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Application of Nanotechnology to Cosmetics: Skin Care and Dermatology

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ABSTRACT

Men and women alike have been accessorizing with cosmetics for generations, but the trends have changed considerably. The cosmetics industry is enormous and has been useful to people for a long time. People used to think that no chemical product could ever be completely natural. Because of industrialization, the field has changed drastically. Consequently, nanotechnology advances, and cosmetics are made in an eco-conscious manner. Various solid lipids, nanomaterial liposomes Skin care products including nanoparticles, cubosomes, dendrimers, etc., exhibit advanced qualities. Regarding this, nano emulsion is the most crucial component. They are substituted with vitamin A and its derivatives in emulsions, gels, lotions, and creams so that they act more efficiently. It is best for skin care products to use sunscreens that include inorganic materials, such as the metals TiO₂ and ZnO₂. This brief overview has focused on the cosmetics industry's potential use of nanotechnology for dermatological and skin care products.

Keywords: Cosmeceuticals Dermatology Nano emulsions
Skin Care Products

1. Introduction

Three layers make up the human skin: the epidermis, which is the outermost layer, the dermis, which is the middle layer, and the hypodermis, which is the deepest layer. Loss of firmness, wrinkles, and sagging skin are effects of ageing caused by a weakening of the collagen and elastin fibers that maintain skin firmness. The dermal layer is the source of these alterations, even though they show up on the skin's surface. This layer is where the majority of the skin-preserving cellular activity takes place. However, up until recently, the surface of the skin was the only part of the skin that was treated with wrinkle treatments and skin creams. Cosmeceuticals, when actives are formulated with nanotechnology or into Nano-vehicles, are Nano-cosmeceuticals. Nano cosmeceuticals provide helpful ingredients in sectors where pharmaceuticals may not be the best choice. Most people think of nanocosmetics when they hear the word "antiaging" (Palmberg, 2008). These products use nano-particles that work by interacting with the body to diminish the look of wrinkles and creases underneath the skin's surface. It is fascinating to examine the development of makeup to comprehend the ever-shifting trends in cosmetics. Men and women alike have been accessorizing with cosmetics for generations, but the trends have changed considerably. The skin is the body's outermost and most delicate layer; like other layers, it requires care and attention. Once upon a time, there was a belief that no chemical product could compare to all-natural. Natural treatments such

as asphalt powder, honey, olive oil, papaya, mashed fruits, eggs, a paste of various plant leaves, lemon juice, vegetables, etc. were the only options available to people back then for skin care. Vitamin C, which is included in lemons and other citrus fruits, makes skin seem healthier and more radiant. Everywhere you see, industrialization has taken place. Thus, there is a need for The world's population increased, which caused everything to grow. Before plants undergo development in the cosmetics sector, they will be chopped for other uses, including timber, houses, etc. Improved outcomes with cosmetics were achieved with the use of newly designed procedures. Recently, a new method called nanotechnology was found, and it is being employed in cosmetics. Formulation, characterisation, and application of compositions, devices, and structures by dominating shape and size on a nanoscale is what nanotechnology is all about. It's the most promising technology of the 21st century. 11 and 18 Nanoparticles are defined as those having a particular surface area more than 60 cm² and a size between 1 and 100 nm. Nanoemulsions, nanocapsules, liposomes, niosomes, solid lipid nanoparticles, carbon nanotubes, dendrimers, and fullerenes are only a few examples of the innovative cosmetic carriers based on nanotechnology. 13 Submicron emulsions (SME) are the most cutting-edge nanoparticulate systems for cosmetics; they consist of nanoemulsions with uniformly tiny droplets ranging in size from 20 to 500 nm. Their application in advanced cosmetics is on the rise. To

reduce their impact on the environment, the cosmetics sector is increasingly turning to cutting-edge methods such as

nanocarrier alteration, nanomedicine innovation, antioxidant usage, and other revolutionary ways. 36

1.1. Advantages and disadvantages of nanoparticles

Advantages of nanoparticles are including:

- It can be lyophilized.^{33, 47}
- It can be freeze-dried to form powder formulation.
- By autoclaving and gamma radiation Sterilization is possible.
- It improves skin protection with an organic compound.³³

Table 1. Advantages and disadvantages of various techniques.

