

AVAILABILITY OF MINERAL ELEMENTS IN AN EXOTIC WEED *ALTERNANTHERA TENELLA* COLLA VAR. *TENELLA* VELDK

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ABSTRACT

Objectives To study mineral status of an exotic weed *Alternanthera tenella* colla var. *tenella* veldk.

Methods Mineral analysis in the leaves was carried out by acid digestion method as described by Toth *et al.* (1948). Sodium and potassium were estimated by flame photometer, Model-Elico, ch-22A. Remaining inorganic elements viz. calcium, potassium, magnesium, iron, manganese, zinc, copper, and cobalt were estimated by using Atomic Absorption Spectrophotometer, Perkin-Elmer, 3030 A.

Result Potassium content of the leaves was high (4.11%) while nitrate content was very low (0.065%) with respect to major elements. In case of minor elements manganese is present at higher concentration (190.75 ppm) while molybdenum in very less quantity (0.10 ppm).

Conclusion This study reveals that leaves of *A. tenella* var. *tenella* may be used as supplementary diet to human as well as livestock.

Keywords: *Alternanthera tenella* var. *tenella*, Exotic weed, Invasive alien, Mineral elements.

INTRODUCTION

Human beings as well as all higher organisms require a number of complex organic compounds as added caloric requirements to meet the need for their muscular activities. Plants are valuable sources of minerals, vitamins and drugs. There is an ever-growing interest in investigating different species of plants to identify their potential therapeutic applications. This increasing interest is due to a tremendous historical legacy in folk medicine and their easy availability, cost-effectiveness and presumed safety [1].

Number of workers tried to determine the nutritive value and mineral composition of medicinal plants, which were also being used as dietary supplements [2]. The wild edible medicinal leafy vegetables occupy an important place among food crops as these provide adequate amount of crude fiber, fats, carbohydrates, proteins, water and mineral elements such as Ca, Na, Fe, P, Mg, Zn, etc., in addition to vitamins and certain hormone precursors [3]. There has been a resurgence in the consumption and demand of medicinal plants [4].

The family Amaranthaceae comprises 65 genera and approximately 1000 described species that originate from the tropical, subtropical and temperate zones of Africa, South America and Southeast Asia. The genus *Alternanthera* is a prominent member of this family and consists of 80 species. *Alternanthera philoxeroides* (Mart) Griseb (alligator weed) and *Alternanthera tenella* Colla (joy weed) are two species that deserve special attention due to their medicinal and economic importance. *A. tenella* Colla (Amaranthaceae), a herbaceous plant commonly known as "enxuga" or "perpetua do mata," is frequently found in northwest Brazil. *A. tenella* is used in folk medicine to treat fever, infections and genital inflammation some species of the *Alternanthera* genus have been reported to inhibit lymphocyte activation to have antiviral and hepatoprotective properties, anti-nociceptive effects, and analgesic activity. *A. tenella* was also found to have antibiotic activity in assays using Gram-positive or Gram-negative bacteria *in vitro* [5].

Invasive aliens are the plants that are moved out of their natural habitat and end up exploiting the local area in their new environment. *A. tenella* var. *tenella* is a noxious exotic weed widely spread. These are prostrate or ascending perennial herbs rooting at lower nodes and

reproduce vegetatively very quickly. Patil and Patil (2007) reported that inflorescence of *A. tenella* is used to cure earache [6].

Investigation of mineral content was carried out to judge the usefulness of this weed for human betterment.

METHODS

Plant material was harvested at the end of vegetative phase in 1st week of April from fields nearby Satara (lies between 17°50'N and 18°11'N latitude and 73°31'E and 74°75' E longitude at 696 m AMSL) (M.S.). The leaves were shade dried and milled into a powder. For mineral analysis acid digestion method [7] has been followed. Sodium and potassium were estimated by flame photometer, Model-Elico, ch-22A. Remaining inorganic elements viz. calcium, potassium, magnesium, iron, manganese, zinc, copper, and cobalt were estimated by using Atomic Absorption Spectrophotometer, Perkin-Elmer, 3030 A.

RESULT AND DISCUSSION

Among all the mineral nutrients nitrogen is very essential for the synthesis of many organic compounds. Total nitrogen content in leaves of *A. tenella* var. *tenella* is 2.85%. According to Gallacher and Sprent (1961) total nitrogen content in plant reflects total plant growth [8]. The optimum concentration of phosphorus is 0.2%. Phosphorus content in leaves of *A. tenella* var. *tenella* is 0.12%.

According to Epstein [9] plants require 1% potassium for their optimal growth. It also plays a significant role in plant growth and developmental processes such as photosynthesis, translocation of proteins and carbohydrates, stability of ribosome, protein synthesis, nitrogen turnover, carbohydrate metabolism, glycolysis, phosphorylation and adenine biosynthesis in plants [10,11]. In leaves of *A. tenella* var. *tenella* potassium level appears to be higher (4.11%) than that of critical level. Higher level of potassium in plants is also recorded by Karadge (1981) in *Portulaca oleracea* (1.89%) [12].

Calcium is also a non-toxic mineral nutrient, even in high concentration and is very effective in detoxifying high concentrations of other mineral elements in plants. According to Clark [13], the activities of many

enzymes have been either stimulated or inhibited by calcium. Clarkson and Hanson [14] reported that major role of calcium in plants is to bind with proteins, nucleic acids and lipids to affect cell adhesion, membrane chromatin organization and enzyme conformation. Concentration of calcium in *A. tenella* var. *tenella* is 4.25%.

