

Nano-Cosmeceuticals: An emerging Novel trend towards Dermal care

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ABSTRACT

In today's world consumers are looking for personal care products that supply multiple benefits with minimal efforts. They also expect the latest technology advances to be incorporated into innovative formulations. The trend toward therapeutic cosmetics will lead to a better understanding of modern ingredients and their assessment techniques. In this review, we highlighted the most important scientific articles, expert opinions by regulatory authorities, and patent literature from Europe and the USA for the time period between 2000 and 2010 concerning the use of nanotechnology in dermatological, dental, and hair-care products intended for improving the appearance of the user. We briefly discussed public opinion of nanotechnology in general, and include the most important definitions related to this emerging technology along with a summary of the general characteristics of nanoparticles and their safety aspects. In recent times, application of nanotechnology is rising in the arena of cosmeceuticals and seems to be promising in overcoming certain drawbacks associated with the traditional products. The nanotechnology-based delivery techniques have proved to offer advantages of greater stability, higher efficacy and have also been reported to show prolonged effects.

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Introduction

In the 21st century nanotechnology is considered as the most eventual expertise, and defined as the critical understanding of how a substance reacts or works at a nano-scale formulation that has novel characteristics [1]. Nanotechnology deals with the exploitation of structures of substance or material. Particles size ranges 1-100 nm are called as nanoparticles, having one or more external size or an internal structure, on the nanoscale [2]. The development of nanotechnology-based nanocarrier's formulations shows impending for skin administration. Nowadays, this growing technology plays a momentous role in the increasing of

conventional drawbacks associated with cosmetics and analogous products. Nanotechnology entered in the cosmetics and health products field, nearly 40 years ago. The Food and Drug Administration (FDA) give details about cosmetics as "A substance which applied to the human body or any part thereof for purification, beautifying, cleansing, promoting magnetism, or altering the look" [3].

Cosmeceuticals refer to the combination of cosmetics and pharmaceuticals. Cosmetic products are that substance or material which was applied on the external part of the human body like epidermis, nails, lips or hair. It also uses as perfuming or cleaning agent for the mucous membrane of the oral cavity. These are

cosmetic products with biologically “active” ingredients to treat, heal or renovate skin tissue also in the treatment of photoaging, wrinkles, hyperpigmentation to hair damage. They are actuality more than pure cosmetics and, hence, the term “cosmeceuticals” was coined [4, 5, 6]. Nanotechnology in the development of Cosmeceuticals offers various advantages like targeting the active remedial constituent to the specific site; better skin retention; increase the stability of cosmetic ingredients; better appearance and sustained release of active ingredients for steadfast effect [7]. Nanoparticles from different cosmeceutical materials applied on the skin can have toxic effects when enters into the blood stream. In the study of cosmetology, two critical uses are present on the basis of nanotechnology. The first approach is the application of nanoparticles as UV filters. Titanium dioxide (TiO₂) and Zinc Oxide (ZnO) are used as a compound for the application of these. And the second approach is nanotechnology as a delivery system. Liposomes and Niosomes are used in cosmetics as delivery vehicles [8]. Nanocrystals, microemulsions, nanoemulsions and dendrimers are another nanoparticle that are used in the cosmetics industry. Fullerene is also applied as novel carriers for beauty products [9].

Nanomaterials, Human and Environmental Risk Assessment:

Nanoparticles might be chemical, physically, electrically and biologically different from their broad parts regarding the protection of formulated nanomaterials like fullerene, nanotubes, nanoparticles etc [10]. To enlarge and promote the application of nanotechnology for In order to promote and enlarge the application of nanotechnology for profitable use, The United States, Japan and Europe with other nation, formulated to evaluate hazards, posed by nanomaterials in sensible exposure conditions. Reliable and revealing hazard and safety evaluations for nanomaterials targeted to ensure their protection for the environment and human health. Physico-chemical properties manipulate the activity of nanomaterials. [11, 12].

Advantages: [13, 14]

- Nanotechnology targets to make cosmetic product more effective, long lasting and protectives.
- Used to protect hair and also used as a safeguard for active ingredients like vitamins, anti-oxidants

and their frothiness and clearance.

- Used to improve UV protection when combined with organic sunscreen like hydroxyl-4-methoxy benzophenone and decrease the concentration of UV absorber.
- Enhances the activity of cosmetics.
- Used in the treatment of damaged skin and also protect from UV rays.

