EFFECT OF NANO ZINC OXIDE ON THE LEAF PHYSICAL AND NUTRITIONAL QUALITY OF SPINACH

Department of Biotechnology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur - 584 104, Karnataka (INDIA)
e-mail: kisanb1@gmail.com

INTRODUCTION
Spinach (Spinaciaoleracea) belongs to family Amaranthaceae and is one of the important and nutritious leafy vegetable consumed in India. It has been postulated that Nano particles have the effect on germination growth at vegetative stage. Hence, the study was designed to test the ability of zinc Nano particles on the leaf physical and nutritional status of spinach. The spinach plants were sprayed with graded concentration of zinc oxide Nano particles (ZnO NPs) (0, 100, 500, 1000 ppm) after 14 days of sowing. The leaf physical parameters like leaf length, leaf width and leaf surface area, are recorded at the time of maturity (45-50 days), protein, carbohydrate, fat and dietary fiber content in leaf samples are determined. The plants sprayed with ZnO NPs at the concentration of 500 and 1000 ppm in comparison with control the increase over control was % leaf length (6.25 and 5.48), %protein (91.86 and 151.30), %fat (960 and 1470) and %fiber (69.15 and 242.82). Hence our study suggests that 1000ppm of Nano Zinc application will enhance the nutritive value of spinach to vegetarian diet by providing protein, fiber and required amount of vegetarian fat.

MATERIALS AND METHODS
Zinc oxide Nanoparticles of mean size of 50 nm diameter (Sigma Aldrich) were Characterized with zeta potential was used in the study. The stock solution of 10,000 ppm Solution prepared and dilutions of 0, 100, 500, 1000 ppm were used for the study. The stock Solutions were prepared by directly suspending the Nano-particles in deionized water and

ABSTRACT
Spinach (Spinaciaoleracea) belongs to family Amaranthaceae and is one of the important and nutritious leafy vegetable consumed in India. It has been postulated that Nano particles have the effect on germination growth at vegetative stage. Hence, the study was designed to test the ability of zinc Nano particles on the leaf physical and nutritional status of spinach. The spinach plants were sprayed with graded concentration of zinc oxide Nano particles (ZnO NPs) (0, 100, 500, 1000 ppm) after 14 days of sowing. The leaf physical parameters like leaf length, leaf width and leaf surface area, are recorded at the time of maturity (45-50 days), protein, carbohydrate, fat and dietary fiber content in leaf samples are determined. The plants sprayed with ZnO NPs at the concentration of 500 and 1000 ppm in comparison with control the increase over control was % leaf length (6.25 and 5.48), %protein (91.86 and 151.30), %fat (960 and 1470) and %fiber (69.15 and 242.82). Hence our study suggests that 1000ppm of Nano Zinc application will enhance the nutritive value of spinach to vegetarian diet by providing protein, fiber and required amount of vegetarian fat.
dispersed by ultrasonic vibration (100 W, 40 KHz) for 1 hour (T.V. Prasad et al., 2012). Magnetic bars were placed in the suspensions for stirring before use to avoid aggregation of the particles. Spinach seeds of variety ‘All green variety’ were used by sowing in pots (20 cm x 40 cm) filled with equal quantity of soil and watered to field capacity. Proper care was taken to use similar soil in all the pots to minimize soil heterogeneity effects. At 14 days after sowing Plants were sprayed with the different concentration of ZnONano particles. The leaf samples were harvested at 45th day of sowing and were further processed for proximate analysis. The physical properties of fresh spinach leaves viz., Length and width were measured Using venirecalipers and surface area of fresh spinach leaves was determined by using digital Planimeter (Make: Placory; model: KP90N roller-type digital Planimeter). The leaf parameters of fresh spinach leaves i.e., color and water activity were Determined using Hunter lab colorimeter (Colour Flex EZ, Hunter Associates LAB INC, C04-1005-631, Taiwan) and RotronicHygrolab water activity analyzer (Model: aw-HP23) (Mohsenin et al., 1986).

The proximate composition of fresh spinach leaves viz., crude protein, crude fat, total ash, crude fiber and carbohydrates were estimated by the recommended methods of the Association of Official Analytical chemists,(2005) in triplicate. Experiments were carried out in triplicate.

RESULTS AND DISCUSSION

Effect of different concentration of ZnO Nanoparticles on leaf physical properties such as leaf length, leaf width and leaf surface area were given in Fig. 1. The leaf length (14.15) was maximum in ZnO-NPs treated leaf samples at the concentration of 500 ppm and minimum in control leaf samples. With respect to leaf width, there is no significant variations were observed between treated and control leaf samples of spinach. However, there is slight improvement in leaf width was observed in ZnO-NPs treated leaf samples. The maximum leaf surface area was observed in ZnO-NPs treated leaf samples at concentration of 1000 ppm (67.45) followed by at 500 ppm (57.17) and lowest value observed in control leaf samples.Similarly, (Prasad et al., 2012) reported that, groundnut seeds treated with Nanoscale zinc oxide particles with a concentration of 1000 ppm have shown significant increment in germination, shoot length, root length and vigor index over the control samples. (Raskar and Lawareet al., 2014) studied effect of ZnO NPs on seed germination and seedling growth in onion and observed that seed germination increased in lower concentrations of ZnO NPs but showed decrease in values at higher concentrations.

The color values viz., L’, a’ and b’ of the fresh spinach leaf was found to be in the range of 37.01-47.11, from -9.79 to -8.97 and 19.68-24.92, respectively and concluded that green in color and water activity of fresh spinach leaves to be in the range of 0.928-0.959. These values were in confirmation with those reported by (Nangula et al., 2010); who reported the moisture content of fresh Spinaceaoleracea found to be92g/100g. (Laware and Raskaret al., 2014) reported that ZnO-NPs can reduce flowering period by 12-14 days and produce healthy seeds of onion vegetable.

The Protein content of the raw spinach leaves ranged between 1.54%and 3.99% (Table 1). The plants treated with ZnO-NPs-500 and 1000 ppm was found to have high protein content (91.86 and 151.30), high fat (960 and 1470) and high fiber (69.15 and 242.82) than the control. The protein content to be obtained in the spinach leaf was close to the values previously reported (Rumeza Hanif et al., 2006) in control
and increase on usage of spinach is evident by proximate analysis.

Zinc is an essential micronutrient for normal growth, development, and health of plants and human beings. Zinc enhances cation-exchange capacity of the roots, which in turn enhances absorption of essential nutrients, especially nitrogen which is responsible for higher protein content. This mechanism may be operating on uptake of Nano Zinc particles to enhance the protein content of the zinc sprayed spinach group. Zinc plays vital role in carbohydrate and proteins metabolism as well as it controls plant growth hormone i.e. IAA. Zn is also an essential component of dehydrogenize, proteinase, and peptides enzymes as well as promotes starch formation, seed maturation and production (Fageria et al., 2002; Laware and Raskar et al., 2014). The application of slow/controlled release fertilizer coated and felted by Nanomaterials were reported to improve grain yield along with an increase in protein content and a decrease in soluble sugar content in wheat (Prasad et al., 2012).

These results indicated that the Nano-zinc oxide enhanced the leaf physical and nutritional properties of spinach leaves. Nano-zinc oxide (1000 ppm) has a potential to be used as a bio fortification agent to improve protein and dietary fiber contents of spinach leaves and could be a natural way of reducing the Zinc related malnutrition.

REFERENCES


