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Analysis of nutrient and antinutrient content of underutilized green leafy vegetables

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Abstract

Analysis of chemical composition of 13 locally available underutilized green leafy vegetables (GLV) was the objective of this study. Moisture, ash and ether extract of the greens were in the range of 73–95 g/100 g, 0.77–3.54 g/100 g and 0.2–0.9 g/100 g, respectively. Four GLV had high iron content (13.15–17.72 mg/100 g) while the rest had lower levels (2.62–9.86 mg/100 g). Calcium content varied largely between the greens ranging from 41 mg/100 g in *Polygala erioptera* to 506 mg/100 g in *Digera arvensis*, whereas phosphorous ranged from 16 to 63 mg/100 g. Ascorbic acid was higher in *Delonix elata* (295 mg/100 g) and *Polygala erioptera* (85 mg/100 g) and lower in others (3–46 mg/100 g). Thiamine was found to be less than 0.1 mg/100 g in six greens and 0.1–0.33 mg/100 g in others. Total carotene content ranged between 10 and 35 mg/100 g in all with exceptionally high amount in *Cocculus hirsutus* (67 mg/100 g) and *Delonix elata* (60 mg/100 g). β-carotene was 13–25% of total carotene in all greens. Oxalate content was below 100 mg/100 g in five greens and less than 1400 mg/100 g in the remaining GLV. Tannin content ranged between 61 and 205 mg/100 g in all GLV with the exception of *Coleus aromaticus* (15 mg/100 g) and *Delonix elata* (1330 mg/100 g).

Keywords: Micronutrient; Macronutrient; Dietary fiber; Tannins; Oxalates; Phytic acid

1. Introduction

The search for lesser-known crops, many of which are potentially valuable as human and animal food has been identified to maintain a balance between population growth and agricultural productivity, particularly in the tropical and subtropical areas of the world. In these regions, indigenous vegetables are abundant immediately after the rainy season and very scarce during the dry season. India, being blessed with a variety of natural surroundings and varying climates and seasons, has a number of edible green leafy vegetables (GLV) some of which are locally grown and utilized. GLV are rich sources of vitamins such as β-carotene, ascorbic acid, riboflavin and folic acid as well as minerals such as iron, calcium and phosphorous. GLV are also recognized for their characteristic color, flavor and therapeutic value. Some of the commonly consumed leafy vegetables are amaranth, spinach, fenugreek, coriander, etc., the nutritive value of which has been reported in the Food Composition tables (Gopalan et al., 1996). Apart from these there are various types of underutilized leafy vegetables, which are available seasonally, and practically no information is available on the nutrient content and antinutritional factors of such vegetables. Consumption of such food materials is confined to the people living in the areas where they grow. Recognizing the need for identification of such GLV, which are believed to be nutritious, may help in achieving nutritional (micronutrient) security. Gupta, Barat, Wagle, and Chawla (1989) analysed the nutrient content of few of the GLV grown in north India and found them

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to be rich sources of macro and micronutrients. Bhaskarachary, Rao, Deosthale, and Reddy (1995) have reported that some of the less familiar GLV are rich sources of β-carotene. Analysis of proximate composition of the unconventional leafy vegetables found in the forest and wetlands of Konkan region of Maharastra, India, revealed that some of the greens contained comparatively higher amounts of crude protein. In general, they contained less oxalates compared to cultivated vegetables (Shingade, Chavan, & Gupta, 1995). However, antinutritional factors viz. oxalates, tannins, dietary fiber and saponins were found in the underutilized GLV (Gupta & Wagle, 1978). A significant variation was observed in the antinutritional factors among the vegetables (Gupta et al., 1989). Bawa and Yadav (1986) reported the phytic acid content of GLV consumed by a certain section of population in Nigeria to be between 12.5 and 18.75 mg/100 g.

