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A REVIEW ON IMPACT OF NANOTECHNOLOGY BASED NANOMATERIALS IN COSMETIC DELIVERY

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ABSTRACT

Presently, Nanotechnology is unique and fastest developing scientific fields. The results of this science have progressed toward turning into piece of our regular day to day existences. Nanotechnology based nanomaterials (NMs) have been broadly use in cosmetics for late couple of years such as in skincare products, sunscreens, hair products, etc. This widespread impact of nanotechnology in the cosmetic industries is due to the improved properties achieved by the particles at the nano level including colour, transparency, solubility etc. The various types of NMs employed in cosmetics products include solid lipid nanoparticles, liposomes, niosomes, fullerenes, etc. Nonetheless, nano-toxicological research expressed concern regarding the influence of producing and utilization of NMs on human well-being and environment with silver nanoparticles used in hits to decrease foot odour and are being free within the wash water causes destruction of natural biological ecosystem. Along these lines, NMs requires a health risk assessment, which must be performed on a case-by-case basis, using pertinent information. This comprehensive review summarizes the recent advances regarding the utilization of NMs, emphasis is made on the types of NMs used in cosmetics by the various cosmetic brands, the potential risks caused by them each to human life and conjointly the atmosphere and what all regulations have been undertaken or can be taken to overcome them. This review will discuss the class, characteristics, potential health hazards, safety issues and role in way forward for NMs used in cosmetic delivery.

Keywords: Nanomaterials; Cosmetics; Solid Lipid Nanoparticles; Nano-Toxicological Research; Pertinent Information; Environment.

INTRODUCTION

Nanotechnology is associate novel science that comprises the strategy, characterization, production and essential application, arrangements, devices and systems by regulating shape and size at the nano meter (nm) scale, that protect the size range from 1 nm to 100 nm, where 1 nm is 1 billionth of a meter. It's not a surprising bit of information to corrective organizations that nanotechnology is that the technique for future and is considered as the hottest and rising technique offered. Cosmetics makers use nano scale versions of ingredients to provide higher UV protection, deeper skin penetration, long-lived effects, increased color and finish quality etc. The worldwide market place for cosmetics using nanotechnology is projected to achieve associate calculated amount $155.8 million in 2012 [1].

This widespread utilization of nanomaterials (NMs) in beautifying agents is because of the undeniable reality that these NMs get newer approaches which be different from the large-scale particles. These changed properties grasp shading, straight forwardness, dissolvability and synthetic reactivity, making the NMs appealing to the cosmetics and personal care industries [2].

In case of particle size approaches in the range between 1-100 nm; there is also a crucial amendment within the crystal structure due to an exponentially growing quantity of atoms being localized at the surface and it is advised to enrich the current size range with a limiting volume specific surface area value of not less than 60 m^2/cm^3 [3, 4]. Also, there is another suggestion that ‘‘one-size-fits-all’’ definition of NMs sought to be abandoned altogether [3, 5]. Nevertheless, particle size or

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specific surface area is that the values derived by various methods are extremely dependent on the strategy of alternative, and none of the method can be used as a best standard [3, 6-8]. Though there has not been any best technique indicated for NMs identification in cosmetics, NMs characterization will be accomplished by employing a type of different techniques drawn from knowledge base areas [8].

Cosmetics area unit outlined are defined by the FDA as “articles intended to be applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance” [9]. FDA does not have the legal authority to approve cosmetics before they are going on the market. However, cosmetics essentially be safe for users and it should be correctly labelled. Companies and united nation agencies who covered cosmetics market have a legal account ability in terms of safety and appropriate labelling of their products [10]. The word “Cosmeceuticals” is employed to framework of a product that present between a drug and cosmetics [11]. It is used in the professional skin care arena to explain a product that has measurable biological action within the skin, like a drug, however is regulated as a cosmetic since it claims to have an effect on appearance [12]. Cosmeceuticals aren't sorted by the FDA, yet this term is utilized by skin researchers, doctors, and skin care professionals, to urge the clients to keep acquiring corrective items especially anti-aging and sun block items, advertised by a few makers with logical cases and characteristic situating as the best approach to underscore that utilizing these items isn't just fundamental however conjointly normal. Cosmeceuticals area units the quickest growing phase of the personal care industry [13]. Cosmeceuticals formulations currently have expanded from skin to body to hair and variety of topical cosmeceuticals treatments for conditions like photo aging, physiological state, hyperpigmentation, wrinkles, and hair damage have acquire widespread use [14].