Entry	Technique	Drugs	Advantages	Disadvantages
1	High-pressure homogenization	Olanzapine	Well-developed tech., Scalable, Commercially demonstrated	Energy intensive process, damage to biomolecule.
2	Hot homogenization	Diazepam	Applicable to insoluble and lipophilic drugs, at high-temperature exposure time is short.	For hydrophilic drug there is low entrapment efficiency.
3	Cold homogenization	Vinorelbinitartrate	Applicable for hydrophilic, thermo labile and thermo sensitive drugs	Exposure to heat can't be completely avoided
4	Microemulsion technique	Paclitaxel	Low mechanical energy input.	Sensitive to change, low Concentration of Nanoparticle
5	Ultrasonication	Insulin	Effective at laboratory scale reduced shear stress	Energy intensive process, high metal contamination potential

Disadvantages of nanoparticles are including:

- Poor drug loading capacity.
- High water contents of dispersion.
- The low capacity to load hydrophilic drugs.

2. Methods to synthesize Nanoparticle

There are some techniques used to prepare Nano Materials, few are given below in **Table 1**.

3. Nanomaterials in cosmetics

Nanoparticles which are used in drugs delivery system are of interest to the cosmetic industry, for example, Nano encapsulations vesicular delivery system, Nanoemulsion and nanocrystal, liposomes and Niosomes, Nicells, polymeric Nanocapsules, solid lipid nanoparticles etc. Due to the widespread use of nanotechnology in cosmetics, concern about their risks for health and environment has gained much more importance.^{2, 4, 11, 13}

3.1. Products in the market

First, lipid globules 10–100 nanometers in size were present in the first nanometric cosmetic constructions. In 1991, the product was introduced at Shiseido in Japan; in 1999, Lancôme recognized

them as vital. Ever since then, a plethora of companies have introduced nanoformulations: Aqua-oléum by Kérastase, Serum antiâge by Guerlain, Solution Destressante Précision by Chanel, Cure

Intensive Aux Extraits de Caviar by La Prairie, etc. In subsequent years, cream jars began to include nanovectors. Active substances, such as beta-carotene and vitamin E, are stored in these reservoirs, which resemble tiny shells or sponges. They're in charge of delivering these substances to the dermal layer deep within the skin.

3. The titanium oxide nanoparticles in this base are rich in iron. Even when exposed to both natural and artificial light, the foundation maintains its makeup-like finish and the latter darkens reversibly according to brightness. Photochromic is the name given to this phenomena. 4 Nano titanium dioxide is the subject of several patents. Then, the company came out with silica and zinc dioxide nanoparticles that inhibit the enzymes that cause dryness and redness of the skin. 5. The business achieved a nano-order level of combination by using oxide powder and silica powder (talc). An inorganic powder might inhibit enzymes that cause dry skin, according to research on this compound.

6. Gold Future at Helena Rubinstein includes colloidal gold, which refers to gold particles less than 10 microns in size. The anti-free-radical capabilities of gold may reach the epidermis via its small particles, which also increase its bioavailability.

7. The first manufactured nanoproducts were nanosomes, which are small, capsule-shaped vehicles for the delivery and subsequent release of active substances, such as vitamins, into the outer layer of the skin. Developed in the company's European facility, the anti-wrinkle lotion incorporates vitamin using a unique nanocapsule method. The ZO1 sunscreen, made by an Australian business, contains tiny zinc oxide particles. Other companies working on nanotechnology-based goods include Johnson & Johnson and Estée Lauder. 9. Using nanotechnology, Germatika Ageless Cream fights the signs of aging. 10. A new line of anti-aging products was introduced in Europe, including an eye care treatment that targets crow's feet and a hypoallergenic wrinkle nano-remover cream that claims to temporarily erase wrinkles for eight hours. 11. Additional anti-aging products in the series include the "New Perfectionist [CP+] with Poly-Collagen Peptides Correcting Serum for Lines/Wrinkles/Age Spots—deep wrinkle correction," which uses poly collagen peptide technology to effectively combat the most noticeable wrinkles. The newest anti-aging technology from P&G is included in the Olay Regenerist anti-aging moisturizer line's unique amino-peptide complex, which has been shown to renew cells in the stratum corneum and make them act more like fresh skin. 13. Shea butter helps the skin to retain moisture by restoring its natural suppleness, which means it can absorb more water

