*Journal of Medicinal and Chemical Sciences 2019 (2) 9-16*

***J. Med. Chem. Sci.***

# Scope of Nanotechnology in Cosmetics: Dermatology and Skin Care Products

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ARTICLE INFO

*Article history:*
Received 2 June 2018
Revised 7 July 2018
Accepted 17 July 2018
Available online 11 September 2018

*Keywords:*
Cosmeceuticals
Dermatology
Nano emulsions
Skin Care Products

ABSTRACT

Women and men have been wearing cosmetics for centuries, although the styles have certainly undergone some dramatic changes over time. Cosmetics are a very vast field which has served humanity throughout the course of history. In old age, it was believed that there is no chemical product in the world that can be at all-natural. Industrialization has revolutionized the field. So, then nanotechnology is evolved and cosmetics become environmentally friendly. Different nanomaterial liposomes, solid lipid Nanoparticle, cubosomes, dendrimers etc. have advance properties for skin care. Nano emulsion is the most important part in this regard. They are widely used in gel, lotion, creams emulsions is replaced with vitamin A and its derivative for more efficient work. Sunscreen with inorganic material such as metal $TiO_2$ and $ZnO_2$ is better in skin care products. In this short review, some nanotechnology scope in cosmetics, in terms of dermatology and skin care products, has been significantly particularized.

## 1. Introduction

Human skin is an extremely complicated tissue defined as a three-tiered structure, epidermis, the outermost layer, the dermis, and the deepest hypodermis. As we grow old, collagen and elastin fibers that keep the skin firm weaken, which results in changes in our skin such as loosening, wrinkles, and sagging. Although these changes appear on the surface of the skin, they originate in the second or the dermal layer. It is in this layer that most of the cellular activity occurs that keeps the skin young and vital. Yet until recently, most, if not all skin creams and wrinkle, treatments are applied to, and only treat the skin's surface. Cosmeceuticals, where actives are formulated with nanotechnology or into Nano-vehicles, are Nano-cosmeceuticals. Nano cosmeceuticals contain ingredients that are beneficial in categories where medicinal may not be beneficial. Antiaging products are the most common example of Nanocosmetics, (Palmberg, 2008 with nanoparticles that go beneath the surface of the skin and reduce the appearance of lines and wrinkles by reacting with the body.

To understand the constantly changing trends in cosmetics, it is interesting to look at the evolution of makeup. Women and men have been wearing cosmetics for centuries, although the styles have certainly undergone some dramatic changes over time. Skin is the most sensitive layer of the body and it also needs nourishment and cleansing. In old age, it was believed that there is no chemical product in the world that can beat all-natural. At that time peoples did not use prepared creams for skin, they only use natural remedies like the use of tarmac powder, honey, oliveoil, papaya, mashed fruits, egg , a paste of different leaves of plants, lemon-juice, vegetables etc. Lemon is an easily available citrus fruit in almost everywhere, contains vitamin C that increases the beauty of skin. Industrialization took place in all over the world. So, the demand for everything increased due to increases in the population of the world. Plants are going to be cut for different purposes such as lumber, residence etc. then evolution is made in the cosmetic industry. new techniques which have been developed produced better results containing cosmetics. Nowadays, the new technique of nanotechnology has been discovered and this technology is used in beauty products. Nanotechnology is the most prospective technology of the **21st**century, and can be defined as the Nano-scale formulation, characterization, and application of compositions, devices, and structures by domineering shape and size.[11, 18] Nanotechnology contain particles with a size range from 1-100 nm and have a specific surface area greater than 60cm.[2] Nanotechnology-based novel carriers of cosmetics including nanoemulsion, nanocapsule, liposome,[2] niosome,[4] nanocrystal, solid lipid nanoparticle,[11] carbon nanotube, fullerene and dendrimers.[13] Nanoemulsions which are the most advanced nanoparticulate systems for cosmetics termed as submicron emulsions (SME) are systems with uniform and extremely small droplet size (20-500 nm).they are used in cosmetics with more advancement. Nowadays, different techniques like modification in Nanocarriers, advancement in nanomedicine, use of antioxidants and some other revolutionized techniques are mainly used in cosmetics industry with less environmental hazards.[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]

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**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 | Vinorelbin-bitartrate | 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, Nanoemulsionand 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*