Recent researches concentrating on cosmeceuticals products highlighted sturdy growth perspectives within the upcoming years. According to them expanding at a speedy compound annual growth rate of 7.7%, the worldwide cosmeceuticals market will reach $31.84 billion by 2016 [15]. The global cosmeceuticals market offers vast potential among the Asian nations, like Japan, China, and India which are set to pull in significant players in the future. Japan has already created a remarkable position within the world cosmetics market and its position in the cosmeceuticals phase is effectively improving [15]. A report, “Cosmeceuticals market to 2018," guage that the worldwide cosmeceuticals market will reach $42.4 billion by 2018 [16].

NECESSITY OF NMs UTILIZED IN COSMETICS

The amplified usage of NMs in cosmetic products is indicative of the enormous potential nanotechnology represents for the cosmetics trade and its consumers as a result of their obvious advantages. A number of NMs types are already in use, including nanoemulsions, and nanoparticles of minerals present in our natural environment, such as titanium dioxide (TiO_2), zinc oxide (ZnO), alumina, silver, silica, metal halide and copper. The principle for the use of NMs in cosmetic products is, that they offer added worth in terms of product performance. The distinctive properties and behaviour of NMs mean that nanotechnologies could profoundly transform industry and daily life. In formulation of cosmetics, TiO_2 and ZnO nanopigments are the main composites used as extremely proficient UV-filters, capable to reflect and scatter the visible part of solar radiation while absorbing UV light. Given these properties, they are extensively utilized in sunscreens. Another instances of nanocosmetic items available incorporate body firming salve, bronzer, exfoliant clean, eye liner, and styling gel, to give some examples. The NMs discovered its next use as embodied bearer for topical conveyance of photolabile and skin sharpening mixes. Liposomes and Niosomes are utilized in the corrective exchange as conveyance vehicles to improve;

- Direct association of delicate specialists with skin.
- The delayed unleash of sensitizing agents.
- Decrease in the amount of mediators and additives.
- Increased lifespan and henceforward greater product satisfactoriness.

Nanocrystals, microemulsions, nanoemulsions, fullerenes and dendrimers are additionally being investigated in corrective businesses and magnificence care applications. Nanopigments are uniquely designed to stay on the outside of the skin and are a noteworthy part of certain sunscreens. Nanoemulsions are oil and water beads typically ensuring delicate dynamic fixings (like nutrients). Unsteady vitamins might be suspended in nanoemulsions. The specialists calls them nanocapsules, liposomes, lyphazones, and so on and nanoemulsions release the captured burden upon contact with the skin on application. Continuous classification of beauty care products incorporates fullerenes or fuller somes that are utilized as enclosures for dynamic fixings. A few fullerenes, explicitly carbon based, might be hazardous once breathed in and they could oxidize some cells [17-19].

CATEGORIES OF NMs EMPLOYED IN COSMETIC FORMULATIONS

Nanoemulsions

Nanoemulsions square measures distributions of nano droplets of 1 liquid state inside another [20]. These emulsions are meta stable systems whose structure may be deployed based on mode of preparation to offer different kinds of creation e.g. water-like fluids or gels [21]. Nano emulsions have variety of benefits over larger scale emulsions. They can be stabilized to extend the time before creaming happens, so increasing the shelf life of products containing them [22]. They are transparent or translucent, and have a larger specific surface area due to the small particle size. It has been discovered that the littler the size of the emulsion, the higher the strength and better reasonableness to convey active ingredients [23]. The parts of nanoemulsions are typically GRAS mixes, hence they are viewed as generally safe frameworks which can separate to their sheltered segments.

A few restorative items are accessible that utilization of nanoemulsions together with Korres' Red Vine Hair sunscreen. Several manufacturer supply ready to use emulsifiers for making stable nanoemulsions for cosmetic applications, including Nanocream® from Sinerga and NanoGel from Kemira [24].

Liposomes

Liposomes are vesicular arrangements with a watery core encompassed by a hydrophobic lipid macromolecule bilayer, made by the expulsion of phospholipids molecules (water soluble and oil like) shown in Fig. 1. Phospholipids are GRAS (generally recognized as safe) fixings, thus limiting the potential for antagonistic impacts. Solutes like drugs, inside the core can't have the hydrophobic bilayer conversely hydrophobic atoms will be assimilated into the bilayer, empowering the liposome to convey both hydrophilic and hydrophobic particles of lipid substances. The lipid bilayer of liposomes can combine with elective bilayers, for example, semipermeable membrane that advances arrival of its substance, making them helpful for drug delivery and for applications of cosmetic delivery. Liposomes can shift in size, from 15 nm up to a few μm and may have contain either uni-lamellar or multi-lamellar structure. Liposomes that include vesicles inside the scope of nm are otherwise called nanoliposomes. Another sort of liposomes called transferosomes, which is the part of versatile than liposomes and have improved productivity, have been established [25]. Transferosomes with sizes in the scope of 200-300 nm can enter into the skin layer with improved viability than liposomes [26, 27].

