Nanotechnology in cosmeceuticals: Benefits vs risks

Nanotechnology is one of the new technologies used in personal care industry. The cosmetic industry is driven by innovation and companies are coming up with new technologies to help people look young. Use of nanotechnology in cosmeceutical preparations is aimed to make fragrances last longer, sunscreens more effective and anti-ageing creams fight back the years. Further, the technology is being used to optimize manufacturing conditions for skin care formulations, a multicomponent system. The technology is so immense in skin care that some companies have decided to incorporate it into the hair-care product-line as well. Facts suggest that nanotechnology was being unknowingly incorporated into cosmetic formulations for at least the past 2000 years. Nanotechnology and all of its applications are projected[1] to be a trillion dollar global business by 2014.

Companies are shifting their focus from cosmeceuticals to nanocosmeceuticals, with the incorporation of nanotechnology in manufacturing processes.

The technology utilizes extremely tiny (or nano) particles to penetrate the skin, far more than traditional anti-ageing treatments. Some of the nanotechnology-based innovations are nano-emulsions which are transparent and have unique tactile and texture properties, nano-capsules which are used in skin-care products, nano-pigments which are transparent and increase efficiency of sunscreen products, and liposome formulations which contain small vesicles (range: 50–5000 nm) consisting of traditional cosmetic materials that protect light or oxygen-sensitive cosmetic ingredients. Some companies are also using nanotechnology in hair-care products; research is ongoing to find ways to use nano particles to prevent hair from turning grey and also for prevention of hair loss.

Questions have arisen about the safety of products manufactured with the help of nanotechnology. Because of the ability of these particles to be captivated into skin cells, long-term effects of the chemicals being introduced into the body are not known. Likewise, questions have been raised over how nano-based cosmetic formulations might perform once they are applied onto the skin, for example, in an anti-ageing formulation. Due to their size, could such particles pierce the inner layer of the skin? Could this then lead to the particles entering the bloodstream? If so, what might be the justification[2]?

The market growth is tremendous, but the area of safety cannot be overlooked. While the technology is still in its early years, research and development work that go into its safety should be worked out right now.

The United States Food and Drug Administration (USFDA) has expressed concerns about the use of nanotechnology in cosmetic treatments. The regulatory agencies are calling for some serious research into the long-term effects of nanotechnology-based cosmetics, which has been moderately unfettered since its conception. According to the USFDA, imperative research is needed to assess safety concerns about nanoparticles used in cosmetics. So the need of the hour is to have a debate/deliberation involving scientists, regulatory agencies and companies across the globe for regulatory and safety considerations of nanotechnology-based cosmetics and adopt a scientific approach of passing on the benefits of the technology to consumers.

1. Burdock, G. and Teske, S., *Functional Foods and Nutraceuticals*, February 2007, pp. 18–20.
2. Forrest, L., Ezine Articles 26 February 2007, accessed on 12 June 2007, http://ezinearticles.com/?Nano-Cosmetics:-Are-They-the-Next-Great-Thing?&id=468247.

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Taxonomy of marine micro-algae, an addendum

The correspondence titled ‘Taxonomy, the legacy of Linnaeus transformed to phylogenomics’ (Sushil Kumar, *Curr. Sci.*, 2007, **92**, 1475) is indeed a timely one. In simple terms, it describes the developments in taxonomy, highlights the advent of new molecular techniques and brings works of the degenerating population of ‘taxonomists’ to some light of honour. We pay our tributes to Carl Linnaeus for his vision and huge task accomplished in taxonomy. Aristotle too deserves admiration here for his attempt around 300 BC, in classifying organisms, which laid the groundwork for more perceptive classification systems that followed, such that of Linnaeus.