from the air and keep it there for longer. It possesses anti-inflammatory agents and natural sunscreen qualities as well. As a humectant, glycerin is "hygroscopic," meaning it draws moisture from the air and fixes it to the skin. Ceramide, on the other hand, improves atopic dermatitis by repairing damage beneath the skin. 14. With the introduction of Imedeen Expression Line Control in 2005, the prominent internal skincare brand Imedeen expanded into topical skincare. Containing Contra-XTM, a proprietary blend of six amino acids shown to reduce the force of muscle contractions caused by repeated facial expressions, this cutting-edge anti-aging line includes serums, day, night, and eye creams. 15 Using a blend of royal jelly and state-of-the-art technology, Royal Jelly Lift Concentrate (part of Jafra Cosmetics International's Signature Royal Jelly range) promotes cell regeneration and aids in the prevention of wrinkles. The new Jafra product makes use of designed liposomes, which are tiny mini-capsules that encapsulate active chemicals, to improve the skin's delivery of royal jelly. It is believed that the efficiency of the Lift Concentrate is enhanced by using liposomes, which have a similar makeup to skin cells and are therefore easier to absorb.

3.2. Liposomes

Liposomes are made up of the lipid bilayer that is why the product made from it was cream capture; created by company Dior in 1986. Although liposomes were unstable and add anti-oxidants, it was going to be used in cosmetics.^{4, 15}

Liposomes are the first class of Nano-carriers developed in the early 1970s for drug delivery system. Liposomes are biocompatible, biodegradable, non-hazardous, flexible vesicles, can encapsulate active ingredients easily and are appropriate for delivery of both hydrophobic and hydrophilic compounds.⁴³ Liposomes have the ability to improve the absorption of active ingredients by the skin and thus increase their concentration.^{14, 36}

3.3. Niosomes

Niosomes which are defined as vesicles made up of non-ionic surfactants are biodegradable and quite safe helping to achieve site-specific delivery by targeting the drug to the site where the therapeutic effect is desired.³⁹ It is liposomes like but has both hydrophilic and hydrophobic end and it is stable. So that in 1987, the first product is Lancôme by company L'Oreal. Niosomes are used as carries of amphiphilic and lipophilic drugs.^{2, 4, 11, 13, 14}

3.4. Solid lipid nanoparticles

Lipid nanoparticles are defined as submicron colloidal vehicles composed of physiological lipid, dispersed in

water or in an aqueous solution of surfactant and with dimensions ranging from 50 to 1000 nm. SLNs are widespread in the field of cosmeceuticals because of their inherent features such as controlled-release properties; a reduced size which warrants close contact with the skin; low toxicity; enhanced skin penetration etc. SLNs and NLCs, offer advantages like stabilization of the active agents, achieve desired degree of occlusion and subsequent hydration of the skin, improved the shelf life of the final product, and higher bioavailability and site-specific action.³⁶ SLN/NLS mark by following principles.⁴⁵

The “VW Beetle 1938 Principle” states following points:

1. Physical adhesion to the skin
2. Physical film formation creating occlusion
3. Physical occlusion promoting drug penetration
4. Chemical interaction of lipids from particles with skin lipids.

It prevents degradation of the substances. So, the delayed release of substances from it. It is used in the perfume industry and insect repellent. Because it increases the hydration of skin and penetrates through stratum corneum. They are also used to reduce redness in an allergic reaction by Nano repair cream and location.²⁴
²⁷ Cyproterone acetate loaded solid lipid nanoparticles enhanced skin absorption resulting in therapeutic drug levels within the target tissue and reduces the systemic side effects compared to the oral administration. The oral application of cyproterone acetate can be used to reduce sebum secretion rate and acne lesions. BMDDBM encapsulated with SLNs and NLCs also with OCT for UVA blocking effect. The best result is with 2.5% of BMDDBM and 1% of OCT.^{3, 36}