On the other hand, first liposomal cosmetic product to show up available was the anti-aging product emulsion 'Capture' launched by Dior in 1986. From that point forward a number of items which use liposomal delivery abilities have been brought into the market, anyway just some contain liposomes in the nanoscale. Liposomes are precarious because of their weakness to oxidation and the breakdown of liposomal structure. In any case, plans have been built up that are progressively steady by streamlining the capacity conditions and including chelators and hostile to oxidants [28]. It is likewise conceivable to include cryoprotectants (substances to shield organic tissue from solidifying harm) to liposomes to store them in solidified or lyophilized structure. One reason for the across the board utilization of liposomes in the cosmetic business is their simplicity of arrangement and the capacity to improve the retention of dynamic fixings by skin. The simplicity of scale up utilized liposomes in restorative applications a reality. Liposomes have been framed that encourage the ceaseless supply of specialists into the cells over a continued timeframe, making them a perfect contender for the conveyance of nutrients and different atoms to recover the epidermis [29].

Nanocapsules

Nanocapsules are sub-microscopic particles usually prepared by a polymeric container encompassing an aqueous or oily core. It has been discovered that the utilization of nanocapsules diminishes the entrance of UV filter octyl-methoxycinnamate in pig skin when contrasted and regular emulsions [30].

Nanocrystals

They are aggregates involving a few hundred to a huge number of particles that consolidate into a "bunch". An ordinary size of these totals are somewhere in the range of 10 and 400 nm and they show physical and compound properties somewhere close to that of mass solids and particles. They permit protected and successful passage through skin [31].

Dendrimers

Dendrimers are uni-atomic, mono-scatter, micellar nanostructures, around 20 nm in size, with a well-characterized, routinely extended symmetrical structure and a high thickness of useful end bunches at their fringe. They contain huge number of outer groups suitable for multi-functionalization [32, 33].

Cubosomes

Cubosomes are distinct, sub-micron, nanostructured particles of bi-constant cubic aqueous crystalline phase [34]. It is shaped by the self-get together of fluid crystalline particles of specific surfactants when blended with water and a microstructure at a specific proportion. Cubosomes offer a huge surface region, low thickness and can exist at practically any weakening level. They have high warmth security and are equipped for conveying hydrophilic and hydrophobic molecules [35]. Joined with the low estimation of the crude materials and the potential for controlled discharge through functionalization, they are an alluring decision for corrective applications moreover for drug delivery.

Hydrogels

Hydrogels are 3D deliquescent polymer systems aggravate that swell in water or organic liquids while not dissolving as an after effects of compound or physical cross-joins. They can foresee future changes and modify their property thusly to stop the damage [36].

Buckyballs

Buckminster fullerene, C60, is conceivably the foremost iconic NMs and is just about 1 nm in diameter. It has found its approach into some terribly pricey face creams. The motivation is to make the most its capability to behave as a potent scavenger of free radicals [37].

Nanostructured Lipid Carriers

With the intention of exhausted issues associated with SLNs, a second era of lipid particles are produced by blending strong lipids with liquid lipids. These are otherwise called nanostructured lipid carriers (NLCs). Along with SLNs, NLCs have a mutilated structure that makes the network structure flawed and makes regions to oblige dynamic mixes. The high stacking ability and long haul security offered by the NLCs fabricate them better than SLNs in a few restorative applications. Be that as it may, Muller et al. [38] recommend that SLNs are better for applications, for example, UV security any place an abnormal state of Crystallinity is required for the transporter. Like SLNs, NLCs are likewise fit for keeping the dynamic mixes from concoction degradation [39]. They conjointly have a high impediment issue and abnormal state of skin adherence properties. When the particles cling to the skin a thin film layer is made that anticipates lack of hydration. As the size of the particles diminishes the impediment factor increases [40].

Along these lines, NLCs manages the likelihood of prevailing impediment while not adjusting the properties for example expanding the impediment of day creams without the reflexivity of night creams. It has additionally been discovered that the discharge profile of the dynamic mixes can be controlled by changing the network structure of NMs. Lipid nanoparticles have been found to upsurge the infiltration capacities of active compounds contrasted with microparticles [41]. The lubricating up result and mechanical obstruction of lipid nanoparticles are likewise wanted to healthy skin applications for diminishing disturbance and unfavorably susceptible responses. Lipid nanoparticles can make items look like white, rather than yellowish, that is a ton of entrancing for consumers [42]. The essential products consist of lipid nanoparticles showed up available in 2005 (Nanorepair cream and salve, Dr. Rimpler GmbH, Germany), given raised skin entrance. In excess of 30 corrective items containing NLCs are directly offered around the world (for example in South Korea, Supervital items in the 'IOPE' line from Amore Pacific). Ongoing surveys of these items and their fixings have been composed by Muller et al. [43].