1. The first nanometric cosmetic structures contained lipid globules of 10 to 100 nanometers in size. The first product saw the daylight in 1991, at Shiseido in Japan, and then Lancôme adopted them as essential in 1999.
2. Since then, lots of brands have also come up with nanoformulations: Kérastase (Aqua-oléum), Guerlain (Sérum antiâge), Chanel (Solution Destressante Précision), La Prairie (Cure Intensive Aux Extraits de Caviar), etc. Later, nanovectors appeared in jars of cream. These reservoirs, in the form of sponges or small shells, are filled with active compounds, like beta-carotene, and vitamin E or A, which they are responsible for transporting these agents deep within the epidermis.
3. There are nanoparticles of titanium oxide in this foundation, which are full of iron. The later darkens reversibly according to luminosity and the foundation keeps the same makeup effect whether exposed to natural or artificial light. The effect is called photochromic.
4. There are many patents relating to nano titanium dioxide. Then the firm developed nanoparticles of silica and zinc dioxide that hold back enzymes causing skin dryness and redness.
5. The company combined oxide powder with silica powder (talc) at the nano-order level. Research on this composite led to the discovery that an inorganic powder could restrain enzymes leading to dry skin.
6. At Helena Rubinstein, Gold Future contains colloidal gold, meaning gold particles smaller than 10 microns. Small particles of gold enhance the bioavailability and allow the epidermis to benefit from the anti-free-radical properties of gold.
7. First nanoproducts, introduced about 15years ago, were nanosomes, tiny capsule-like structures that transport active ingredients, such as vitamins into the skin's outer layer, and then release them. anti-wrinkle cream uses a patented nanocapsule process developed at the company's European lab to incorporate vitamin.
8. An Australian company has just launched ZO1, which uses miniaturized zinc oxide particles as sunscreen. Estée Lauder and Johnson & Johnson are also developing products based on nanotechnology.
9. Germatika Ageless Cream is an anti-aging cream that features nanotechnology.
10. Eye Care treatment, formulated to help fight crow's feet, together with a Hypoallergenic Wrinkle Nano-Remover cream that is said to smooth out wrinkles for up to eight hours was launched in Europe.

11. New Perfectionist [CP+] with Poly-Collagen Peptides Correcting Serum for Lines/Wrinkles/Age Spots-deep wrinkle correction" is another product in the anti-aging line using the poly collagen peptide technology which is effective against the most prominent wrinkles.
12. Olay Regenerist anti-aging moisturizer line includes P&G's latest anti-aging technology in an exclusive amino-peptide complex, proven to regenerate cells in the stratum corneum so that they behave more like new skin.
13. Shea butter restores the skin's natural elasticity, enabling it to absorb moisture from the air, resulting in longer lasting moisture. It also has natural sunscreen properties and anti-inflammatory agents. Ceramide has been found to improve atopic dermatitis, reversing damage under the skin; and glycerin is a humectant that is "hygroscopic," meaning it absorbs water from the air and attracts it to the skin.
14. Imedeen, a leading internal skincare brand, has also moved into topical skincare with the launch in 2005 of Imedeen Expression Line Control. This high-tech anti-aging range consists of a serum, day, night and eye creams which contains Contra-X™, a combination of six powerful amino acids, clinically proven to help minimize the intensity of muscle contractions used in repetitive facial expressions.
15. Royal Jelly Lift Concentrate, product of Jafra Cosmetics International's Signature Royal Jelly line, uses a combination of royal jelly, and cutting-edge technology to stimulate cell renewal and help prevent the appearance of wrinkles. The new product from Jafra utilizes specially engineered liposomes, small mini-capsules that encapsulate active ingredients to deliver royal jelly to the skin more effectively. Because liposomes are similar in composition to the structure of skin cells, they absorb more easily, and are said to increase the Lift Concentrate's efficacy.

### *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. Physicalocclusion promoting drugpenetration
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 corneal. 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. BMDBM encapsulated with SLNs and NLCs also with OCT for UVA blocking effect. The best result is with 2.5% of BMDBM and 1% of OCT.[3, 36]

### *3.5. Nano- capsules*

Nano-capsules are formed of a liquid/solid core in which the active ingredient is positioned into a cavity, which is enclosed by a polymer membrane fabricated of natural or synthetic polymers. Nano-capsules are used as hydrogels and emulgels. The hydrogelis also used for the production of various personal care products.[13] Nano capsulation has sensory properties.it has been demonstrated that with the development in the cosmeticsindustry, some companies also modify to change the properties of the product to improve the efficacy and quality. For this purpose, sensory analysis is done.it is nothing; it's just human responses to identify that, how much this product is affected for use. This sensory analysis is proved to be powerful analysis tool in research for the development of the cosmetic industry.