3.5. Nano-capsules

A polymer membrane made of either natural or synthetic polymers encloses the active substance inside a nano-capsule, which is composed of a liquid or solid core with a hollow. Hydrogels and emulgels are two applications for nano-capsules. Many other kinds of personal care products also make use of hydrogel. Nano encapsulation may be felt. As the cosmetics business evolves, it has been shown that certain corporations also alter product features to enhance their effectiveness and quality. This is why sensory analysis is carried out. It's insignificant; it's only human reactions to determine the extent to which this product is impacted by its use. In studies aimed at advancing the cosmetics sector, sensory analysis has shown to be an effective analytical technique. Nanocapsules containing lipoic acid are effective anti-aging skin care products. Improve a physiochemical stability feature of lipoic acid upon synthesis Encasing the chemical in nanoparticles prevents it from breaking down. When compared to competing formulations, cosmetics containing lipoic acid excel in several respects, including believability, stic-sulphur odor, oiliness, and kiness. 19 In addition, the

chitosan-alginate NPs successfully encapsulated the widely used anti-acne drug benzoyl peroxide (BP), which exhibited less toxicity to eukaryotic cells and superior antimicrobial activity against propionic bacterium *acnes* compared to benzoyl peroxide alone. 36

3.6. Nanocrystals

Nanocrystals as particles having, at least, one dimension smaller than 100 nanometers (nm) and being composed of atoms in either a single or poly-crystalline arrangement, possess rutin (flavonoid) as the active ingredient.¹ Nanocrystals exhibited several properties like increased penetration into a membrane, increased adhesion, and enhanced permeation through the gastrointestinal wall; these properties were then used to apply nanocrystals for topical application.² By using a nanotechnology in toothpaste, it is very helpful for preventing damage to tooth enamel. Hydroxyapatite is a key component of tooth enamel as nanocrystals.⁵

3.7. Sunscreen nanoparticles

Translucent compositions containing TiO₂ and ZnO nanoparticles may be applied to the skin. The cosmetic acceptability that is not possible with formulations with bigger particles is provided by this transparency. A new sunscreen formulation including ZnO nanoparticles was the subject of this investigation since its possible penetration of the skin and exposure to the bloodstream were important research questions. After applying the ZnO nanoparticulate sunscreen formulation topically for 24 hours, we measured the quantity of zinc that penetrated the epidermis and where the particles were located inside the skin. Sunscreen formulations including micro-fine ZnO (mean primary particle size 80 nm) and TiO₂ (needle-like particles 30-60!10 nm) were not able to permeate the stratum corneum of pigs, according to more recent experiments. Even more recently, it was shown that encasing the sunscreen ingredient octyl methoxycinnamate (OMC) in 250 nm solid lipid nanoparticles improved the availability of OMC in pig skin. Nevertheless, it was acknowledged in the later research that this impact was not only due to nano-encapsulation but rather to basic formulation thermodynamics leading to enhanced partitioning into the stratum corneum. The direct impact of solid lipid nanoparticles on skin hydration—increasing water retention in the stratum corneum via film development on the skin surface and effectively occluding the application site—has also been linked to enhanced levels of penetration. We compared the reported absorption rates of chemical sunscreens to the absorption rates of nanoparticulate coated ZnO on human skin. Using a mineral oil carrier, the following concentrations of oxybenzone, octocrylene, ethylhexyl methoxycinnamate, and ethylhexyldimethyl were absorbed in vitro across human epidermal membranes: 5-7%, 0.03-0.14%, 0.07-0.17%, and 0.09-0.2%, respectively. There are 1,200 sunscreens approved by the Australian Therapeutic Goods Administration (TGA), and among them,