Solid lipid nanoparticles

SLNs are oily droplets of lipids that are durable at body temperature and balanced out by surfactants. They can guard the embodied fixings from debasement, utilized for the controlled conveyance of corrective specialists over a delayed timeframe and have been found to expand the infiltration of dynamic mixes into the stratum corneum. *In-vivo* studies have demonstrated that SLNs containing definition is a ton successful in skin hydration than a fake treatment. They have likewise been found to show UV protective properties (Fig. 2), which improved when an atomic sunscreen was fused and tried. Upgraded UV hindering by 3, 4, 5-trimethoxybenzoylchitin (a respectable UV absorber) was seen when joined into SLNs [44-46].

The first generation of SLNs was developed at the start of the nineties as a different carrier system to drug delivery of liposomes, polymeric NMs and emulsions. SLNs are nm sized particles with a solid lipid matrix [47]. Within the second generation technology of the NLCs, the particles are produced by employing a mix of a solid lipid with a liquid lipid, this mix conjointly being solid at body temperature. SLNs have occlusive properties creating them best for prospective use. NLCs were established to fulfil some potential limitations associated with SLNs. Compared to SLNs and NLCs, have shown a higher loading volume for number of active complexes, a lower aqueous content of the particle present in suspensions and minimize the potential expulsion of active compounds throughout storage. SLNs and NLCs are innovative colloidal drug delivery systems with numerous cosmetic and dermatological characteristics; such as skin adhesive properties when applied to the skin leading to occlusion, to improved skin hydration, whitening properties, protection against degradation, absorption growing effects, active penetration enhancement, and controlled release effects [48, 49].

MAJOR CATEGORIES IN NANOCOSMETICS

Cosmetics are contemplated because the quickest growing segment of personal care industry. An excess of nanocosmetics are blend in nail, hair, lip, and skin care.

Skin Care

Cosmetics for skin care products ameliorate the skin consistency and functioning by stimulating the growth of sclera protein by combating harmful influence of free radicals. They create the skin healthier by maintaining the structure of keratin in good condition. In sunscreen products ZnO and TiO_2 nanoparticles are much effective minerals that protect the skin by penetrating into the deep layers of skin and create the product less greasy, less smelly, and clear as crystal [50]. SLNs, liposomes, nanoemulsions, and niosomes are broadly used in moisturizing preparations as they form skinny film of humectants and recall the moisture for extended period. Marketed anti-aging nanocosmetics products conforming liposomes, niosomes, nanocapsules, and nanospheres for manifest benefits such as collagen regeneration, skin revolution, and stimulating the tissue of skin [51].

Hair Care

Hair nanocosmetics products embrace shampoos, conditioning agents, hair growth stimulants, colouring, and styling products. Hair follicle, shaft targeting, and increased amount of active ingredient are attained by inherent properties and unique size of nanoparticles. Nanoparticles listing in shampoos seals moisture inside the cuticles by enhancing resident contact time with scalp and hair follicles by forming protective film [52].

Conditioning nanocosmetics preparations have function of conveying smoothness, shine, silkiness, and increase untangling of hair. Different carriers like liposomes, niosomes, microemulsions, nanoemulsions and nanospheres, and also have major effectiveness on repairing impaired cuticles, reinstating texture and gloss, and to make hair smooth, shiny, and less breakable [53].

Lip Care

Lip care products in nanocosmetics include lip balm, lipstick and lip smoothner. Wide Range of NMs able to be fused into lip balm and lipstick to make softening the lips by obstructing transepidermal water loss [54] and also prevent the stains to transfer from the lips and preserve colour for extended period of time. Liposomes increases lip volume, hydrates, outlines of the lips, and stop up wrinkles in the lip contour by using Lip volumizer [55].

Nail Care

Mostly nail care products have better superiority over the standard products. Nanotechnology supported nail paints have advantages such as improved toughness, quick dryness, durability, chip resistance, and easy of application because of elasticity [56]. Novel approaches such as mixtures of silver and metal oxide nanoparticles acts as antifungal agent in nail paints for the treatment of toe nails [57].

