INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

Short Communication

CHITIN NANOFIBRILS AND ITS APPLICATION IN HEALING THE SKIN

[1]Saumya Choudhary, [2]*Anamika Pandey, [2]Mohd Kamran Khan, [3]Sheeba Khan, [2]Erdogan E. Hakki, [4]Mahinur S. Akkaya, [1]George Thomas

[1]Department of Molecular and Cellular Engineering, Sam Higginbotom Institute of Agriculture, Technology and Sciences, Allahabad, India

[2]Department of Soil Science and Plant Nutrition, Selcuk University, Konya, Turkey

[3]Department of Food Science and Technology, Sam Higginbotom Institute of Agriculture, Technology and Sciences, Allahabad, India

[4]Department of Chemistry, Middle East Technical University, Cankaya, Ankara, Turkey

ABSTRACT

In this era with crucial scientific development, nanotechnology has evolved as key technology with enormous potential for innovation and growth. Nanotechnology basically deals with the structures, size and shapes on nano scale. A nanometer is 10^{-9} meter and typical atoms are about one third of a nanometer. Cell biology exploration can be done both at molecular and cellular stage with the production of nanoscale biomolecular compounds and analytical equipments employing nanotechnology along with biotechnology. This context is used to discuss the possible role of nanoscience in cosmetic dermatology. Usage of nanoscience in cosmetic dermatology is a promising approach towards the progress of eco-friendly drug usage and additionally active components. The bottom-up and top-down are the two principle approaches used to obtain nanoparticles. For application in cosmetic and pharmaceutical industry, nanostructured lipid carriers, nanovesicles and solid lipid nanoparticles have been evolved. Another assemblage of nanoparticles with broad purpose is UV filters of Titanium oxide and Zinc oxide. Microcapsules are yet another group of nanoparticles with its application in this sector. With synthesized nano particles there is usual existence of natural nano particles like chitin nanofibrils. Chitin nanofibrils, derived from exoskeleton of crustaceans, are used as an active component in cosmetic dermatology. Their task is well established in stimulating keratinocyte propagation along with the cytokine secretion and macrophage activity. With these many scopes, it is dependent on us that how we revolutionize our industries and way of life with the help of nanoparticles.

KEY WORDS: nanoparticles, nanotechnology, cosmetic dermatology, chitin nanofibrils.

INTRODUCTION

Benefits of drugs and cosmetics can be revolutionized with the prospective combination of nanomaterials and nanobiotechnology. Nanoparticles particularly are emerged to enfold a broad array of constituent valuable to the skin. Two principle methods used to obtain nanoparticles are, a) The Bottom-Up Method: In this approach nanoparticles are gathered using the molecular aspect of the particle in use. b) The Top-Down Method: In this approach various chemical and physical methods are employed to condense the larger particle. In order to obtain different useful structures like nanosomes, cubosomes, niosomes, and liposomes the top-down approach is preferred for cosmetics. The nanoscale structures obtained by Top-Down approach ranges from 50 to 5000 nm in diameter, preferred in production of micro and nano-emulsions competent enough to carry and protect oxidation of active compounds and leads to their better perforation all the way through dermal layers (Morganti, 2010). Size of the molecule is the detrimental factor in deciding the ability of substance to perforate the dermal layer. Likewise, drug delivery system has very important role in ascertaining that the accurate concentration of correct chemical reaches appropriate body site for suitable time duration. Efficacy of an active compound is dogged by its Bioavailability i.e. it becomes essential that it should reach the site of action and its release can be extended for sufficient time duration. To meet this end, recent intense research has developed varied controlled delivery system based upon the approaches of nanotechnology which are both simple as well complex in nature. Application of several recent approaches has lead to manifold advancement, be it development of nanovesicles as a tool for skin delivery system, and solid lipid nanoparticles (SLN) or nanostructured lipid carriers (NLC), for use in cosmetics and pharmaceuticals. These nanovesicles are multi-functional acting as a carter to distribute the entrapped molecule in or across the dermal layer; as modifier of the intercellular middle lamella by enhancing the penetration capacity; as a repository area for persistent discharge of active compounds and as an obstruction during trans-dermal delivery system. However; SLN and NLC enjoys enormous advantage in its stability over vehicle based delivery system. In addition, these lipid carriers increases skin hydration by preventing evaporation as they form a nano layer lipid coating on top of the skin. Inorganic physical UV filters titanium dioxide (TiO_2) and zinc oxide (ZnO), are an additional group of nanoparticles with wide implication in cosmetic dermatology. The distinguishing feature of these UV filters lies in the fact that they are insoluble both in water as well in oil and are regarded as sun protection screen in USA, Japan and Germany (Morganti *et al*., 2011; 201_2).Transparent mixture is obtained by using both TiO_2

