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Editorial

Application of Nanotechnology in Phytochemical Research

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Nanotechnology, known as 'nanotech' in short, is the branch of technology that deals with dimensions and tolerances of 1-100 nanometres, especially the manipulation of matter on an atomic, molecular and supramolecular scale. While the concepts behind nanotechnology were first introduced by Richard Feynman, a world-known physicist, in 1959, the actual term 'nanotechnology' was used by Norio Taniguchi in 1974 for the very first time. Since its arrival, nanotechnology has influenced research methodologies and outcomes almost in all areas of science, particularly, surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, drug formulation and delivery, and molecular engineering. Most recently, nanotechnology has been applied in the delivery of various bioactive phytochemicals including nutraceuticals, like curcumin, resveratrol, and many more.

The very basis of these applications in phytochemical research is based on the fact that nanoparticles can increase solubility and stability of phytochemicals, enhance their absorption, enhance permeation and retention in target tissues, increase bioavailability, protect them from premature degradation in the body, exhibit high differential uptake efficiency in the target cells over normal cells and prolong their circulation time.[1] Commonly used biocompatible and biodegradable nanoparticles in phytochemical research include nanoliposomes, nanoemulsions, lipid nanocarries, phytosomes, micelles and poly(lactic-co-glycolic acid) (PLGA) nanoparticles. Nanoliposome is actually a nanometricsize liposome (Figure 1).

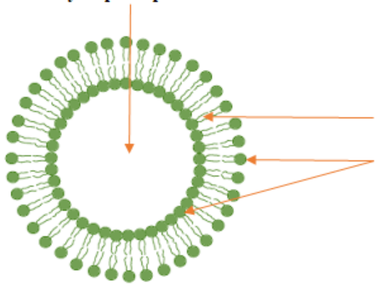

Figure 1. Liposome.

Many bioactive phytochemicals and herbal medicines suffer from the limitations like poor (or none) solubility in aqueous media, poor bioavailability, poor stability and toxicity, as often observed with many conventional drugs.[2-4] Nanotechnology has now been proven useful in overcoming these drawbacks and in delivering bioactive phytochemicals to a certain target with greater efficiency, utilizing the techniques like, nanoformulation and encapsulation. For this purpose, nanoparticles can be designed, prepared in different shapes, sizes, compositions, and functionalized and modified physicochemically to achieve specific properties depending on the characteristics of both the bioactive molecule and the targeted organ. In addition to organic nanoparticles as listed above, inorganic nanoparticles, e.g., gold, silver, zinc, copper oxide, aluminium oxide, iron oxide, ceramics and carbon nanoparticles are also used in phytochemical studies. Inorganic nanoparticles are of three main types: transition metal nanoparticles, ceramics nanoparticles and carbon nanoparticles. While there are numerous publications available to date on the use of nanoparticles for the delivery of various bioactive phytochemicals, Conte et al.[5] have recently reviewed published literature on the application of nanotechnology in the delivery of anti-inflammatory phytochemicals including chemical classes like polyphenols (e.g., curcumin, ellagic acid, quercetin and resveratrol), terpenoids (e.g., lycopene and squalene), phytocannabinoids (e.g., Δ-9-tetrahydrocannabinol), phytosterols (e.g., phytosterol), carbohydrates (e.g., mannose-6-phosphate) and essential oils (e.g., carvacrol, cymene, linalool and thymol).

Nanotechnology has already changed, among many other fields, the field of drug delivery, influencing the enhanced and efficient delivery of various poorly bioavailable conventional drugs and bioactive phytochemicals. Nanotechnology will certainly continue to influence phytochemical research, particularly in relation to delivery of novel bioactive phytochemicals, and will facilitate the process of phytochemical drug discovery in the years to come.

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References

1. Wang S, Rui S, Nie S, Sun M, Zhang J, Wu D, et al. Application of nanotechnology in improving bioavailability and bioactivity of diet-derived phytochemicals. J Nutr Biochem. 2014;25(4):363-76. doi:10.1016/j.jnutbio.2013.10.002
2. Ansari SH, Sameem M, Islam F. Influence of nanotechnology on herbal drugs: a review. J Adv Pharm Technol Res. 2012;3(3):142-6. doi:10.4103/2231-4040.101006
3. Odeh F, Al-Jaber H, Khater D. Nanoflora - how nanotechnology enhanced the use of active phytochemicals. In: Sezer AD editor. Application of Nanotechnology in Drug Delivery. Intech Open Access Book Publisher; 2014. doi:10.5772/57028
4. Subramanian AP, Jaganathan SK, Manikandan A, Pandiaraj KN, Gomathi N, Suprianto E. Recent trends in nano-based drug delivery systems for efficient delivery of phytochemicals in chemotherapy. RSC Adv. 2016;6(54): 48294-314. doi:10.1039/c6ra07802h
5. Conte R, Marturano V, Peluso G, Calarco A, Cerruti P. Recent advances in nanoparticle-medicated delivery of anti-inflammatory phytocompounds. Int J Mol Sci. 2017;18(4): 709. doi:10.3390/ijms18040709