Nanoscale insoluble metal oxide particles were present in 70% of sunscreens using titanium dioxide (TiO₂) and 30% of sunscreens containing zinc oxide (ZnO) in 2005, according to the Australian Agency for Therapeutic Goods Supply. Both of these ingredients are popular UV-ray blocking agents. Sunscreens made of nanoscale TiO₂ and ZnO are more see-through than their larger counterparts because of this phenomenon. This petition called on the Food and medication Administration to "declare all current available sunscreen drug products containing engineered nanoparticles of zinc oxide and titanium dioxide as imminent hazard to public health," referring especially to the growing usage of TiO₂ and ZnO nanoparticles in sunscreens. Active ingredients in sunscreens listed on the ARTG may include no more than the concentrations of TiO₂ and ZnO authorized by the TGA. The ARTG does not make a size-based distinction between listed substances like TiO₂ and ZnO under this paradigm. Initially, this was due to the fact that there were no smaller versions of these substances accessible, and their quality and safety had already been proven in their molecular form. In light of recent reports about the possible toxicity of ENPs, the TGA is currently evaluating whether or not TiO₂ and ZnO use necessitates further regulation. Sunscreen ENPs would have needed a separate safety evaluation from manufacturers in accordance with their classification as novel active ingredients if TGA regulation had determined that they differed in attributes from their bulk equivalents. Sunscreens with active TiO₂ and ZnO ENPs are exempt from the need for a separate quality and safety evaluation, according to the TGA's stance (TGA 2006;). The thinking behind this strategy has been that these particular ENPs do not provide any novel dangers to human health. "There is no evidence that sunscreens containing these materials pose any risk to the people using them" (TGA 2006), according to a TGA evaluation from 2006. Studies using static imaging techniques to examine nanoparticle penetration into the skin cannot yet identify even trace amounts of nanoparticles that have made it to the dermis, vascular bed of the dermis, and ultimately the bloodstream. Even fractions as tiny as 10⁻⁴ may induce buildup and ensuing inflammation in secondary target organs' if the dosage of nanoparticles is very high, as is the situation with TiO₂ in sunscreens. Thirteen patients, with a mean age of 71 years, who were scheduled to have skin removed surgically owing to lesions were studied in this research by Tan et al. They were asked to apply a TiO₂ sunscreen preparation to their skin twice a day for a duration of 2-6 weeks. The amounts of TiO₂ in the skin were measured and compared against controls after the skin was removed.

With no TiO₂ detected in the surrounding tissue and one out of ten hair follicles harboring microfine TiO₂, Lademann et al. reached similar conclusions. Isolation of TiO₂ particles (20-50 nm) inside hair follicles was another finding of Pflucker et al., who used transmission electron microscopy and tape stripping on pig skin. Most people agree that nanoparticulate TiO₂ and ZnO pose serious risks to cells. Research has shown that crystalline TiO₂ may cause cancer cell lines and human fibroblast cells to undergo cell death due to the production of reactive oxidative species (ROS)

when exposed to ultraviolet light. To reduce the possibility of reactive oxygen species (ROS) formation from irradiation, manufacturers cover TiO₂ with inert chemicals.

3.8. Dendrimers

Dendrimers are well-defined, regularly branched symmetrical entities with a tree-like configuration and the terminals of the branches imparting a high density of surface functionality. Because of its size and M.W it is used in various cosmetics products. Like mascara, nail polish. Due to new film forming property of it, they are used in artificial tanning, hair, skin care and nails. They can be used as anti-acne agents.^{5, 21, 35}

3.9. Nano-gold and Nano-silver

Nano-gold and Nano-silver both have antibacterial and anti-fungal properties. Their use in cosmeceutical products like deodorant, face pack and anti-aging cream is widespread. They have been used in moisturizer cream and facial mask.^{11, 16, 17}

3.10. Cubosomes

Cubosomes are defined as discrete nanoparticles of continuous cubic liquid crystalline phase comprising much larger specific surface area as compared to the parent cubic phase. It also has high heat stability and have ability to moisturize the skin.¹²

3.11. Fullerenes

Fullerenes are a new type of material which is produced using nanotechnology like carbon fullerenes. Fullerenes are also known as "buckyballs". Fullerenes are super powerful anti-oxidant activity at least two orders of magnitude over Vitamins. Fullerene is also having brightening effect. It shows its brightening effect by eliminating UV-induced free radicals and by preventing excessive melanin production. Fullerenes have been used in many cosmetic products because of their antioxidant properties; thus, recognized for their application in the formulation of skin rejuvenation cosmeceutical products. They are used to produce creams for healthy looking features & later is used to refresh dark circles under eyes.^{22, 30, 50}

