

Genetic Engineering and Nanotechnology: When Science-Fiction Meets Reality!

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Rec date: Aug 01, 2015, Acc date: Aug 26, 2015, Pub date: Aug 30, 2015

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Keywords: Nanotechnology; Grey and green technology; Genetics; Translational medicine; Personalized medicine; Integrative medicine

Letter to the Editor

Genetic engineering represents the direct manipulation of an organism's genome using biotechnology. The manipulation usually consists in modifying the genetic background of cells by transferring/inserting or deleting one or more genes, genetic fragments or even altering a single nucleotide, in order to produce improved or novel organisms. For instance, we recently showed the possibility to engineer stem cells to enhance the anti-tumor immune response and lifespan of animals [1].

Nanotechnology is the science of engineering on a molecular scale, in effect building matter atom-by-atom from the "bottom-up". Nanotechnology involves the construction of matter a billionth of a meter in size (i.e. roughly the size of several atoms), and represents a fast growing business [2]. The nano-product can be observed and characterized using microscopic and spectroscopic machines [3].

Nowadays, genetic nanotechnology (i.e. the combination of genetics with nanotechnology) is employed in agriculture to overcome production-related issues. Thereby, a recent method called "nanoinjection", based on using a MEMS chip with a moveable, nanometer-sized lance that is capable of holding DNA based on electrical charge, was reported to be more effective (i.e. higher survival rates albeit similar DNA integration rates) than microinjection to deliver DNA and fertilize mouse eggs [4]. Nanotechnology also offers disturbing parallels to GMOs (i.e. Genetically Modified Organisms). Indeed, nanotechnology would contribute on novel environment-friendly crop improvement strategies to overcome food insecurity and malnutrition worldwide [5]. After all, DNA is a complex biochemical polymer with properties that make it an ideal platform for engineering new nanotechnologies (e.g. advanced synthesis, sequencing, communication and digital data storage tools) [6,7]. Furthermore, likewise for proteomics [8], advances in nanotechnology have begun to allow researchers to identify low-abundance nucleic acids in samples

through techniques that rely upon both nanoparticles and nanoscale devices.

One day, nanotechnology combined with genetic engineering and computerized artificial intelligence may allow people to choose their feelings, increase their intelligence, or lengthen their life spans. Nanotechnology obviously carries a host of ethical concerns and, unfortunately, the science is likely to advance much more quickly than ethical debates about "humanity" and the part of "science-fiction".

Eventually, genetic engineering and nanotechnology fit like hand to glove, and should significantly contribute to faster translational medicine and personalized medicine.

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