Disadvantages:

- Due to smaller particle size, they are highly chemically reactive, as a result, it may damage proteins, membranes and DNA.
- In a study it has been proved that nanoparticulate shows toxic effect on human tissue and cell cultures Nanomaterials has proved toxic to human tissue and cell cultures, hence increase oxidative stress and cell death.
- It proved that titanium dioxide cause oxidative damage to DNA, toxic to the skin, may also cause cancer.

Novel Nano Carriers Based Cosmeceuticals:

Liposomes:

Now a day's various approaches have been designed for delivering a therapeutic substance to the target site in a sustained controlled release fashion. One such approach is by the help of liposomes as a carrier for the drug. Liposomes are spherical polymolecular concentric bilayer vesicle. They are used in an assortment of cosmeceuticals they are biocompatible, biodegradable, non-hazardous, flexible vesicles, it can encapsulate active ingredients and are suitable for the release of both hydrophobic and hydrophilic compounds [15]. In the study, researchers have deliberated the effects of the liposomal system on several compounds: tretinoin is an anti-acne agent i.e. Used in the pharmaceutical product. Liposomes were investigated for the first time in 1980 as a topical delivery system for dermatological agents into the skin [16] since then studies on liposomes for the dermal application have progressed. The first liposomal cosmeceuticals become visible on the market was Capture ®, in 1986 Christian Dior® launched an anti-aging cream. The Capture® claimed to be innovative as they used Liposomes in their product which prevents wrinkles [17]. Estee Lauder launched their product, the liposomal delivery system in Advanced Night Repair Protective Recovery

complex Serum®, targets free radicals into the skin and helps to repair the skin naturally. Liposomes enriched hydrating treatment gel, nourished and deeply penetrate into the fragile skin around the eyes and also soften fine lines of the face, this claimed by the Urban Sense®. Liposomal gel integrated with vitamins and botanical extract penetrate into the skin to nourish skin cells and soften fine lines [18]. Liposomes used in Kara vita's Clean It® products such as mist, lotion, spot treatment etc for controlled release of botanical activities and deeply penetration, including tea tree oil, for all-day detoxifying effect [19]. Glutathione in Liposomes, formulated by Rosenblatt and coworkers [20] explained that daily consumption of 12.5 or 50 mg/kg of liposomal glutathione, leads reduction of atherosclerosis development. In a research, Leitner and Coworkers explained that Permeation of human growth hormone from corner to corner nasal mucosa in vitro and in vivo enhanced by 0.5% of glutathione in the aqueous nasal gel. Recently, glutathione used in cosmetic products as a depigmenting mediator in skin lightening and as antioxidant for skin lipid protection [21]. Glutathione in depigmentation might involve direct inactivation of tyrosinase enzyme. Presently, glutathione via parenteral and oral administration is preferable for systemic therapy. Glutathione have a positive charge at physiological pH, therefore, topical administration is limited for skin penetration. Glutathione confirmed as the application of skin lightening, anti-aging and anti wrinkle products.

Advantages of liposomes in cosmetics and dermatology are as follows:

1. They are biodegradable and nontoxic.
2. They show controlled release activity for many substances.
3. It enhances the activity of drugs such as skin penetration, vesicle adsorption, fusion onto the skin surface, and interaction of the lipid of liposomes and the stratum corneum.

Niosomes:

Niosomes are non-ionic vesicles that have an analogous arrangement to that of phospholipids vesicles. They are used to encapsulate aqueous solutes and act like a drug and cosmetic carriers. It has been originated for the application of percutaneous drug delivery. [22] Niosomes have also been used as the deliverance of anti-inflammatory, anti-infective agents and it also enhances transdermal drug delivery

system. Niosomes were formulated and patented by L'Oreal (www.loreal.com) in the 1970s and 80s [23, 24]. Niosomes are used as delivery vesicles prepared by non-ionic surfactants which are biodegradable and reasonably not dangerous. The stability of niosomes is greater than liposomes [25].