CHARACTERISTICS OF NMs IN COSMETICS

Small Size NMs

The foremost characteristic of NMs is their lesser size. This may alter their physicochemical properties and might be produces the chances for increased uptake and interaction with the biological tissues. Toxicity is principally involved with the production of reactive element species like oxygen, including free radical which is able to lead in aerobic stress, inflammation, and subsequent injury to proteins, membranes and DNA. For the reason of their size, these NMs can simply access to the blood stream via skin penetration or inhalation and from there, they are going to be transported to the assorted organs. The higher dose and prolong residence time of the NMs within the very significant organs may alter their dysfunction [58, 59]. Carbon nanotubes have been made known to reason of the death of kidney cells and may stop further growth of cell [60]. Whereas 500 nm TiO_2 particles have separately less capability to cause DNA strand breakage, 20 nm particles of TiO_2 are able to inflicting complete destruction of super-coiled DNA, even at less doses and absence of acquaintance to UV [61]. In another study, it was found that mice that were sub intensely unprotected to 2-5 nm TiO_2 nanoparticles showed a significant however moderate inflammatory response [62].

Shape of NMs

NMs are prepared in a wide range of shapes like spheres, tubes, sheets etc. and this may be major cause for the health risks associated with them. An experience has shown that revealing the abdomen of mice to extended carbon nanotubes are linked with inflammation of the abdominal wall of mice [63].

Surface area of NMs

Based on experimental work as the size of particle decreases, their surface area increases which resulting increase in their reactivity. NMs are also extremely reactive because of their high surface area to mass ratio, providing a lot of interest by weight for chemical compound reactions to occur. Researchers exposed that due to this refers to increase in reactivity, there is some nano atoms might be potentially explosive and/ or photoactive. As an example, some NMs such as nanoscale TiO_2 and silicon dioxide may detonate if finely spread within the air and they acquire contact with a sufficiently strong ignition source [64].

Penetration of NMs via skin

Entrance of NMs by means of skin scientific investigations have demonstrated that NMs can penetrate skin, especially if skin is adaptable [65]. Broken skin might be an immediate course for the entrance of particles even up to a size of 7000 nm. The nearness of skin issue like skin inflammation, dermatitis and wounds can improve the ingestion of NMs into the circulation system and may prompt further difficulties. A preliminary study found that NMs penetration was more profound in skin suffering from psoriasis than in unaffected skin [66]. As of late, the base bearers are being modified so as to upgrade the skin infiltration by coordinating certain penetration enhancers, both physical and synthetic, and conjointly by making more up to date vesicular systems with improved skin vulnerability like ethosomes and transferosomes. Although flexing and massage can also enhance the skin penetration of NMs. Some studies found that even particles up to 1000 nm in size can be concerned through intact skin to achieve living cells, once skin is flexible [67].

Environmental risks of NMs

Our atmosphere is additionally at risk because of the exposure of NMs through release into the water, air and soil, during the manufacture, use, or disposal of these materials. These NMs, if antibacterial in nature and whenever discharged least sums, could possibly meddle with advantageous microorganisms in sewage and waste water treatment plants and could likewise taint water expected for reuse, as per a portion of the examinations surveyed by US GAO. For instance, studies have unconcealed the poisonous quality of TiO_2 nanoparticles to the principle body frameworks of rainbow trout [68]. During the investigation directed by the University of Toledo, the analysts found that nano-TiO_2 used in close to personal consideration items decreased biological roles of microorganisms once not exactly an hour of introduction. These discoveries suggest that these particles, which end up at metropolitan sewage treatment plants could take out microorganisms that assume vital roles in ecosystems and help treat waste water [69]. Among the investigations done on carbon fullerenes, it has been noticed that they can cause brain damage in largemouth bass [70], a species acknowledged by regulatory offices as a model for depicting eco-toxicological impacts. Fullerenes have conjointly been found to slaughter water bugs and have disinfectant properties [71]. Rice University's Center for Biological and Environmental Nanotechnology has brought up the propensity for NMs to tie to polluting substances effectively inescapable inside the air like cadmium and petrochemicals. This inclination would make NMs a potential component for long range and across the board transport of toxins in ground water [72, 73].

Certain investigations have even suggested that NMs have the potential for biomagnifications [74]. An interdisciplinary group of specialists at the UC (University of California) Santa Barbara created a weighty perception on how NMs can biomagnify in a straightforward microbial evolved way of life [75].

HEALTH HAZARDS OF NMs WITH SKIN APPLICATIONS

Consumers apply cosmetics when they are available into direct physical contact with NMs that can be absorbed by the body via the lungs, (from products within the type of sprays), the digestive organs (inadvertent swallowing of face or li applications), eye membranes (inadvertent insertion of creams or sprays applied to the face; mascara) and the skin. Because of their tiny dimensions certain NMs can penetrate cell membranes and thereby cause inflammation and/or cell damage as a result of oxidative stress. However, the beginning level at which the absorbed NMs trigger have an effect remains unknown.

