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EFFECT OF VERMICOMPOST ON NUTRITIONAL STATUS OF SOME LEAFY VEGETABLES

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ABSTRACT

Green leafy vegetables are the rich sources of micro nutrients and vitamins and available at low cost throughout the year. The natural compositions of such vegetables have huge significance as nutrient supplement and in cure of various diseases. Pot experiments was carried out during year 2018 to study the effect of vermicompost on nutritional status of different leafy vegetables such as *Amaranthus dubius*, *Amaranthus polygonoides* and *Trigonella foenum – graecum* . The studies showed the concentration of Na, K, Mg and Zn in leafy vegetables grown in pots containing soil mixed with vermicompost was higher than the control group. Hence, it is recommended that application of vermicompost is essential to enhance the soil quality, plant growth and productivity.

(Key words: Green leafy vegetables, nutrient, soil, vermicompost)

INTRODUCTION

Micronutrient deficiencies are widespread with more than half the women and children suffering from anaemia and sub optimal reduction in Vitamin A deficiency and iodine deficiency disorders (IDD) (Government of India). This is in spite of the significant growth of the economy in the recent past, increase in food production and provision of food through PDS and other supplementary food programs. There is urgency to address these food and nutrition security issues through additional ways. One such avenue is to address this nutritional insecurity issues is increased production and exploitation of green leafy vegetables.

Leafy vegetables are easy-to-grow nutrient rich foods that can help to improve nutrition and food security among developing countries. Malnutrition or the so-called hidden hunger has affected almost 31% of all children under the age of five years and become a major public health problem in many developing nations (Muller and Krawinkel, 2005). There are two variants of malnutrition: micronutrient deficiencies and protein malnutrition.

The lack of knowledge especially on the nutritive value of these green leafy vegetables among the public in general is the main drawback in their lower consumption. (Oyenuga and Fetuga 1975). The World Health Organization (WHO) recommends daily intake of more than 400 g of vegetables person^{-1}. Narayanan (2017) opined that green leafy vegetables found in South India, used as a source of food have many health benefits like protection from eye problems, iron deficiency and oxidative damage. Therefore, the promotion of their production can be highlighted as an alternative to alleviate malnutrition in many developing nations in a more sustainable way.

Intensive crop production including leafy vegetables to fulfil the demand of the fast growing population by using inorganic fertilizers has led to increased yield at the expense of environmental degradation. Continuous application of inorganic fertilizer to increase crop production including vegetables to meet the growing demand in developing countries, has led to high cost of chemical fertilizer, degradation of environment and poor quality of vegetables. However, environmental degradation due to intensive use of agrochemicals in crop production has created greater interest in the use of vermicompost to supply necessary mineral elements to produce organically grown fruits, vegetables and livestock of a high nutritional value, while recycling all wastes, thus minimizing contamination of soils and waterways (Follet *et al.,* 1981; Matson *et al.,* 1997).

Under normal circumstances, plants are able to access the nutrients required from the soil. However, continuous extensive cropping without adequate nutrients replenishment depletes the soil nutrient levels, particularly N, P, K and Ca (Conradie and Saayman,1989; Ndakidemi and Semoka, 2006) which are taken in relatively large amounts by the plants compared with micronutrients (Marschner, 1995). In the soil, plants obtain nutrients from different sources, including the soil reserves, crop residues, vermicompost, synthetic and organic fertilizers.

Commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops (Masarirambi *et al.,* 2010). The chemical fertilizers

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used in conventional agriculture contain just a few minerals which dissolve quickly in damp soil and give the plants large doses of minerals (Masarirambi *et al*., 2010). Organic material such as vermicompost and organic manure improves soil physical chemical properties that are important for plant growth

Utilization of cost effective vermicompost is best alternative to chemical fertilizer. The application of chemical fertilizer to the soil is considered as good agricultural practice because it improves the fertility of the soil and plant quality. Inorganic fertilizer has significantly supported global population growth, it has been estimated that almost half the people on the earth are currently fed as a result of artificial nitrogen fertilizer use (Erisman *et al.,* 2008).

However, the physical, chemical and biological properties of vermicompost disclose that it can serve as a good biofertiliser and best alternative to inorganic chemical fertilizer. Vermicompost are materials characterized by high porosity, aeration, drainage, water holding capacity and microbial activity (Edwards and Burrows, 1988; Edwards, 1998; Atiyeh *et al.,* 2000).