Taxonomic progress and transformation of Linnaeus’ legacy into phylogenomics is rather slow in the marine environment. Let me cite micro-algae (free-floating microscopic plants of 20–200 μm size) in particular as an example, since they are discussed over decades globally for notoriety in forming toxic or harmful algal blooms (HAB). Perhaps nowhere is the value of taxonomy more readily realized than when some members of these notorious groups, viz. dinoflagellates, raphidophytes and haptophytes create havoc by suddenly populating and discolouring ocean waters and silently killing tonnes of fish and upsetting coastal ecology. Needless to say that just one HAB event can cost millions of dollars to coastal economy, besides adversely affecting human health. Despite drawing such attention of the global oceanographic community, scrutiny of data on HAB (ioc.unesco.org/hab) reveals that only 99 new toxic species have been discovered over a period of say 170 years (between 1827 and 2004); only a small population of taxonomists have more often been associated with new discoveries or revision of old species, and 32 species among these 99 were revisited and revised either because of wrong description or for a narrow morphological distinction between the species. It is time to thank Balech, Cleve, Hasle, Faust, Fukuyo, Lundholm, Moestrup and others for their sustained taxonomic interest, invaluable contributions to HAB research and, of course, for many wishful legacies of the Linnaeus' kind.

Taxonomy no doubt is concerned with recognition and characterization of organisms and it does involve studies on life cycles, ecology and evolutionary history, and not mere morphological description as many think. Apart from such long-term studies, obvious handicaps for the slow progress in micro-algal taxonomy are expensive cruises for sampling and involvement of very few marine biologists in the taxonomic endeavour. Now the natural slowdown is due to the advent of new molecular approaches. Though molecular approaches are gaining acceptance, some are not yet inclined to replace taxonomy based on visible and ecological characteristics by the one based on molecular/genetic details, where characters may not even be expressed in the phenotype. No doubt that once genomics becomes more popular, and its application cheaper and easier, radical revision in the known taxonomies is bound to take place. Then what happens to the already degenerating population of taxonomists? Would that mean the end of the Linnaean legacy?

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Age of plant galls

With reference to the article 'Insect-induced plant galls of India: unresolved questions' by Raman[1] and a related 'In this issue' note published under 'Plant galls' (p. 706) in the same volume, I would like to draw attention of the readers to some small but important mistakes in the abstract of the article[1] and the related comments on p. 706.

The statement 'Fossil records indicate that galls existed in India from the late Cenozoic period' (p. 748) is incorrect and contrary to the fact mentioned on p. 749, namely 'galls on the fossil leaves of mango … from the Upper Palaeocene-aged flora of Tura Formation'. The age of the formation is about 55 million years. The Cenozoic period starts from 65 million years BP; obviously the above statement indicates a wrong age. Accordingly, it should read as 'Fossil records indicate that galls existed in India from the early Cenozoic period[1].

I would like to add here that galls on fossil leaves have also been reported from the late Eocene (about 35 million years) sediments of Manipur[2]. The available Indian records indicate that galls have continued to occur on angiosperm leaves from early Cenozoic till today, and they need more attention in view of the significance of plant–animal interaction studies.

In the note on p. 706 it is stated that 'intimacy between certain plants and certain insects commenced from leaf-mining habit in the Eocene, and stabilized in the upper Cretaceous, coinciding with the diversification and establishment of angiosperms'. The statement regarding age is erroneous; it should have been as follows, 'intimacy between certain plants and certain insects commenced from leaf-mining habit in the upper Cretaceous, coinciding with the diversification and establishment of angiosperms and stabilized in the Eocene'.

Further, the occurrence of leaf galls has been reported[3] on the *Glossopteris* leaf remains of Permian age (about 270–275 million years) from Kashmir. Evidently this has great bearing on the antiquity of gall-forming insects.

1. Raman, A., *Curr. Sci.*, 2007, **92**, 748–757.
2. Guleria, J. S. *et al.*, *Palaeobotanist*, 2005, **54**, 61–77.
3. Pant, D. D. and Srivastava, P. C., Proceedings of the International Conference on Global Environment and Diversification of Plants through Geological Time, Society of Plant Taxonomists, Allahabad, *Birbal Sahni Centenary Volume*, Allahabad, 1995, pp. 317–326.

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Response:

I acknowledge that an inaccuracy had crept into my text inadvertently with regard to the terms referring to the geological timescale. I regret the same.

I am not only aware of the two articles on the occurrence of leaf galls that Guleria has referred to in his comments, but also another[1] published from India in 2004. However, I refrained from referring these in my article, because they include only vague comments on 'plant galls', with no explicit pointer to the possible identity of the inducing arthropod and the nature of the galls they were suspected to be.

1. Banerji, J., *Gondwana Res.*, 2004, **7**, 205–210.

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