For the resolutions of risk assessment a distinction is formed between NMs that are soluble or degradable and those which are insoluble or non-degradable. The former, such as the carrier systems mentioned higher than (liposomes, nanoemulsions, lipid nanoparticles, microemulsions) break back off into their individual components when the active ingredient is released. Scientists presently believe that these NMs are unlikely to own a toxic result on humans or ecosystems that may be different from the effect the larger particle [76]. However, these carrier systems can alter the bioavailability and the toxicological actions of the agents. This has to be consider when conducting safety tests on NMs and/or the agents contained within them [77].

To date, no appropriate methods have been found for conducting a wide-ranging risk assessment of insoluble/non-degradable NMs and as a result there are still considerable gaps in our knowledge of this area. Following a report by its “Scientific Committee on Consumer Products” (SCCP) the European Commission prohibited the use of ZnO as a UV filter [78]. The SCCP criticized the fact that the risk assessment data submitted to it was largely outdated and that were no studies into whether nanoform ZnO could penetrate cells through the skin and enter into the blood vessels [79].

It was also studied and examined that the potential effects of TiO_2 on health when it is used as a UV filter. The EU NANODERM project, as an example, concluded that the appliance of nano-TiO_2 on healthy skin was unlikely to have a harmful outcome on health since the particles could not penetrate the skin. Presently no studies available on skin disorders (e.g. neurodermatitis) or damaged skin, so that the penetration of nanoparticles into cells or the blood stream via the skin barrier cannot be dominated out. Massage or mechanical flexion (bending a joint) can assist the penetration into deeper skin layers. Still there is a necessity for appropriate studies [80-83].

Likewise only a few research into the potential health hazards of non-soluble fullerenes. They can penetrate the skin due to their tiny size and that in tests on bacteria they had a phototoxic [84] and genotoxic effect [85]. Here too, a substantial quantity of research needs to be conducted so as to evaluate the potential risk [86].

Recently, German survey of experts was conducted named “Delphimethod” analysis on the subject of nanotechnology, those questioned were very life-threatening of the use of fullerenes. 87 % claimed that their use in cosmetics was to be expected to have a harmful influence on health and categorized them as having “moderate toxic potential” [87].

SAFETY CONCERN FOR NMs

Dermal contact has lifted concerns regarding safety and toxicity of NMs that are present in several cosmetic products for example skin care products, hair products, sunscreens and other beauty products etc. [88] for skin. Even though current discussions regarding NMs toxicity associated with their dimension less than 100 nm, hazardous effects may also occur once exposure to larger particles and agglomerates, wherever destabilization and disintegration can cause discharge of smaller fragments and toxic components [89, 90]. As the studies related the penetration depth of substances as nanoparticles or loaded nanoparticles go into deeper than the larger ones.

For instance a nanoparticle formulation of a fluorescent color entered further than a molecule free formulation of a comparable dye just when the definitions were applied with a massage [91]. Conjointly size of the applied nanoparticles is characteristic inside the entrance profundity and in this manner the particular focusing of specific compartments inside the hair follicle [89, 92]. The fastener siphon instrument and a couple of others may clarify size-subordinate penetration of particles on the nm scale [89].

In spite of the fact that nanoparticles can infiltrate into the shallow layers of the corneum stratum, they can't enter the obstruction of flawless skin and come to the feasible epidermis [89, 93, 94]and though NMs can be kept on the follicle hole that they don't infiltrate the skin by means of the follicle [95, 96]. Just if there should arise an occurrence of outside impacts like UV radiation may debilitate hindrance capacity of skin that deliberate by transepidermal water loss, accepted to be consequences of disruption of the living thing like lipid lamellae [89, 97] and therefore the expression of tight junction connected proteins was found to be flustered following UVB exposure [89, 98].

In a specific order, sunscreens become indispensable and different NMs arrangements of ZnO or TiO_2 have been tried *in-vitro* for percutaneous entrance, phototoxicity or photograph genotoxicity [99]. Coating can be one of the point of view for safety concerns [100]. In a number of *in-vivo* toxicity tests, cytotoxicity, genotoxicity, photo-genotoxicity, general toxicity and carcinogenicity studies on TiO2 and ZnO NMs found no difference in the safety profile of micro or nano sized materials, were found to be non-toxic[101] while the others were found to be toxic [102, 103].

The study indicated that until now there is little evidence for NMs in cosmetics may penetrate to human skin and uptake human systemic circulation. Thus available data proposed that risk from the dermal exposure to NMs is low, but the published data needs extension and it is also ethically suggested that five complementing actions; closing the gap, setup monitoring tools, continuing review, designing for safety, and regulative improvements essentially considerable for sunscreens and for other NMs [88, 104-106].