Vermicompost is made up primarily of C, H and O, and contains nutrients such as NO_3, PO_4, Ca, K, Mg, S and micronutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil (Singh *et al.,* 2008). Similarly, vermicompost contains a high proportion of humic substances (that is, humic acids, fulvic acids and humin) which provide numerous sites for chemical reaction; microbial components known to enhance plant growth and disease suppression through the activities of bacteria (*Bacillus*), yeasts (*Sporobolomyces* and *Cryptococcus*) and fungi (*Trichoderma*), as well as chemical antagonists such as phenols and amino acids (Nagavalemma *et al.,* 2004). Research shows that vermicompost improves the growth of many agricultural crops (Arancon *et al*., 2004, Gutierrez-Miceli *et al.,* 2007).

Several studies have centred on the effect of organic, inorganic fertilizer or used in combination on soil properties, nutrients uptake, growth, yield and some minerals contents. However, there is scarce research information on the effect of vermicompost on nutritional composition (minerals) in leafy vegetables.

In view of the advantages posed by vermicompost as growth supplements for plants, the present study was undertaken to study the effect of this organic fertilizer on the nutrient content of some leafy vegetables.

MATERIALS AND METHODS

Study plants

***Amaranthus dubius* Marx. ex Thell.**

It is an annual herb, wild and cultivated leafy vegetable inflorescence spike like or paniculate, glomerules more or less isolated at base of inflorescence and clustered towards apex; leaves broadly triangular blade down; female flowers 5 tepals; fruit an ovoid-urceolate capsule, dehiscing circularly, blackish seeds.

***Amaranthus polygonoides* (L.)**

‘ A small herb; branchlets erect or ascending. Leaves oblong- lanceolate, obtuse or acute, entire or toothed. Flowers in axillary spikes. fruit an utricle, enclosed in the perianth.

***Trigonella foenum - graecum* (Linn.)**

Fenugreek is an aromatic, 30-60 cm tall, annual herb, cultivated throughout the country. A nearly smooth erect annual. Stipulets not toothed. Leaflets 2-2.5 cm long, oblanceolate-oblong, toothed. Flowers 1-2, axillaries, sessile. Calyx-teeth linear. Corolla much exserted. Pod 5-7.5 cm long, with a long persistent beak, often falcate, 10-29 seeded, without transverse reticulations.

Sample preparation for analysis of trace elements

Pot experiment was conducted using leafy vegetables. Seeds of the above said leafy vegetables procured from local nursery at Courtallam, Tenkasi, in Tirunelveli district of Tamil nadu. Seeds of these leafy vegetables were allowed to germinate and grown in different pots containing garden soil mixed with vermicompost (10 kilogram soil + 100 gram vermicompost) and also in pots containing garden soil only. Leaves from well grown leafy vegetables collected, air dried, powdered and stored in container for further mineral analysis.

Determination of Na, K, Zn and Mg

To the powdered plant sample, 5ml of 65% HNO_3 was added and then the mixture was boiled gently for 30-45 minutes. After cooling, 2.5 ml of 70% $HclO_4$ was added and the mixture was gently boiled until dense white fumes appeared. Later the mixture was allowed to cool and 10 ml of deionised water was added followed by further boiling until the fumes were totally released (Hseu, 2004). The contents were allowed to cool and then filtered through what man NO_4 filter paper in a flask. The filtrate was diluted to 50ml with deionised H_2O and stored for further analysis.

Analytical procedure

Na, K, Mg and Zn in plant samples were analysed using atomic absorption spectrometer (AA-7000) equipped with flame furnace. The absorption wavelength for the determination of each mineral together with its linear working range and correlation coefficient of calibration graphs are given in table1.

RESULTS AND DISCUSSION

A total of four elements (Na, K, Mg and Zn) were analysed in two differently grown, three varieties of leafy vegetables and their results were tabulated (Table 2). The concentration of Na varied in range of 207.3384-844.82 ppm in organically grown leafy vegetables and 138.6025-828.7468 ppm in leafy vegetables grown in garden soil only. Higest sodium was found in organically grown *Amaranthus* *polygonoides* (844.82 ppm) where as lowest Na content was found in *Trignonella –foenum graceum* (138.6025 ppm) grown in garden soil.

Sodium is essential to all living organism and is one of major electrolytes found in the blood. Sodium and potassium take part in ionic balance of the human body and maintain tissue excitability, carry normal muscle contraction, help in formation of gastric juice in stomach (Anonymous, 1996).

Highest K content (462.96 ppm) was found in organically grown *Amaranthus dubius* and lowest (235.75 ppm) was found in *Trigonella foenum graceum* grown in garden soil. Potassium is accumulated within the human cells by the action of the Na^+, K^+-ATPase and it as an activator of some enzymes; particular co-enzyme for normal growth and muscle function (Birch and Padgham, 1994).

