BIOSCIENCES BIOTECHNOLOGY RESEARCH ASIA, December 2019. Vol. **16**(4), p. 693-695

Advantages and Drawbacks of the Nanotechnology and Biotechnology toward Shaping a Global Sustainable Development

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http://dx.doi.org/10.13005/bbra/2784

(Received: 06 Decebmer 2019; accepted: 07 December 2019)

Nanotechnology and biotechnology have changed our daily life since several years ago, each one contributing since their respective cutting-edge knowledge area. However, just a few years ago, nanotechnology, nanoscience, and biotechnology started working together to develop new knowledge areas such as agronanobiotechnology[1], phytonanotechnology[2],nanoremediation[3], among others. Besides new technological advances were also developed, such as strategies for grafting DNA on carbon nanotubes (CNT)[4], the pollen magnetofection for genetic modification with magnetic nanoparticles as gene carriers[5], the plant molecular farming to produce metallic nanoparticles and therapeutic proteins using green factories[6], or the use of OMICs technologies[7] such as genomics, proteomics, metabolomics, transcriptomics, and glycomics, which are the major branches of omics[8].

Currently, thousands of tons of novel nanosized materials with outstanding properties never seen before are being synthesized worldwide, while additional research is carrying up to launch even more innovative nanomaterials. However, these engineering nanomaterials (ENMs) will be in the environment (soil, water, or air), when their lifespan ends or even before. Therefore, ENMs have been found in soil, water, air, plant tissue, organisms, wastewater or sludge. Besides, every day, ENMs are spread intentionally or unintentionally in the environment with the objectives of remediating polluted areas, increasing the yields, quality, and innocuity of edible plants, improving or taking care the human health, offering affordable renewable energy, or changing the personal appearing through using cosmetics. The above could imply that ENMs become ubiquitous pollutants in a short time as fast as or even faster than a legal framework is published on the base of a long-term in situ field trials.

The society has received information continuously from scientists or technologists

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regarding the never seen before dazzling advantages of nanoscience, nanotechnology, and biotechnology. However, there was scare information available about the ecological, medical, or toxicological drawbacks of this cutting-edge knowledge. It has to be stated that, fortunately, the availability of this kind of information has changed during the last five years. Therefore, currently, a wide variety of experimental results can be found in the scientific databases or web pages that discuss bluntly both situations that the humanity is facing up worldwide regarding the advantages and disadvantages of the sophisticated and nanosized technological developments.

It has to be clearly stated that the synthesis and production of multipurpose nanomaterials, smart materials,or bionanomaterialsworldwide have been done to shape sustainable development but not to hamper the pursuit of the seventeen sustainable development goals (SDGs). However, holistic and transdisciplinary research must be carried out to avoid historical mistakes such as the global marketing of dangerous chemicals or materials such as dichlorodiphenyltrichloroethane (DDT), asbestos, among others. Accordingly, it is not possible to define if the technological advances yielded by nanoscience, nanotechnology, and biotechnology could jeopardize the environment and human health. Therefore, humanity has to realize that collateral damage could be a real option that highlights that more research is required before nanoproducts or genetically modified organisms (GMO) are scattered in worldwide ecosystems.

Nanoscience, nanotechnology, and biotechnology have great potential to solve several problems that ordinary people are facing up daily in a broad range of knowledge areas. Environmental sciences are useful to evaluate and remediate polluted sites, and it has been demonstrated that it is improved co-working with nano- and biotechnology. Agriculture has also gotten benefits from nanosciences and biotechnology, enhancing the production and protection of crops for affordable and innocuous food. Other areas such as medicine, manufacture of daily use products, electronic, among others, also have been benefited by the joint findings between nanoscience, nanotechnology, and biotechnology.

Besides, nanotechnologies, nanosciences, and biotechnologies might be the way to a sustainable future. Still, more in-depth research is required to assure that their positive impacts are not outweighed by their potential to be harmful to the environment and humans. Therefore, the standardization of techniques, the use of international standards (reference reagents), and the development of risk assessment methods along with long-term in situ field trials are required. Also, domestic and international regulations must be discussed and published shortly to assure the inexistence of human or environmental risk by nanobiotechnologies.

Nanoscience, nanotechnology, and biotechnology are three cutting edge knowledge areas that are being merged, working together to offer eco-friendly technologies that improve human well-being, dissipate pollutants, and ensure environmental and human health.However, exploring the research-policy interface in pursuit of sustainable development along with the responsible use of nanotechnology and biotechnology in all sectorshas to be a global priority. Moreover, substantial and operational knowledge gaps that may hamper the search of the new and green technologies must be filled with the participation of scientists, technologists, and stakeholders to finish with the pollution and the ravenous hunger, and to strengthen the global wellbeing.

It is well-known that the scientific areas here discussedhave progressed by leaps and bounds looking for global benefits. However, in the agricultural sector, long-term experiments at field conditions regarding agricultural nanobiotechnologies are scarce so that hundreds of bio- or nanotechnological supplies are being spread worldwide. The above could jeopardize the soil quality and decrease its potential to respond to agricultural management by maintaining agricultural production and sustains plants, animals, and humans. There is a growing concern about the presence of engineering nanoparticles and GMOs in the ecosystems,considering the healthy soil importance so that several studies have stated that human-made nanoparticles and GMOshave an impact on the physical, chemical, mechanical, or biological soil properties.

There is a huge technological challenge regarding the quantification and identification of engineering nanoparticles in natural environments such as soils, air, or water. Also, similar challenges

have to be faced with the identification of these materials in cells or tissues from plants, microorganisms, or animals. Fortunately, scientists and technologists from several cutting-edge knowledge areas are working together to increase the yield of crops and improve the quality, affordability, and innocuity of food to underpin the sustainability of agroecosystems worldwidethroughout the use of the safest and best available technologies.

Metabolomics or other scientific areas such as OMICs could be very important to characterize not only the synthesis of plant growth regulators but also the metabolic pathways involved in the synthesis of a specific compound. Therefore, the characterization of plant growth regulators by crops amended with nanomaterials could promote the molecular farming of high-value compounds synthesized by plants. It has to be remembered that environmental concerns regarding non-well studied technologies recently taken center stage in policy and scientific discussions around the globe due to their frequently observed impact on human and ecological health.Unfortunately, environmental concerns have always met with difficulties to become a priority worldwide because these have remained as a secondary priority for governmental or social organizations.

CONCLUSION

Nanoscience, nanotechnology, and biotechnology, together with other knowledge areas, have been merged in scientific laboratories worldwide to provide materials, organisms, or raw materials with unusual properties or characteristics never seen before. The above let to afford better technological solutions to solve problems or dissipate human concerns. However, it has to be stated that these solutions could be partials or temporalis because they come accompanied by advantages and drawbacks. Therefore scientists, technologist, politicians, and society has to work together to shape sustainable development, increase social welfare, and preserve human and environmental health. Besides, it has to be remembered that good intentions can result in far more significant problems, especially if a holistic and transdisciplinary study is not carried out.

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