One more issue need to be considered is probability of change in physico-chemical characteristics of NMs within the final product and coverings or impurities may be released which found to be the material more or less toxic. Furthermore the properties of NMs may differ also for the duration of storage and handling [107]. The unfamiliar properties of NMs build them hard to predict their reactivity and risk. So in order to support the research data available in production, the European Commission has funded a project entitled 'Intelligent Testing Strategy for Engineered NMs'. This project aimed to spot the foremost effective analysis needed to associate an Intelligent Testing Strategy (ITS) for assessing exposure, hazard and therefore the potential risks of engineered NMs. The ITS, has launched in 2013 and can be a fluid document which might be adapted as new information emerges and the current information gaps are filled, and can offer a direction for new research to satisfy the increasing demands for risk assessment of NMs[108].
Lest of developing new cosmetics technical, economic associated sensory aspects ought to be taken into consideration whereas choosing an appropriate type of novel delivery system to improve the safety, stability, extended efficacy and to enhance the aesthetic attractiveness of the final product [109]. Here, some manufacturers employing different nanotechnology to prepare their marketed cosmetic products [110], shown in Table 1.

PRESENT AND FUTURE PROSPECTS

At present, nanotechnology is the fastest developing zone of research engaged with deciding science based answers for cutting edge therapeutics and beautifying agents. Henceforward, it will end up being a tremendous prospect for beauty care products and purchaser care item makers. Around there of innovation is remains similarly new, scientists must be constrained to cross-check solvency and bio-ingenuity of the NMs reasonably. The most much of the time utilized nanopigments in makeup are TiO_2, ZnO and aluminum oxide. Nano-aluminum oxide is utilized in concealers and mineral establishments because of diffuses light, giving a 'delicate center's impact that camouflages wrinkles.

Nano-TiO_2 is utilized to give assurance from UV beams of sun. As a greater molecule, TiO_2 is white and opaque anyway in nano size, TiO_2 turns out to be clear. Nanosized TiO_2 particles proceed with the external surface or stratum corneum of the skin and don't infiltrate through the living skin. Generation of free radicals by nanoparticles used in sunscreens and makeup is better once uncovered than UV light. A few beauty care products developers create an idea in regards to silver nanoparticles, they are require to utilize this sort of nanoparticles in dentifrice (toothpaste). At present, Gold nanoparticles are consolidated in facial veils, getting utilized in magnificence centers and cantinas. It is accepted to make sense of by rising the blood dissemination, skin flexibility, and diminishing the arrangement of wrinkles and they don't create poisonous quality in human skin [111-113].

Commonly useful beauty care products that uses nanotechnology is sunscreens. The particles utilized in sunscreens are ZnO and TiO2. The use of these nanoparticles makes the sunscreen, straightforward and less oily. There are different makeup, for example, skin creams, skin chemicals, hostile to wrinkle items and hair care items that are welfares from nanotechnology [114].

Table 1. Marketed cosmetic products name employing nanotechnology with characteristics, use and manufacturers

Product name	Characteristics of product	Indication/ use	Manufacturers
Nano-gold energizing cream	Anti-aging cream	It offers moisturizing, anti-oxidant & anti-inflammatory benefits. Also boosts cell metabolism & stimulates collagen production. It maintains skin health & youthful vitality	Chantecaille
Molecular renewal serum	Anti-aging serum	To stimulate collagen production, increasing the healing process of skin and protects it from the effects of daily stress	Lifeline skin care
Brightening toner	Small molecule technology	It helps to reduce dark spot, age spots, sun spots, and discoloration, while leaving the skin extremely moisturized also increase cell turnover, while smoothing, soothing, and providing a light exfoliation to restore the natural radiance of the skin.	Lifeline skin care
Elastin booster	Targeted molecular technology	It delivers the essential proteins needed to fill in fine lines, firm sagging skin, and stimulate elastin production.	Lifeline skin care
Vital nanoemulsion α-vc (beauty essence serum)	Nanoemulsion	It is refined beauty serum penetrates to nourish from deep in the skin	Marie louis cosmetics
Natural progesterone liposomal skin cream	Anti-aging with small liposomes	With high impact endotherapeutic anti-aging maintenance of healthy feminine balance designed to upgrade the skin healthy and youthful looking state.	Now solutions
Revita	High performance Hair stimulating shampoo containing nanosomes	It is designed to upgrade scalp and hair roots to an appearance of health and Hair loss treatment	Ds laboratories
Visionnaire serum	Lancome soleil soft-touch anti-wrinkle sun cream SPF 15 containing Vitamin nanocapsules	Advanced skin corrector; Wrinkles, pores, texture	Lancome/ L'Oreal
Zema-nil™	Nanoemulsions	Skin care formulation for people with eczema often associated with microbial proliferation that may aggravate the problem.	Elsom research
Advanced climate control heat & humidity gel	Gel	Harnesses anti-frizz nano technology that seals the cuticle to lock in moisture & lock out humidity	Ouidad
Revitalift®	Anti-aging skin cream	It provides advanced action against the signs of aging. Also works to increase cell turnover, reduce wrinkles, firm skin, and provide 24-hour hydration.	L'Oreal paris
Olay regenerist	Micro-sculpting serum regime	Renew skin's surface layers revealing youthful look. Reduce fine line & wrinkle appearance with moisturisation. Exfoliate and smooth skin	Olay

Fig 1. Schematic Diagram of liposome containing water soluble and oil like phospholipid molecule.