Nowadays, 70-80% of teenagers suffer from skin acne disease. For the treatment of acne, topical therapy plays an important role. Some adverse effects allied with topical anti-acne agents may influence the patient satisfaction and their efficacy. Niosomes plays an important role in increasing penetration of anti-acne agents when applied topically and reduces their side effects. [26]. A macrolide antibiotic drug (Benzoyl peroxide) commonly applied in the acne agents either alone or in the combination. Benzoyl peroxide has some adverse effects such as irritation, itching, skin redness, rashes and edema which may discomfort the patient and it leads the ignorance of therapy. In a research, the researcher explained that niosomal Benzoyl peroxide intended with HPMC gel was premeditated and optimised by limited factorial design. Improvement in drug skin retention, comprehensive drug release and improved drug penetration from corner to corner of the skin explained by the ex vivo release study on human cadaver skin. It will reduce the toxicity of drug and improve the remedial effects [27]. Gallidermin has great action against multidrug-resistant staphylococcus Aureus strains and propionibacterium. According to the characteristics or property of Gallidermin they are widely used for the treatment of dermal and cosmetic formulation of acne [28]. Anionic niosomal Gallidermin was prepared with the adoption of Tween61/dicetylphosphate/cholesterol.

Antibacterial activity of that preparation against S.Aureus and propionibacterium acne was assayed with macro dilution method which minimizes the concentration of the sample to kill or inhibit the microorganisms. The result of the study showed that Niosomes loaded with Gallidermin gives minor antibacterial activity against microorganisms as compared to unloaded Gallidermin because it makes sustain release of the drug into the skin. Gel formulation of Niosomes shown more stability at high temperature. Because of chemical stability and high skin localization with no hazards of systemic effect, anionic niosomes of Gallidermin used as a better topical antibacterial preparation. [29].

Advantages of niosomes are as follows:

1. Niosomes are water based vesicles so they have a better patient compliance as compared to the oil-based emulsion.
2. They are particularly helpful for drugs with low absorption and high 1st pass metabolism.
3. They enhance their oral bioavailability by delaying excretion of drugs and decreasing drug availability for metabolism.
4. They can be used to delivery of drugs through oral, parenteral and also through topical routes as they are quite stable and osmotically active.

Nanoemulsion:

Nanoemulsions are “ultrafine emulsions”, due to the formation of droplets in the submicron range. The size of the droplet of nanoemulsion is in the range from 50 to 1000nm. In recent years nanoemulsions are used as potential vehicles for the application of personal care for control drug delivery of cosmetics. [30]. They are generally used in hair and skin care, deodorants and shampoo products. Due to good sensorial properties, they have simply valued in skin care i.e. rapid penetration, absorption textures and its biophysical properties mainly, hydrating power. They are commonly prepared by milky emulsions with the help “high energy emulsification method” of highly specialised mechanical devices, e.g., a high shear stirrer, a high-pressure homogenizer or an ultrasound generator. The dispersed nano-droplets of nanoemulsion easily penetrate through the stratum corneum, the outermost layer of skin [31]. This has experimented for dibucaine, lidocaine, tetracaine and their hydrochloride salts [32, 33].

Diphenhydramine hydrochloride (hydrophilic drug) from water in oil nanoemulsion investigated as a transdermal delivery system for excised human skin. The formulation transdermal delivery of the hydrophilic drug Diphenhydramine hydrochloride from a W/O Nanoemulsion into excised human skin have also been investigated. The Combinations of Span 20 and Tween 80 with IPM based formulation were established. A formulation containing oleic acid and cholesterol were tested which shown that oleic acid had no quantifiable effect whereas cholesterol increases drug penetration. Authors evidently verified that penetration properties can be modulated by compositional selection. Due to high solubilization perspective of nanoemulsion for hydrophilic and lipophilic drugs, the better-quality transdermal fluctuates and generates better thermodynamic action towards the skin [34, 35, 36]. Nanoemulsions may also

have an effect on the permeability of drug into the skin. In that case, nanoemulsion components act as permeation enhancers. For the improvement of transdermal permeation, many components are used in nanoemulsions, by varying the structure of the stratum corneum. Short chain alkanols broadly used as a permeation enhancer [37,38]. Nonionic surfactants are extensively applied in topical preparation as solubilizing agents and it may also affect the skin barrier function [39] O/W emulsion products patented by L’ Oreal, contains filters such as Restylane® and Radiesse® which can use as a cosmetic and dermatological applications. They are appropriate for all type of skin. Korea’s Red Vine Hair® sunscreen used as microemulsions and protects hair from UV radiation in the presence of water-resistant UV filters [40].