Looking into the prevalence of high level of micronutrient malnutrition among the vulnerable sections in the developing countries and the increasing prevalence of chronic degenerative diseases globally, the need for exploration of underutilized foods is significant to overcome the nutritional disorders. The diet and food based approach in combating micronutrient malnutrition is essential for its role in increasing the availability and consumption of micronutrient rich foods (FAO, 1997). Increasing the utilization of GLV in our diet, known to be rich sources of micronutrients as well as dietary fiber can be a food-based approach for ensuring the intake of these nutrients. It is essential that the locally available GLV, which are inexpensive and easy to cook, be used in the diets to eradicate micronutrient malnutrition and also to prevent the degenerative diseases.

Therefore, the present investigation was undertaken with the objective of exploring the lesser-known underutilized GLV grown in and around Mysore district of Karnataka state, South India (nutrient composition of which has not been reported in literature) and to analyse the chemical composition of the same.

2. Materials and methods

Thirteen GLV were selected for the study. They were identified by a taxonomist and are as follows—Adachitkana (*Trianthema portulacastrum,* Linn.), Annae (*Celosia argentea,* Linn.), Bagargunchi (*Boerhaavia diffusa*, Linn.), Balae (*Polygala erioptera*, DC.), Brahmi leaves (*Centella asiatica*, Urb.), Doddipatre (*Coleus aromaticus*, Benth.), Gurchi (*Digera arvensis*, Forsk.), Javanada (*Cocculus hirsutus*, Diels.), Kanne (*Commelina benghalensis*, Linn.), Kilkeerae (*Amaranthus tricolor*, Willd.), Naribalae (*Gynandropsis pentaphylla*, DC.), Pumpkin leaves (*Cucurbita maxima*, Duch.) and Vayunarayani (*Delonix elata*, Gamb.).

The fresh leaves were procured from the local markets or field locations. The leaves were separated from roots, washed under running water, followed by double glass-distilled water. They were drained completely and used for analysis. Double glass-distilled water was used for preparation of reagents used in the entire analysis. All chemicals used for the study were of analytical grade. Moisture was estimated by standard method. Ascorbic acid was estimated by visual titration method of reduction of 2,6-dicholorophenol-indophenol dye. Total carotene was extracted in acetone; β-carotene was separated by column chromatography and estimated colorimetrically (Ranganna, 1986). Thiamine was analysed by oxidation to thiochrome, which fluoresces in UV light (Raghuramulu, Nair, & Kalyansundaram, 1983). Total oxalate was analysed by extraction with hydrochloric acid and soluble oxalate with water followed by precipitation with calcium oxalate from deproteinized extract and subsequent titration with potassium permanganate (Baker, 1952).

The samples were dried in a hot air oven at $50 \pm 5\,^{\circ}C$ for 10–12 h, finely powdered and stored in airtight containers for further analysis. The nitrogen content was estimated by Kjeldhal method, based on the assumption that plant proteins contain 16% nitrogen, protein content of the GLV was calculated using the formula, protein = nitrogen $\times$ 6.25. Ether extractives and ash (minerals) were estimated by standard methods (Ranganna, 1986). Insoluble and soluble dietary fiber was analysed by separation of non-starch polysaccharides by enzymatic gravimetric method (Asp, Johansson, Hallmer, & Siljestrom, 1983). Tannins were extracted in methanol and read colorimetrically by using vanillin-hydrochloride method (Burns, 1971). Phytic acid was extracted and determined according to the precipitate analysis method of Thompson and Erdman (1982). The conversion factor 3.55 for phosphorus to phytic acid was used.

The samples were ashed in a muffle furnace and ash solution was prepared by dry ashing. Total iron and phosphorous were estimated colorimetrically by α-α-dipyridyl method (AOAC, 1965) and Taussky and Shorr (1953), respectively. Calcium was analysed by precipitation as calcium oxalate and subsequent titration by potassium permanganate (Oser, 1965). Samples for determination of mineral contents were digested using nitric/sulphuric acid mixtures and diluted to a known volume (Ranganna, 1986). The samples were analysed for sodium, potassium, magnesium, zinc, copper, chromium and manganese using flame atomic absorption spectrophotometer. Instrument parameters such as resonant wavelength, slit width and air–acetylene flow rate that are appropriate for each element was selected. The instrument was calibrated against a range of working standards of each element. Test solution was aspirated and the concentration of the element