3.12. Phytosome

They are used in sun-care product to protect the sun-exposed skin by releasing a photo-reactivating enzyme obtained from a marine plant, Anacystinidulans.⁶

3.13. Transferosomes

They are more elastic than liposomes and have greater efficiency. It is used in anti-wrinkle cream.⁶

3.14. Ultrasome

Ultrasomeis also used in anti-wrinkle cream. It helps to prevent the damage of collagen and elastin production.³⁸

3.15. Ethosomes

Ethosomes are soft, malleable vesicles used for enhanced delivery of active agents.⁹

4. Role of Nanoemulsions in skin penetration (dermatology)

The three primary components of a nanoemulsion are the water phase, the oil phase, and the surfactant phase. Most emulsions are the result of methods that use both low and high energies. The high energy approach makes use of ultrasound. This emulsion uses octyl methoxycinnamate as the water phase and avocado oil as the oil phase, with the oil phase being composed of a nonionic surfactant. Nano emulsion sunscreens include 5% avocado oil, 1% octyl methoxycinnamate, 0.25 percent titanium dioxide in makeup oil, and polyoxyethylene as a surfactant. The rapeseed oil makes up 56.6%, the miglyol 35.5%, and the salmon oil 8%. One part of low-energy emulsions is the water-in-oil phase. The emulsion oils employed in the low energy approach include hexadecane, leylammonium chloride, oleylamine, and C12 E10. There is hope that emulsion will influence the development of new cosmetics in the future. There are 312 cosmetics-related patents that have been found. The size range of nano emulsion droplets is 50 to 1000 nm. Both W/O and O/W configurations are possible for these particles. A high surfactant concentration is unnecessary for NEs. thus, they are beneficial for the skin, since a surfactant concentration higher than 20% might cause skin irritation. 8 Some of the characteristics of NEs that make them valuable in the cosmetics business are their vast surface area and free energy, their versatility in being turned into foams, creams, liquids, and sprays, and their lack of irritation. 28, 39, 42 It may improve the absorption of active substances into skin and hair, and it has a nice, bright light. The use of nano emulsion allows the active substances to be encapsulated and transported deeper into the hair. In doing so, they enhance the drug's penetration into the hair follicle openings and may even serve as a depot for the drug's continuous release inside. Cosmetic items, such as lotions and conditioners, are a great place to find nano emulsions because of their optical, tactile, and textural features, which are useful for skin and hair.

4.1. NEs in sprays

They also increase the hydration of the skin, due to their occlusive properties. The delayed release of substances from the solid lipid nanoparticles is also used in the perfume industry (Allure, Chanel) and for

insect repellents. They have the same properties as the solid lipid nanoparticles. They are also used for reducing the redness in allergic reactions due to their lubricating effect and the mechanical barrier, which they create on the skin. Nano repair cream and lotion, Dr. Rimpler GmbH, Germany is the first product containing lipid nano- particles. It has been on the market since.²⁷

4.2. Replacement of NEs from Vitamin A

Many skin conditions, including acne, wrinkles, and hyperpigmentation, may be treated with vitamin A. Although tretinoin (all trans retinoic acid) is effective in preventing the visible signs of aging on the skin, such as dark spots and wrinkles, its irritant properties restrict its usage in dermatology. Alternate forms of vitamin A, such as retinol and retinyl palmitate (RP), may be used in lieu of tretinoin in cosmetic formulations to lessen the likelihood of adverse effects. RP is gentler and helps maintain healthy skin.

The effectiveness of active compounds has been investigated by studying the conditional connection of vitamin A derivatives with different delivery systems. The goal of this research is to enhance the penetration of lipid-soluble NEs with vitamin A derivatives into the skin. NEs have recently attracted a lot of attention because of their ability to decrease skin water loss, increase skin hydration, and improve product performance. 10

