EFFECT OF BULK AND NANO-ZINC OXIDE ON MORPHOLOGICAL CHANGES IN CICER ARIETRIUM (CHICKPEAS).

Shewta Pathania[1],Lakhvinder Kaur[2], DrPriya Mishra[3]

[1] MSc. Student, Department of Nutrition and Dietetics, ManavRachna International University, Faridabad.Email:shwetapathania94@gmail.com

[2]Assistant Professor, Department of Nutrition and Dietetics, ManavRachna International University, Faridabad. Email: lakhvinder.fas@mriu.edu.in

[3]Assistant Professor, Department of Nutrition and Dietetics, ManavRachna International University, Faridabad. Email:priya.fas@mriu.edu.in

ABSTRACT

Nanotechnology is emerging as the technological platform for the next wave of development and transformation of agri-food systems. The continual use of engineered metal oxide nanoparticles in agriculture, including in various consumer applications, will undoubtedly contaminate the environment, potentially impacting the agriculture and food/feed quality, and may pose unknown risk to human health and safety.This study summarized the effects of nanoparticles zinc oxide (ZnO) at different concentrations.25gm/liter,0.5gm/liter,1gm/liter,2gm/liter chlorophyll and protein content and development of chickpeas in vitro and under aseptic condition. The data revealed that with increase in the concentration of bulk ZnO and Nano ZnO the chlorophyll content and protein content increases. The total chlorophyll percentage and protein percentage was statistically significant at ($p<0.05$) between bulk ZnO and Nano ZnO.

Introduction

Nanotechnology is based on the prefix "Nano", a Greek word meaning "dwarf". [1] Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers. To be more specific, nanotechnology is defined as the design, production and application of structures, devices, and systems through control of the size and shape of the material at the nanometer (10-9 of a meter) scale where unique phenomenon enable novel applications [2][3]

Zinc oxide (nano-ZnO) is a commonly used metal oxide ENPs. Zinc oxide is used in a range of applications such as sunscreens and other personal care products, electrodes and biosensors [4], photo catalysis and solar cells. Owing to increasing use in consumer products, it is likely that through both deliberate application and accidental release, ENPs will find their way into aquatic, terrestrial and atmospheric environments [5-7]. There is considerable concern about the potentially harmful effects of those ENPs due to their unique properties, they may have significant effects on many organisms [8,9], especially plants which are essential base component of all ecosystem.

Most of these studies are focused on the potential toxicity of ENPs to plants and both positive and negative or inconsequential effects have been reported [10]. Among the positive effect reports on plants, nano-TiO2 was observed to promote the growth of Spinach. [11,12].Some research found that Carbon nanotubes (CNTs) could enhance root growth of onion (Allium cepa) and cucumber (Cucumis sativa) [13]However, majority of the reports available in the literature indicate phytotoxicity of ENPs. Nano-aluminum oxide (Al2O3) could inhibit root elongation of corn, cucumber, soybean, cabbage and carrot [13]while nanoZnO was reported to be one of the most toxic nanoparticles that could terminate root growth of test plants (radish, rape, ryegrass, lettuce, corn and cucumber)[14].

METERIAL AND METHODS

Procurement of material

Nano-ZnO were purchased from Nanoshel, Intelligent Materials Pvt. Ltd. Panchkula, Haryana, India .Bulk Zinc oxide were purchased from Faridabad, Haryana, India.

PROPERTIES OF THE NANO-ZNO (ZN01)

Weight – min 93 %, Alumina – Yes, Amorphous silica – Yes, Specific gravity – 4.0, Bulking value L/Kg (gal/lb) – 0.25 (0.03), Organic treatment – Yes, Color CIE L* - 99.6, Median particle size – 40-60 mm.

PREPARATION OF TEST SOLUTION

The bulk and NPs were suspended directly in distilled water. For the present study four concentrations viz. 250, 500, 1000 and 2000 mg/L of both bulk and NPs were used and for all experiments freshly prepared solutions were used.

