Incredible Edible Selenium Nanoparticles Produced by Food-Grade Microorganisms

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***Background*:** Microorganisms commonly employed in food industry, such as *Lactobacillus plantarum* and *Saccharomyces cerevisiae*, are also excellent natural nanotechnologists. They reduce selenite (SeO_3^{2-}) to form nanoparticles of red selenium (Se^0) of exceptional quality and with interesting physical and (bio-)chemical properties.

***Objectives*:** The production of these nanoparticles has been studied in several relevant microorganisms to gain a better picture of the overall properties and quality of these particles, possible differences between producers, ease of production and, in particular, biological activity.

***Methods*:** Several common microorganisms, namely *L. plantarum*, *S. cerevisiae* and *E. coli* have been cultured under standard conditions and 1 mM concentrations of SeO_2 have been converted into red particles of elemental selenium. These particles are characterized extensively with respect to uniformity, size, shape, consistency and, in particular, biological activity against infectious microbes.

***Results*:** Highly uniform amorphous spherical particles of 100 nm to 200 nm in diameter could be produced by several microorganisms, including *Lactobacillus*. Although originating in bacteria and yeast, these particles exhibit antimicrobial activity when employed at concentrations of around 100 µM. This activity may in part be due to the inherent chemistry of selenium and /or of the protein coating of the particles. Interestingly, yeast also forms larger rod-like structures. These micro-needles with around 85 nm in diameter and up to 3 µm in length exhibit considerable antibacterial activity, possibly resulting from additional, physical interactions with cellular structures.

***Conclusion*:** Common microorganisms traditionally employed in the preparation of food produce nanoparticles of selenium which may be harvested and explored as natural antimicrobial agents or antioxidants. These particles provide a fine example of natural nanotechnology with biological activity and applications in the food and food supplementation, medicine, agriculture and cosmetics.

Keywords: Antimicrobial activity, bioreduction, *Escherichia coli*, *Lactobacillus plantarum*, natural nanoparticles, physical toxicity, *Saccharomyces cerevisiae*, selenium, yeast.