The active substances in Nanocapsules containing lipoic acid used in prevention a treatment of skin anti-aging. Enhance a property of lipoic acid physiochemical stability after its Nano capsulation protects the substance from degradation. Cosmetic product with lipoic acid is better than other formulation by many properties such as credibility, stic-

kiness oiliness, and Sulphurodor.[19] Furthermore, benzoyl peroxide (BP), a commonly used anti-acne drug, was effectively encapsulated in the Chitosan-alginate NPs and then it shows superior antimicrobial activity against propionic bacterium acnes compared with Benzoyl peroxide alone while demonstrating less toxicity to eukaryotic cells.[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] Nano-crystals exhibited several properties like increased penetration into a membrane, increased adhesion, and enhanced perm-eation 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*

Nanoparticles of $TiO_2$ and ZnO are transparent in formulations spread on the skin surface. This transparency provides the cosmetic acceptability not achievable with larger-particle formulations. The goal of the present study was to assess the potential epidermal penetration and systemic exposure of a novel ZnO nanoparticulate sunscreen formulation. We determined both the location of ZnO particles within the epidermis and the total amount of zinc penetrating through epidermal membranes in vitro over a 24-hour period after topical application of the ZnO nanoparticulate sunscreen formulation. More recent studies using pig skin exposed to micro-fine ZnO(mean primary particle size 80 nm) and $TiO_2$ (needle-like particles 30–60 !10 nm) sunscreen formulations suggested that neither particle types could penetrate porcine stratum corneum.

More recently, encapsulation of the sunscreen agent octyl methoxycinnamate (OMC) in solid lipid nanoparticles (250 nm) similarly showed increased availability ofOMC within porcine skin. However, in this latter study it was recognized that simple formulation thermodynamics resulting in increased partitioning into the stratum corneum contributed to this effect rather than as a direct result of nano-encapsulation itself. Solid lipid nanoparticles have also been associated with increased levels of penetration due to their direct effect on skin hydration, causing increased water retention in the stratum corneum because of film formation on the skin surface and effectively occlusion of the application site. Human skin absorption of nanoparticulate coated ZnO was relatively compared with published absorption rates for chemical sunscreens. Absorption levels, expressed as percentage of applied amount, through human epidermal membranes in vitro from a mineral oil vehicle of approximately 5–7% for oxybenzone, 0.03–0.14% for octocrylene, 0.07–0.17% for ethylhexyl methoxycinnamate and 0.09–0.2% for ethylhexyldimethyl.

The Australian Therapeutic Goods Administration (TGA) has noted that of the 1,200 sunscreens authorized by that Agency for supply as a therapeutic good in Australia in 2005, 70% of the sunscreens containing titanium dioxide ($TiO_2$) and 30% containing zinc oxide (ZnO)—both of which is common ultraviolet ray blocking agents—contained these insoluble metal oxide particles in a nanoscale. When reduced to nanoscale dimensions $TiO_2$ and ZnO become increasingly translucent which consequently provides sunscreens greater transparency when applied to the skin. The petition specifically addressed the increasing use of TiO2 and ZnO nanoparticles in sunscreens, and requested that the FDA, 'declare all current available sunscreen drug products containing engineered nanoparticles of zinc oxide and titanium dioxide as imminent hazard to public health. The TGA has set concentrations of $TiO_2$ and ZnO that are permitted as active ingredients in sunscreens listed on the ARTG. Under this framework, the ARTG does not differentiate between listed ingredients such as TiO2 and ZnO based on their size.