Advantages of nanoemulsions:

1. Nanoemulsion enhances the adhesiveness and permanence of nail polish compositions.
2. Used as a carrier in nail enamel and kept it in good condition.
3. Increase absorption rate.
4. Nanoemulsions improve the transdermal delivery of drugs over the topical preparations such as emulsions [41] and gels.
5. Nanoemulsion permitted for hair to give shiny and

Disadvantages of nanoemulsion are as follows:

1. Its solubilising capacity is restricted for high-melting substances.
2. Environmental parameters such as temperature or humidity fluctuate the stability of nanoemulsion.

Nanocrystal:

Nanocrystals have dimension ranges from 10–400 nm and are used as a delivery of meagerly soluble active ingredients [42]. In a study, compared to the water-soluble rutin glycoside (rutin attached with glucose) the nanocrystal formulation of novel rutin molecules shows 500 times greater bioactivity [43]. La Prairie having hesperidins, a glycoside plant antioxidant, is another product containing nanocrystal carrier. Lancôme, a French company, launched an anti-wrinkle cream ‘Renergie Microlift’ [44, 45]. Juvedical having rutin is the first cosmeceutical product containing nanocrystal, marketed by juvena in 2000

[46]. Poorly soluble drugs containing nanocrystal can also be included in cosmetic products and gives high penetration on a dermal application.

Nanocapsules:

Nanocapsules are a liquid/solid formulation, having measurement ranges from 10nm to 1000nm. In that, the active ingredient is placed into a cavity, enclosed by a polymer membrane made-up of natural or synthetic polymers [47]. In another investigation, it was reported that the nanocapsules decrease the penetration of UV filter octyl methoxycinnamate in pig skin as the model when correlated with conventional emulsions [48]. Depending on the nature of the material (hydrophobic or hydrophilic) different types of nanocapsules to be incorporated. Polymer capsules could be included into perfumes to release the therapeutic agents on exposure to sunlight or hot weather. It shows great stability in aqueous solution, nontoxic and biodegradable.

Advantages of nanocapsules:

1. Nanocapsules are widely used in UV filter to protect skin.
2. It gives protection against UV-induced erythema.

Dendrimers:

A dendrimer have special characteristical structure around the core, and habitually adopts a spherical three-dimensional morphology. The kome dendrimer is one of the first dendrimers, synthesised in 1985 [49]. Dendrimers have also been used in the cosmetic industry. Quite a lot of patents have been used for the application of dendrimers in cosmeceutical products. Dendrimers have been used as a carrier and act as controlled release from the inner core. A patented product of L'Oreal consisting of hyper branch polymer or dendrimer forming a film when deposited on substrate its application contains a variety of cosmetics e.g. Mascara or nail polish. Dendrimers for artificial skin tanning have also been formulated by L'Oreal. A patented product of Unilever, hydroxyl-functionalized dendrimers from polyester units is created for the application in sprays, gels and lotions. [50]. A patented product consisting of carbo siloxane dendrimer claimed that it gives good water resistance, tangible sensation, glossiness and adhesive properties to the skin and hairs [51].

Cubosomes:

Cubosomes are the bicontinuous cubic liquid crystalline phase of submicron nanostructured particles [52]. They are used as antiperspirants and topical application. Many types of research of cosmetic companies like L'Oreal and Nivea is trying to make use of cubosome as oil-in-water emulsion stabilisers and contaminant absorbents in cosmetic product [53, 54]. They are formulated by mixing of water and a microstructure at a specific ratio with the help of self-assembly of crystalline particles of surfactants [55]. Cubosomes recommend as a low viscosity, large surface area, and it capable of existing at almost several dilution levels. They are capable of carrying hydrophilic and hydrophobic molecules and having elevated heat stability. Low-cost raw materials along with a potential for control release are a beneficial choice for cosmetic use as well as drug delivery.

Nanogold and Nanosilver:

Gold and silver nanoparticles are widely used in cosmeceuticals due to its antibacterial and antifungal properties. It considered as more valuable in cosmeceuticals because of their antibacterial and antifungal properties. A silver containing ointment claimed that it gives antibacterial activity and can be used for the application of skin wound disinfection and skin inflammation [56]. In a study, Dr. Philippe Walter and temper, a French scientist, tried to synthesise fluorescent gold nanoparticles inside the human hairs [57]. It comprises a solution of the gold compound in which white hairs are soaked. After sometimes the colour of hair changes from pale yellow to darken deep brown. The researcher ensures that the hair particles are formed inside the hair's central core cortex. It has been observed that gold colour still remains after continues washing of hairs [58]. Cosmetic researchers are harnessing the increase antibacterial properties of Nanosilver in a broad range of applications. It has been claimed by the manufacturer that underarms deodorant containing silver provides 24-hour antibacterial action. Nanosilver is being added in toothpaste as it has highly efficient antibacterial activity that's why it also has been used to disinfect the bacteria present in the mouth [59, 60].