5. Lipid Nanoparticles

For topical administration of actives, lipid-based formulations are likely to be the most suitable, considering that skin is made up of two layers: the dermis, which contains blood, lymphatic vessels, and nerves, and the epidermis, which is a matrix of connective tissue. Because of their pearl-like form and submicron size, SLN and NLC play a vital function. When submicron-sized particles come into touch with surfaces, they exhibit adhesive-ness. This quality has been shown for liposomes and polymeric nanoparticles. This is a good usage for lipid nanoparticle suspensions as, upon application to the skin, the pressure causes the particles to fuse together, creating a thick coating. In addition to their obvious skin-care and protective uses, cosmetic compositions may serve more complex functions. There are a number of benefits to using lipid nanoparticles, the most important of which are the controlled release of the active substance and its ability to penetrate the skin's layers thanks to their solid core. Utilizing lipid nanoparticles as carriers for molecular sunscreens shown a cumulative impact on UV scattering. Wedemark/Hannover, Germany's Dr. Rimpler GmbH presented the world to the first two

NLC-based cosmetics. The introduction of Nano Repair Q10 cream and NanoRepair Q10 serum to the cosmetic market in October 2005 by Dr. Kurt Richter Laboratorien GmbH of Berlin, Germany, demonstrated the effectiveness of lipid nanoparticles in the anti-aging arena. Due to the release of fragrance from the particles' outer layers, lipid nanoparticles and oil droplets showed comparable release patterns in the first three hours. The ensuing 10 hours saw SLN's release being drawn out. The emulsion released all of the scent after 6 hours, however the SLN released just 75%. There is a significant deal of control over the skin penetration of several actives when using NLC and solid lipid nanoparticles, which have an impressively broad variety of characteristics. They are also safe to employ in cosmetic and dermatological preparations to produce unique characteristics since they do not exhibit harmful consequences. While developing preparations to meet specific demands, it is important to remember the epidermal tissue's dynamic nature so that their dermatological and cosmetic applications may be fully appreciated. As a result, it is important to take into account the body's natural protective barrier; SLN and NLC are biocompatible, thus this may be achieved. However, due to the lipid composition of SLN and NLC, only two UV blockers—zinc oxide and titanium dioxide—have been deemed hazardous for topical sunscreen formulations due to the danger of skin absorption. Additional toxicity investigations are required for lipid nanoparticles loaded with particles.

6. Inorganic material in cosmetics

Inorganic materials are also widely used in cosmetics to make pigments. Inorganic materials are used in conjunction to organic materials to make cosmetics the best they can be. The inorganic materials are necessary to do the job that organic materials can't do. Sunscreens which contain insoluble mineral based material whose performance depend upon their particle size TiO_2 reflect&scatter UV light efficiently at size of 60-120nm and ZnO at size 20-30nm. ZnO of size 30-200nm their surface treated with inert coating materials silicon oils, SiO_2 , Al_2O_3 to improve their dispersion in sunscreen production.^{28, 48} Inorganic nanoparticles are used in sunscreens, along with a majority of other cosmetic products. One of the main cosmetic products inorganic materials are used in is sunscreen. Metal oxides, such as TiO_2 and ZnO , are preferred for this because of their stability, low cost and small amount of toxicity.^{20, 41} Pearl luster pigments are made from inorganic metal oxide coating on mica platelets. Inorganic particles can also be used to stabilize foams, which are used often in the production of cosmetics. Foundations and concealers

also use inorganic materials to cover imperfections and provide a natural skin appearance. Absorbent fillers like talc, silica, kaolin, and other inorganic materials are used to obtain a desired matte finish on the skin. Alumina and silicone elastomers have been used to achieve the soft-focus effect, but silicone elastomers are incompatible with water, making it difficult to use them for the purpose of covering imperfections. Silica spheres are another popular material used in many cosmetics because of their ability to improve the "skin feel" of the product. Silicon particles are also used in facial cosmetics. They help to treat, clean, prevent acne, oily skin, and wrinkles on the face. The porous silicon may be loaded with one or more active ingredients including antioxidants. Natural inorganic materials are also used to make pigments. A natural dye, cochineal carmine, has been a possible substitute for synthetic dyes that are prohibited in some makeup. Hair and skin cosmetics often contain polyoxy-alkylene-modified polysiloxanes, but they usually give off an odor after time. Anti-aging materials are also in high demand for consumers. New products are being developed using inorganic materials to create a smoother appearance to wrinkles Pigments, sunscreen, foundation, toothpaste, and eyes hadow are just some of the products that rely on inorganic materials. carbon dots (CDs) is added in Ag NPs nanoparticles and make the Nanoparticles products more efficient.^{7, 34} Nanoparticles add in cosmetics improved product because nanoparticles are nontoxic.⁴⁸ Melanin is a phenolic biopolymer found in the skin, hair, retina, adrenal glands, inner ear, and substantiating. In humans, melanin has two important functions: to determine the coloration of the skin and hair depending on the amount and type of melanin, and to protect the body against the harmful effects of UV radiation. The melanin production significantly decreased with nano- cRRtreatment.⁴⁶