Originally this was because the quality and safety of these ingredients in molecular form had been established and no smaller forms were available. The development of ENPs and publicity surrounding their potential toxicity however, has required the TGA to assess whether the use of $TiO_2$ and ZnO now requires further regulation. If ENPs used in sunscreens were found to have different properties from their bulk counterparts according to TGA policy they would have required separate safety assessment by manufacturers in keeping with their status as new active ingredients. The TGA has taken the position that sunscreen products containing active $TiO_2$ and ZnO ENPs do not require their own quality and safety review (TGA 2006;. The rationale for this approach has been that the ENPs in question do not pose any new risks to human health. A 2006 review by the TGA states, 'there is no evidence that sunscreens containing these materials pose any risk to the people using them' (TGA 2006). 'Current investigations of nanoparticle penetration into the skin using static imaging technology are unable to detect small fractions of nanoparticles reaching the dermis, vascular bed of the dermis, and hence, the blood stream. However, if the dose of nanoparticles is very large, as is the case for $TiO_2$ in sunscreens, even fractions as small as 10-4 may cause accumulation and subsequent inflammation in secondary target organs'. The study by Tan et al. involved application of a $TiO_2$ sunscreen preparation twice daily for a period between 2–6weeks to the skin of thirteen patients with a mean age of 71years, who were to undergo surgical removal of the skin due to lesions. Once excised the concentrations of $TiO_2$ in the skin was measured and compared against controls.

Lademann et al. obtained similar results with one in every ten hair follicles containing microfine $TiO_2$ and no $TiO_2$ observed in surrounding tissue. Using tape stripping and transmission electron microscopy Pflucker et al. also found that $TiO_2$ particles (20–50nm) applied to porcine skin were isolated within hair follicles. The cellular hazards of $TiO_2$ and ZnO in nanoparticulate form are generally considered well established. Ultra violet irradiation of crystalline $TiO_2$ has been found to produce reactive oxidative species (ROS) damaging to cancer cell lines and human fibroblast cells. Manufacturers coat TiO2 with inert substances to decrease the potential for ROS generation due to irradiation.

### 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 aphoto reactivating enzyme obtained from a marine plant, Anacystinidulans.[6]

### 3.13. Transferosomes

They are more elastic than liposomes and have greater efficiency. It isused in anti-wrinkle cream.[6]

### 3.14. Ultrasome

Ultrasomeis also used in anti-wrinkle cream. It helps to prevent the damage of collagen andelastin 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)

Nanoemulsion mainly consists of three components water phase, oil phase and surfactant phase. Emulsion mostly occurs due to low energy and high energy method. In high energy method ultrasound method is used. In which avocado oil-nonionic surfactant and octyl methoxycinnamate are used as an emulsion component in which avocado is oil and octyl methoxycinnamate is used as a water phase. In sunscreen products Nano emulsion consist of 5% avocado oil, 1% octyl methoxycinnamate, 0.25% titanium dioxide in cosmetics oil, polyoxyethylene is used as surfactant. These oils are 56.6% rapeseed oil, 35.5% miglyol and 8% salmon oil. In low energy emulsion component is W/O phase. In low energy method emulsion oils are leylammonium chloride – oleylamine –$C_{12}$ $E_{10}$/hexadecane is used. Thus, emulsion has potential to shape the future of cosmetics products.

In cosmetics, 312 patents have been discovered related to dermatology or cosmetics. Nano emulsions droplet size is ranging from 50 to 1000 nm. These particles can exist in W/O or O/W.NEs do not need high surfactant concentration. therefore, they are useful for skin, because surfactant concentration more than 20 % can be irritating to the skin.[8] There are some features related to NEs which give them importance in cosmetic industry such as they have larger surface area and free energy , they can be transformed in a variety of ways such as foams , creams , liquids and sprays and they are less irritating.[31, 37, 42] It has a pleasant and light fixture, and it can enhance the penetration of active ingredients in skin and hair. By using Nano emulsion to encapsulate active ingredients and carry them deeper into hair. They do so by increasing drug penetration into the hair follicle openings and can act as a depot for a sustained drug release within the hair follicle. Nano emulsion are used in cosmetic products i.e. conditioners or lotions which apply to skin, hair, optical, tactile, texture properties made them highly attractive for cosmetic or consumer products.[29, 40]

### 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 nanoparticles. It has been on the market since.[27]

### 4.2. Replacement of NEs from Vitamin A

Vitamin A can be used to cure many skin diseases like acne, wrinkles and hyper pigmentation. All traus retinoic acicl or tretinion is used for prevention of skin aging magnification such as dark spots and wrinkles, but its use in dermatology is limited because it induces skin irritation. To reduce side effects of cosmetic formulation, tretinoin can be replacedWith Vitamin A, and its alternative such as retinol, retting palmitate (RP). RP is the less irritating and can keep the skin in good

condition association of vitamin A derivatives with various delivering system has been studied to enhance efficacy of Active compound. In this study, the focus is made on the self-Nano emulsifying system aim to improve skin penetration of lipid soluble with vitamin A derivative NEs have gain great interest in recent years due to reduce skin water loss, improve skin hydration, and improving product performance.[10]