Many studies showed that organic fertilizer can notably influence N metabolism and nutrient status in plants (Pramanik *et al*., 2007; Yuan *et al*., 2016). It is well documented that vermicompost can maintain and improve soil fertility, soil structure as well as nutrient status of leaves and hence high plant productivity (Riley *et al*., 2008).

Amaranth greens perhaps have the highest concentrations of vitamin-K of all the edible green-leafy vegetables. 100 g of fresh greens provides 1140 µg or 950% of daily vitamin-K requirements. Vitamin-K plays a vital role in strengthening the bone mass by promoting osteoblastic activity in the bone cells. Additionally, it also has an established role in patients with *Alzheimer's disease* by limiting neuronal damage in the brain. Amaranth greens also contains ample amounts of B-complex vitamins such as folates, vitamin-B6 (pyridoxine), riboflavin, thiamin (vitamin B-1), and niacin. Folates rich diet help prevent neural tube defects in the newborns.

Moreover, its leaves carry more potassium than that of in the spinach. Potassium is an important component of the cell and body fluid that helps regulate heart rate and blood pressure. Additionally, it has higher levels of other minerals than spinach such as calcium, manganese, magnesium, copper and zinc. The human body uses manganese and copper as a co-factor for the antioxidant enzyme, superoxide dismutase. Copper is also required for the production of red blood cells.

Magnesium content in leafy vegetables grown in garden soil and garden soil mixed with vermicompost varied from 109.9157-146.5144 ppm; 706.2593-2877.6626 ppm respectively. Highest Mg content was noted in organically grown *Amaranthus polygonoides.*

The availability of Zn is highest (207.0546 ppm) in *Trignonella –foenum graceum* grown in soil mixed with vermicompost and lowest in *Amaranthus dubius* which was grown in garden soil (62.7933 ppm). Zinc is essential to all organisms and has an important role in metabolism, growth, development and is essential co-factor for a large number of enzymes in the body. Zinc is a co-factor for many enzymes that regulate growth and development, digestion and nucleic acid synthesis.

Zinc deficiency leads to coronary heart diseases and various metabolic disorders. Zinc fortification to the diet would decrease the prevalence of growth stunting in many developing countries, because linear growth is affected by zinc supply in the body (Anonymous, 2005).

The above results showed that plants grown in vermicompost mixed soil contain highest amount of minerals such as Na, K, Mg and zinc compared to control group. Under normal circumstances, plants are able to access the nutrients required from the soil. However, continuous extensive cropping without adequate nutrients replenishment depletes the soil nutrient levels, particularly N, P, K and Ca (Conradie and Saayman, 1989; Ndakidemi and Semoka, 2006) which are taken in relatively large amounts by the plants compared with micronutrients (Follet *et al*., 1981; Marschner, 1995).

Therefore, in a commercial horticultural environment such as those involving the production of vegetables, a continuous supply of both macronutrients (that is, N, P, K, Ca, Mg, S), and micronutrients (Fe, Cu, Zn, Mn, Mo, B) via organic fertilizer is crucial to a successful harvest.

From the results of this present study, it sums up that, leafy vegetable such as *Amaranthus polygonoides, Amaranthus dubius* and *Trigonella foenum – graecum* grown in soil mixed with vermicompost contain highest concentration of Na, K, Mg and Zn when compared to those leafy vegetables grown in garden soil only. Therefore, in a commercial horticultural environment such as those involving the production of vegetables, a continuous supply of both macronutrients and micronutrients is essential to a successful harvest. Hence, soil quality, plant growth and quality are enhanced through an application of vermicompost. To conclude, we need to recommend consumers to consume organically grown leafy vegetables to obtain maximum amount of micro nutrients.

Table 1. Operating parameter of AAS for studied elements

Elements	Wavelength	Lamp intensity(mA)	Silt width(nm)	Correlation coefficient (r)
Na	589.0	12	0.2	0.9991
K	766.5	10	0.7	1.0000
Mg	285.2	8	0.7	0.9999
Zn	213.9	8	0.7	0.9996

Table 2. Concentration of minerals in leaves of leafy vegetables grown in garden soil andVermicompost mixed soil (ppm)

	Garden soil				Vermicompost soil			
Name of leafy Vegetables	**Na**	**K**	**Mg**	**Zn**	**Na**	**K**	**Mg**	**Zn**
Amaranthus polygonoides	828.7468	380.4099	109.9157	67.1576	844.8292	457.1002	2877.6626	69.0453
Amaranthus dubius	161.0491	243.4895	146.5144	62.7933	207.3384	462.9611	1558.4349	162.2377
Trigonella foenum - graecum	138.6025	235.7582	109.9157	64.1311	275.0243	237.1299	706.2593	207.0546

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