7. Advancement in nanocarriers

Lipid nanocarriers based on vegetable resources (RSO & RBO) have less harmful effects, having self anti oxidative property and cosmetic formulations. Entrapment of 79%

(octocrylene) in the vegetable oil results in increase of anti- oxidative property and UV absorptive properties. Vegetable oils slowly release BMDDBM and OCT which results in reduce skin disorders due to UV. RBC Life Science's Nanoceuticals

Citrus Mint Shampoo and conditioner are made with nanocluster which is used to nourish scalp and for shining the hair.²⁶

Table 2. Marketed formulation of Nano material as a cosmetic.

Entry	Brand name	Composition	Company name	indication	Citation
1	Emend	Nanocrystalline aprepitant	Melan, Merck	Antiemetic	1
2	Tricor	Nanocrystalline fenofibrate	Melan, abbet	Antihyperlipidemic	1
3	Depodur	Liposomal morphine	Skye pharma, Endo	Postsurgical Analgesia	49
4	Abelet	liposomal amphotericin B	Enzon	Fungal infection	32
5	mbisome	liposomal amphotericin B	Giled(Foster city a USA)	Fungal infection	49
6	Macugen	Pegylated anti-EGF aptamer OSI	Pharmaceuticals	Age-relatedmacular desertion	--
7	Abraxane	paclitaxel protein bound	aAbraxas bioscience	in Cancer therapy	36
8	Myocet	liposomal doxorubicin	Zeneus pharma	Breast cancer	49
9	Acticoat	Silver nanoparticle	Nucryst (USA)	Antimicrobial care	49
10	Rapamune	nanocrystalline sirolimus	Elan, Wyeth	Immunosuppressant	36

8. Role of Antioxidants in cosmetics

Antioxidants are used in the cosmetic industry for prevention of the new wrinkles and reduce skin aging which is caused by UV light. These antioxidants, such as vitamin C, vitamin E and pycnogenol, have been shown to have a synergistic effect when combined for photo-protection.²⁵ Mostly exogenous antioxidants (like vitamin E) and endogenous antioxidants (enzymes like superoxide dismutase, catalase,) having topical applications are used for skin care formulations but they may show unfavorable physiochemical properties such as excessive lipophilicity, chemical instability and poor penetration in the skin. So nano-carriers (which are colloidal delivery system) like liposomes, niosomes and solid lipid nanoparticles, are used for effective delivery of anti-oxidants to the dermal layers of skin as they can improve the measured performance of cosmetic products.²²

10. Nano-medicine

Cosmetic surgery with nanomedicines is one method of body alteration. Nano-medicines work wonders on skin because they eliminate imperfections, even out skin tone, smooth out wrinkles, and eliminate fat. The use of anti-aging lotions formulated with nanomedicines, such as titanium dioxide, gives women a radiant, youthful appearance. Cosmetic surgery is becoming more popular among women, maybe as a result of societal pressures. When nanomedicines penetrate the blood-brain or blood-air barriers, they have the potential to produce cancers and other adverse effects. Therefore, it is important for the public to understand the potential consequences of nanomedicines. The 20 Cosmetics Regulations of the European Union and the Hygienic Standards for Cosmetics of China both list

chloramine-T as a

prohibited drug. The maximum amount of chloramine-T allowed in cosmetics is 2×10^1 mg/kg, as stated by the Hygienic Standard for Cosmetics of China. To safeguard human health, it is crucial to establish an analytical technique that can detect chloramine-T in cosmetics with high selectivity, accuracy, and sensitivity. numbers 23, 44 Table.2 covers the majority of products.

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