MEASUREMENT OF CHLOROPHYLL AND PROTEINCONTENT

Take 50 seeds of chickpea Sterilized with 10% sodium hypochlorite for 10min. The seeds were sowed in the cups containing sand.Fresh test solutions were added in the cups and kept in the natural environmental for 10 days to grow and subsequently on the 10th day the chlorophyll and protein content measured.

STATISTICAL ANALYSIS

Each treatment was conducted with three replicates, and the results are presented as mean±SE (standard error of the mean). Comparisons between the control and treated groups were evaluated by one way ANOVA using SPSS software package and $P<0.05$ was considered as the level of significance and the level of one factor was compared to each level of the other factor by all pairwise multiple comparison procedures (Turkey's test).

RESULTS AND DISCUSSION

Table 1-Mean score of Chlorophyll percentage of differentconcentration of Nano ZnO and bulk ZnO.

Control sample in water=4.28±0.41(mean±SD)

s.no	Dilution	Nanoparticles ZnO (%)	Bulk ZnO (%)	F value	p-value
1)	0.25gm / liter	5.73±0.225^{c}	4.1±0.41^{b}	17.44	0.003*
2)	0.5gm/ liter	12.36±0.90^{a}	4.7±0.82^{a}	112.26	0.001*
3)	1gm/ liter	18.41±0.62^{ac}	15.77±0.53^{ab}	597.09	0.045*
4)	2gm/ liter	21.66±0.62^{ac}	17.32±0.51^{ab}	1251.760	0.002*

Anova(p<0.05) mean value with same superscripts are significantly different as tested by ANOVA POST HOC test.

Table 1 revealed the mean score of chlorophyll percentage in chickpeas seeds.

Chlorophyll content - In this study, the chlorophyll percentage significantly increased with increased the concentration of bulk ZnO and Nano ZnO. The chlorophyll percentage was highest at 2gm/litre (21.66±0.62) in Nano ZnO and (17.32±0.51) in bulk ZnO but in case of control sample showed the low chlorophyll percentage (4.28±0.41). It was found that the degree of chlorophyll synthesis is gradually increased in Nano ZnO and bulk ZnO as compare to control sample. In lowest concentration 0.25/litre of Nano ZnO showed (5.73±0.225) and bulk showed (4.1±0.41) lowest chlorophyll percentage.The results were statistically significant (p>0.05).

Table 2 -Mean Protein percentage Scores of control and differentconcentration of Nano ZnO and bulk ZnO.

s.no	Dilution	Nanoparticles ZnO (%)	Bulk ZnO (%)	F value	p-value
1)	0.25gm/liter	25±0.78^{ac}	27.38±0.45^{ab}	306.59	0.001*
2)	0.5gm/ liter	27.73±0.61^{ac}	32.86±0.60^{ab}	182.92	0.041*
3)	1gm/ liter	31.50±0.50^{ac}	35.46±0.53^{b}	84.11	0.045*
4)	2gm/ liter	34.55±2.39^{c}	36.38±0.35^{b}	29.21	0.001*

Control sample in water=33.7±0.50 (mean±SD)

Anova(p<0.05) mean value with same superscripts are significantly different as tested by ANOVA POST HOC test.

Table 2 revealed the mean score of chlorophyll percentage in chickpeas seeds.

Protein content - In this study, the protein percentage significantly increased with increased the concentration of bulk ZnO and Nano ZnO. The protein percentage was highest at 2gm/litre (34.55±2.39) in Nano ZnO and (36.±0.35) in bulk ZnO but in case of control sample showed relatively low protein percentage (33.7±0.50). And in lowest concentration 0.25/litre of Nano ZnO showed (25±0.78) and bulk showed (27.38±0.45) lowest chlorophyll percentage.The results were statistically significant (p>0.05).

SUMMARY AND CONCLUSION

A research study was conducted to assess the effect of Nano ZnO and bulk ZnO on physio- morphological changes in cicerarietrium. The present study used different concentration of bulk ZnO and Nano ZnO to analysis the chlorophyll and protein content.

