis* (85%). *A. cruentus* contains less water content (60%) than others, *A. spinosus* (79%) and *A. tricolor* (76%). A similar value of moisture content was reported by Singh *et al.* (2000) in *A. tricolor*, Akubugwo *et al*. (2007) in *A. hybridus* and Marcone (2000) in *A. hypochondriacus.*

Oxalate is a common constituent of a plants with dicarboxylic acid anion, is considered to be anti nutritional factor as well as toxin. It can render some mineral nutrients unavailable by binding them to form insoluble salts that are not absorbed by the intestine (Libert and Franseschi, 1987). The four species contain prominent percentage of oxalate. *A. cruentus* contains high value (15.1 mg/g) and the lowest value was observed in *A. viridis. A. tricolor* and *A. spinosus* possessed 14.75 and 8.05 mg/g.

From the foregoing discussion, it may be concluded that *A.spinosus* had the best combination of high ascorbic acid, moderate amount of carbohydrate, phenol, flavanoid and protein and low amount of oxalate. The study suggest that the applicability of utilizing the weedy relatives for the improvement of cultivated species *A. tricolor* by transferring the traits related to increase the ascorbic acid, protein and flavanoid content and the anti nutritional factor oxalate.

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