and ZnO in size of 60 and 200 nm in order to increase the cosmetic conformity. Higher refractive index property of these minerals increases not only their transparency, but also their filtering capacity, once the miniaturization is done (Souto and Muller, 2008). Once these minerals are applied on skin it becomes invisible in its microionized form hence regarded as a wide-ranging UV-Blockers (Islam *et al*., 2004). In addition, coating of neutral materials like silica, polysiloxane compounds, glass, or aluminium oxide (Starzyk *et al*., 2008), is present which enhances their rate of distribution, efficiency and photo stability thereby, removing any chance of direct contact with skin and increasing its safety percentage (Tharanathan and Kittur, 2003). TiO_2 is present in almost all the sunscreen product because of its potential as an extremely efficient UVA as well an UVB filter. Macro-capsules are one more important class of insoluble nanoparticles used in cosmetics. They are tiny molecules with an active agent and shell or coating layer as surrounding areas. Their diameter ranges from 1-1000m; with lower and higher scale than extremes regarded as nano-capsules and macro-capsules respectively (Wiechers, 2008; Healy *et al*., 2003). Nanotechnology is a very wide area and suspected activity against human health is assumed due to its various specific properties whether it is natural or man-made. Natural nanoparticles do exist in our environment, say, in waste matters which are not the materials discovered by the scientists (Vidanarachchi *et al*., 2011). Chitin nano-fibril is one such type of naturally evolved nano particle presently being used as an active component.

CHITIN-NANOFIBRILS

Chitin, a dangerous innate raw substance, beneath the sea direct to swift eutrophication wielding a high biochemical oxygen demand (BOD) whereas on terrain it is quickly colonized by pathogens and spoilage organisms leading to diverse environmental and public health concerns (Hides and Trotter, 2008; Madonna *et al*., 2008; Dreyler, 2003). Consequently, utilization of this waste material to produce useful goods and acquiring valuable resources from its economical recycling has to be considered compulsory for our society, to progress the standard of life while admiring the environment. It is exciting to emphasize the multipurpose biological activity of chitin and its derivative. Being polymer of glucosamine and acetyl-glucosamine, these are efficient and harmless to be exploited in therapeutics, clothing, food and beverage industries. Chitin is a natural ingredient of normal human body and has certain extraordinary features like exciting bioactivity, elevated stress bearing and environment friendly. These are neither noxious nor effected by antigens and hence utilized in several products. Along with these exceptional qualities, easy availability of chitin as waste raw product and its conversion to high value product direct towards the progressive research to develop novel and eco-friendly products. In present time, chitin crystalline nanoparticles (known as, chitin nanofibrils or CN) can also be used that naturally occurs in chitinaceous waste raw material (Morganti and Chen, 2011; Nohynek, 2007). These chitin nanofibrils are superior to powdered chitin accessible in contemporary market due to larger surface area. Physical, chemical and biological properties of this innate nano-sized polymer facilitate its capacity to bound metal ions, preserve water and binding with active constituents at molecular intensity (Morganti *et al*., 2008). CN and its derivatives are stimulated by intercellular signals of surface receptor proteins, acquire the role of chemical messenger and hence extract both humoral and systemic response of human body. It becomes interesting to understand the recognition of these novel nanostructured polymers by human cells and their consequence on the constant transfer of signals amid different cells that may unite them with different body systems (Pflucker *et al*., 2005; Morganti *et al*., 2008).

Dimensions and characteristics

Chitin-nanofibrils (CN) are the nano crystals obtained after the removal of protein portion. They are the pure and sugary molecular portion of alpha-chitin. These can be easily degraded in our body involving endogenous enzymes and employed in cosmetics and biomedical sectors. Due to the possession of average size of 240x7x5 nanometers (nm) and needle like structure, these are categorized as nano and fibrils respectively. These are natural, safe and easily recognizable by enzymes, hence, bio and eco-compatible.

Biodegradability

Chitin-nanofibrils are broken down to oligomers with the help of nitric oxide (NO) and hydrolytic enzymes like lipase, N-acetyl-D-glucosaminidase and lysozyme. Oligomers are subsequently reduced to N-glucosamine and glucose that are further either assimilated to glycoproteins or removed as carbondioxide. Ability of chitin-oligomers to serve as the basis for hyaluronic acid formation is also a promising research perspective.

Application of Chitin Nanofibrils in Cosmetic Delivery System

Chitin nanofibrils within it structure has the capacity to amalgamate drugs, cosmetically active products thereby, assuring its presence at the most appropriate junction of the body in function of the chitin nano-fibril complex used. These used Chitin Nano-fibril complex are explicitly created in laboratory conditions with its two most highlighting property i.e. its biodegradability and bio-availability. As the size of the complex is condensed, the rapid is the degradation and higher is its bioavailability. Depending upon the type and form of carrier like gel, fiber or porous matrix these Chitin nanofibrils can be used to address the multiple statements like skin and mucous membrane hydration, bone regeneration, or for anti-ageing or anti-acne cosmetic therapy (Morganti, 2009; 2010; Nasu and Otsubo, 2006). In addition, the CN antioxidant/ immune modulant complexes have shown great efficacy as anti-ageing agent (Nasu and Otsubo, 200619), whereas the same complex when used with different carriers improve skin conditions as mild to severe xerosis.

CONCLUSION

In conclusion, nature has been the creator of the most the most multifarious, versatile and exceedingly efficient nanoscale systems. We have to find a way ahead so that this knowledge can be organized for the benefit of mankind without adversely impacting the environment. It becomes important to customize the nano-products with fully addressing the concerns of its users. Nanotechnology

along with Biotechnology can do wonders if is used wisely for our industries and can define our life.

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