The chlorophyll percentage data indicated that for Nano ZnO the highest mean value was 25.66±0.62 and for bulk ZnO was 17.32±0.51 at2gm/litre of concentration but in case of control sample low chlorophyll percentage (4.28±0.41) was observed. The chlorophyll percentage increased with the increase in concentration of Nano ZnO. The data was statistically significantly at p <0.5 between NanoZnO and bulk ZnO.

The result indicated that with increasing the concentration of bulk ZnO and Nano ZnOthe protein percentage in seeds were increased. . The protein percentage was highest at 2gm/litre (34.55±2.39) in Nano ZnO and (36.±0.35) in bulk ZnO but the control sample showed relatively low protein percentage (33.7±0.50). The data was statistically significantly at p <0.5 between NanoZnO and bulk ZnO. Zinc is an essential for the growth of plant, when ZnO add in the soil, soil secrete the enzyme which react with bacterial microbes to turn the nutrients into a form the plant can use and increase the protein and chlorophyll content.

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to my research supervisor Lakhvinder Kaur and co-guide Dr. Priya Mishra who was abundantly helpful and offer invaluable guidance and support. I cannot express how much helpful was she to me in developing an idea and making it a reality.

References

1. Roco, M. 2005. “International Perspective on Government Nanotechnology Funding in 2005”Journal of Nanoparticle Research 7: 707-712.
2. Helmut Keiser. 2004. Study: Nanotechnology in Food and Food Processing Industry Wide 2003-2006-2010-2015. Tubingen, Germany: Helmut Keiser Consulting.
3. Pehanich, M. 2006. Small gains in processing, packaging. Food Processing, 46-48.
4. S.A. Kumar, S.-M. Chen. Nanostructured zinc oxide particles in chemically modified electrodes for biosensor applications. Analytical Letters 2008, 41(2): 141 - 158.
5. V.L. Colvin. The potential environmental impact of engineered nanomaterials. Nat Biotech 2003, 21(10): 11661170.
6. B. Nowack, T.D. Bucheli. Occurrence, behavior and effects of nanoparticles in the environment. Environmental Pollution 2007, 150(1): 5-22.

7. R.F. Service. Report Faults U.S. Strategy for Nanotoxicology Research. Science 2008, 322(5909): 1779.
8. A. D. Maynard, R. J. Aitken, T. Butz, V. Colvin, K. Donaldson, G. Oberdorster, M. A. Philbert, J. Ryan, A. Seaton, V. Stone, S. S. Tinkle, L. Tran, N. J. Walker, D. B. Warheit, Safe handling of nanotechnology. Nature 2006, 444: 267–269.
9. M.R. Wiesner, G.V. Lowry, P. Alvarez, D. Dionysiou, P. Biswas. Assessing the risks of manufactured nanomaterials. Environmental Science & Technology 2006, 40(14): 4336-4345.
10. A. Menard, D. Drobne, A. Jemec. Ecotoxicity of nanosized TiO2. Review of in vivo data. Environmental Pollution 2011, 159(3): 677-684.
11. F. Hong, J. Zhou, C. Liu, F. Yang, C. Wu, L. Zheng, P. Yang. Effect of nano-TiO2 on photochemical reaction of chloroplasts of spinach. Biological Trace Element Research 2005, 105(1): 269-279.
12. F. Yang, F. Hong, W. You, C. Liu, F. Gao, C. Wu, P. Yang. Influence of nano-anatase TiO2 on the nitrogen metabolism of growing spinach. Biological Trace Element Research 2006, 110(2):179-190.
13. L. Yang, D.J. Watts. Particle surface characteristics may play an important role in phytotoxicity of alumina nanoparticles. Toxicology Letters 2005, 158(2): 122-132.
14. D. Lin, B. Xing. Phytotoxicity of nanoparticles: Inhibition of seed germination and root growth. Environ Pollut 2007, 150: 243 - 250.