Magnesium is a mobile and strongly electropositive divalent cation in the plants, found both inbound as well as free form. According Epstein, 2% magnesium on dry weight (dry wt.) basis has been regarded as critical value for plants. Most well-known role of magnesium is its contribution to the center of the chlorophyll molecule. It also acts in enzymatic reactions involved in organic acid synthesis. Though, magnesium participates in a number of physiological and enzymatic reactions, its requirement for the plant growth is relatively low. Magnesium also activates the enzymes such as RuBP carboxylase, ATPase, fructose 1, 6 diphosphatase and glutamate synthetase. Concentration of magnesium is 1.6% in *A. tenella* var. *tenella*.

Sulfur is present in plant tissue in minor quantities only; its content varies strongly between species and ranges from 0.03 to 0.2% dry wt. [15]. In the present study, sulfur content in leaves of *A. tenella* var. *tenella* is 0.15% (dry wt.). Generally micronutrient sodium stimulates growth when potassium supply is limited. It stimulates growth through enhanced cell expansion. It is also required in maintaining membrane integrity. According to Gauch (1972) [16] range of sodium in glycophytes is 0.1-1.4% dry wt. In leaves of *A. tenella* var. *tenella* concentration of sodium is 0.35%.

Zinc is an essential element for various metabolic processes such as carbohydrate metabolism, nitrogen metabolism, protein synthesis, auxin synthesis; particularly indole acetic acid (IAA) synthesis and it act as catalyst for many enzymes. It is required for chlorophyll biosynthesis. It participates in synthesis of IAA from its precursor, tryptophan [17,18]. In leaves of *A. tenella* var. *tenella* concentration of zinc is 114.74 ppm.

According to Machold and Stephan (1969) [19], iron has role in the synthesis of common precursors of chlorophyll. Leaves of *A. tenella* var. *tenella* contain 153.32 ppm iron respectively. Higher level of iron content in *A. tenella* var. *tenella* indicates that plant has usefulness in preparation of iron-rich tablets for anemia patient. High level of elemental iron was also recorded in *Averrhoa bilimbi* L. [20].

Copper plays a vital role in reproductive growth as well as another trace element whose requirement in redox reactions of photosynthesis is well known [21]. The leaves of *A. tenella* var. *tenella* have shown beneficial effect on concentration of copper. According to Epstein the optimum level of copper is 6 ppm (dry wt). Leaves of *A. tenella* var. *tenella* contain 13.21 ppm copper.

Manganese is another element associated with photosynthesis, respiration, oxidation of carbohydrates and IAA and activation of enzymes of nitrogen metabolism. According to Marschner [10], it is directly involved as a component of the biotin enzyme in the biosynthesis of fatty acids. Manganese activates the enzymes such as IAA-oxidase, decarboxylases, and dehydrogenases of tricarboxylic acid cycle. Jimenez *et al.* (1998) [22] reported the role of manganese in shikimic acid pathway and it enhances the resistance of plants to various diseases. Leaves of *A. tenella* var. *tenella* have 190.75 ppm (dry wt.) of manganese, respectively.

Arnon and Stout [23] demonstrated for the first time, requirement of molybdenum for plant growth using hydroponically grown tomato. Molybdenum is a trace element, which can exist in several oxidative states. Plants contain boron both in a water-soluble and insoluble form, which is essential for the growth of higher plants. The primary function of the element is to provide structural integrity to the cell wall in plants. However, it is required in minute quantities. The optimum boron content of the leaves for most crops is 20-100 ppm. Boron content in

Table 1: Mineral composition of leaves of *A. tenella* var. *tenella*

| S. No. | Parameters | Concentration (%) |
|--------|------------|-------------------|
| 1. | Nitrogen | 2.85 |
| 2. | Nitrate | 0.065 |
| 3. | Phosphorus | 0.12 |
| 4. | Potassium | 4.11 |
| 5. | Calcium | 4.25 |
| 6. | Magnesium | 1.6 |
| 7. | Sulphur | 0.15 |
| 8. | Sodium | 0.35 |
| 9. | Zinc | 114.74 ppm |
| 10. | Ferrous | 153.32 ppm |
| 11. | Copper | 132.10 ppm |
| 12. | Manganese | 190.75 ppm |
| 13. | Molybdenum | 0.10 ppm |
| 14. | Boron | 24.72 ppm |

A. tenella: Alternanthera tenella

the leaves of *A. tenella* var. *tenella* is 24.72 ppm of dry wt. It is evident from result that there is no any kind of deficiency or toxicity of boron in *A. tenella* var. *tenella*.

In case of major elements potassium content is highest (4.11%) while nitrate content is lowest (0.065%). With respect to minor elements, manganese content is maximum (190.75 ppm) while molybdenum is in the lowest quantity (0.10 ppm) (Table 1).

CONCLUSION

Overall composition of minerals in leaves of *A. tenella* var. *tenella* may act as a supplementary diet to the human being as well as fodder to livestock. Like many wild members of family Amaranthaceae viz. *Amaranthus biltum* L., *Amaranthus spinosus* L., and *Celotia argentea* L. *A. tenella* var. *tenella* may be used as a vegetable. Mineral composition supports this view.

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