## 5. Lipid Nanoparticles

Keeping in mind the fact that skin is composed of a matrix of connective tissue (epidermis) that rests upon the dermis (confining the nerves, blood and lymphatic vessels), it is most likely that lipid-based formulations will be the most appropriate for topical application of actives. SLN and NLC play an important role because of their submicron-size and pearl-like nature. Submicron-sized particles show adhesive-eness when in contact with surfaces. This property has been demonstrated for polymeric nanoparticles and for liposomes. Lipid nanoparticle suspensions are suitable for the purpose because when applied onto the skin, the pressure leads to fusion of the particles forming a dense film. Cosmetic formulations can be used for simple toiletry and protective purposes or can have additionally some skin activity. Regarding the use of lipid nanoparticles, these show some advantages related to their solid core, and the main points to be considered are the release of the active ingredient and its penetration into the skin layers. Lipid nanoparticles proved to have a synergistic effect of the UV scattering when used as vehicles for molecular sunscreens. The first two cosmetic products based on NLC technology were introduced to the market by the company Dr Rimpler GmbH in Wedemark/Hannover, Germany. The products Nano Repair Q10 cream and NanoRepair Q10 Serum (Dr. Kurt Richter Laboratorien GmbH, Berlin, Germany) were introduced to the cosmetic market in October 2005 revealing the success of lipid nanoparticles in the anti- ageing field. In the first 3 h, similar release patterns were observed between lipid nanoparticles and oil droplets because of the release of perfume from the outer layers of the particles. During the remaining 10 h, the release from SLN was prolonged. After 6 h 100% of perfume was released from the emulsion, but only 75% was released from SLN. Solid lipid nanoparticles and NLC have remarkably wide range of properties and have shown greatly to control the skin penetration of several actives. In addition, they do not show toxic effects, and can therefore be safety used in dermatological and cosmetic preparations to achieve distinct features. However, to appreciate the implications of dermatological and cosmetic preparations, the dynamic character of the epidermal tissue needs to be kept in mind in the development of preparation in accordance with the requirements. This means that natural defensive barrier needs to be respected and this can be accomplished with SLN and NLC because of their biocompatible chemical nature. Nonetheless, SLN and NLC being composed of lipid materials, and if these are for topical applications for sunscreen formulations, only two UV blockers (i.e. titanium dioxide and zinc oxide) have been considered as unsafe because of the risk of dermal absorption. For such particulate-loaded lipid nanoparticles, special toxicological studies should be performed.

## 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 $Zn_O$ at size 20-30nm.$Zn_O$ 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 $Zn_O$, 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 mater-ials 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% BMDBM (butyl-methoxydibenzoyl methane) and 90% OCT

(octocrylene) in the vegetable oil results in increase of anti-oxidative property and UV absorptive properties. Vegetable oils slowly release BMDBM 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 nano-particles, 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

Body modification is carried out in the form of cosmetic surgery by using Nano-medicines. Nano-medicines are effective on skin as they make the body or face blemish free, uniform in color, smooth, fat free and wrinkle free. Use of nanomedicines like titanium dioxide in anti-aging creams makes the women beautiful and young. Now-a-days women rapidly move towards cosmetic surgery which may be due to cultural pressure. The use of nanomedicines may be harmful and can cause tumors if they cross the barrier between blood and brain, blood and air. So people should be well informed with the causes and effects of Nano-medicines.[20] European Union Cosmetics Regulations and Hygienic Standards for Cosmetics of China have designated chloramine-T as a restricted substance. According to the Hygienic Standard for Cosmetics of China, the maximum level for chloramine-T in cosmetics is 2 × 103 mg/kg.

Therefore, developing a selective, accurate, and sensitive analytical method for determining chloramine-T in cosmetics is important to protect human health.[23, 44] Most of Products are discussed in **Table.2.**

## Acknowledgement

This research study is done just to highlight the scope of nanotechnology in cosmetics in terms in dermatology and skin care products carried out by many researchers in recent years. So, further work can be done on same work. Corresponding Author say thanks to all staff of chemistry department, especially to Mrs. Erum Maharvi, who guided him too much during this study.Authors declared thatno assistance or funding was achieved from university, any other Research Centre or Cosmeceutical/Pharmaceutical industries. Authors also declared that they have no conflict of interest to disclose in future.

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