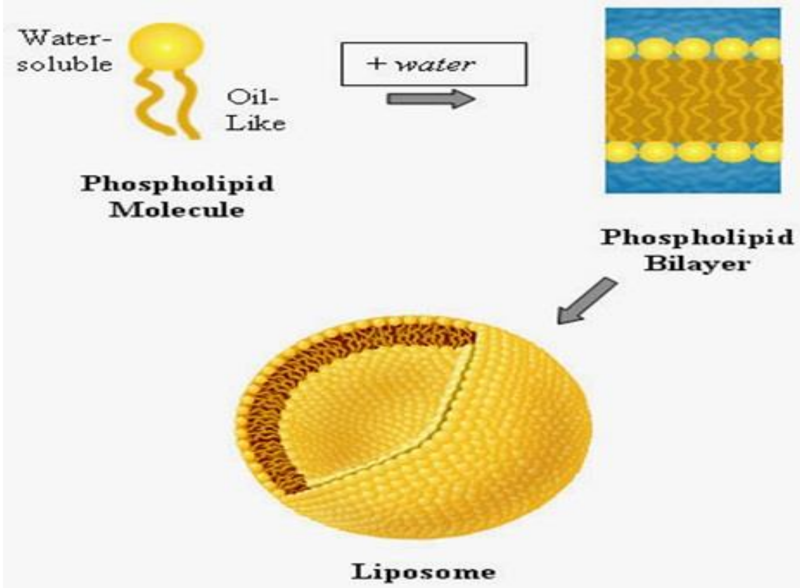
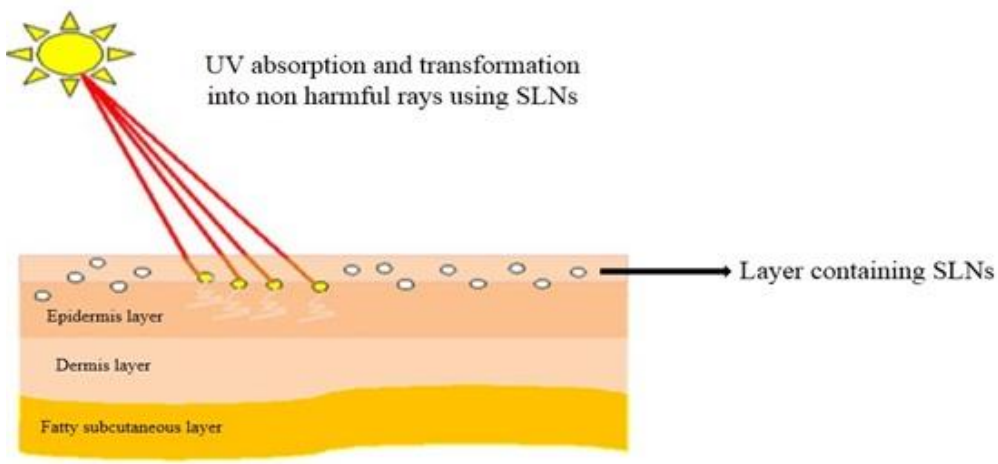


Fig 2. Transformation of UV rays into non harmful effect



CONCLUSION

Nowadays, nanotechnology is an important topic of the science; it is a promising area for the development of cosmetics, drugs, health products, digital devices and others. Development of cosmetics industry is increasing day by day because the cosmetics market is extremely diversified, with products coming from major and small manufacturers and local companies everywhere in the whole world. Nanotechnology represents the key technologies of the 21st century, contributing excellent opportunities for both research and business purposes. Consuming importance in consumer aspects and economy, nanotechnology appears to be greater in cosmetics field. Because of their wide use in cosmetics concerns regarding their risks for health and surroundings have gain much more importance. The speedy unfold and commercialization of nanotechnology in cosmetics have given rise to great technical and economic aspirations but also question regarding the emerging risks to health and safety of users. Therefore, nanotechnology based cosmetic products should be designed and sold in a way that totally with respects to the health of consumers and the atmosphere.

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CONFLICT OF INTEREST

The authors declare no conflict of interest neither financial nor otherwise.

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