Lipid Nanoparticles:

In the early nineties the 1st generation of solid-liquid nanoparticles (SLN) was developed as a substitute carrier system to the emulsion, polymeric particles and liposomes. These are particles of nanometer size having a solid liquid matrix. There are only droplets of

lipids were solid at body temperature and surfactants stabilised them [61]. Nanostructured lipid carriers (NLC) is the 2nd generation formulated by using In the second generation technology of the nanostructured lipid carriers (NLC), the particles are produced by using a mixing of a solid lipid with a liquid lipid. The occlusive property of SLN made it ideal for potential application in day cream further NLC were developed to overcome the demerits associated with SLN. When compared with SLN, NLC showed a greater loading capacity for no. of active components, decrease water content of suspension. SLN and NLC were a colloidal delivery system having cosmetic and dermatological application including penetration enhancement control property, enhanced absorption and skin hydration. [62,63]. SLNs are very trendy in cosmeceuticals. Due to physiological and biodegradable lipids properties, it shows low toxicity and used to increase skin hydration [64]. Now a day's too many companies marketed their products containing NLC or SLN. A German manufacturer, Dr Rimpler GmbH, introduces their 1st lipid nanoparticles based cosmetic product into the market as Cutanova cream Nano Repair Q10® in 2005. A cream containing NLC gives better skin hydration as compared to conventional o/w emulsion creams [65]. Chanel's Allure® aroma is integrated into nanoemulsions and SLN (gives prolong release perfume) [66].

Classes of Nano Cosmeceuticals

Sunscreens:

Harmful rays of sun on the exposure of skin have been protected by sunscreen lotion. Mineral-Based ingredients such as Zinc oxide (ZnO) and Titanium dioxide (TiO₂) are approved to protect the skin from harmful sun rays. It reflects UVA and UVB rays enter into the deeper layer of skin and is not provide irritation on the skin [78]. The main negative aspect of long lasting and conventional sunscreen is that it leaves white crumbly or dry layer on the skin. Sunscreen using nanoparticles are crystal clear, less oily, less greasy and less putrid and improved visual appeal.

Antiaging Products:

Lots of Chemical products, mental stress and pollution, irradiation from ultraviolet (UV) and infrared (IR) sources, and graze are troubled in skin ageing. Collagen plays a major role in skin transformation and wrinkle problem. Increasing age decreases the quantity of collagen in the skin.

Modification of surface line isotropy, wrinkles, loss of softness and texture, the appearance of spots, damaged barrier function and finally, dry out manifests the ageing of the skin. Too many cosmetic products are manufactured and marketed with claims of moisturising and lifting, antiwrinkle, skin toning and whitening activity. Recently L'Oreal using nanotechnology in their products such as Revitalift anti-wrinkle cream (contain Pro-retinol A) which reduces wrinkles [79].

Moisturisers:

The primary wall of the skin is stratum corneum, and it plays an important role as to keep inside in and outside out. Water, present in stratum corneum, gets evaporated and cause dehydration of the skin. Dehydration of skin can be fulfilled by using moisturisers and provide flexibility to the skin. Liposome, SLNs and nanoemulsions are generally used in moisturising formulations because of their long lasting effects.

Hair Care:

Too many companies use nanotechnology in hair production. In a study, researcher claims that nanoparticles used to prevent damage of hairs and it maintain silkiness, shine, and health of hairs. Cationic sericin nanoparticles are an active area of hair care production. In a study, it has been proved that sericin nanoparticles easily adhere on the surface of hairs to treat the damaged cuticles [80, 81].

Skin Cleanser:

The outermost covering of the body, skin is believed to be exposed to the secretions of sebaceous and sweat stands. The skin ensures a natural defence to prevent the entry of pathogens, pollutant/dirt from the environment. Various microorganisms attached to the skin surface, on reacting with film release by-products, sweat and odour [82]. It is very important to remove debris, odour and dirt to maintain skin health. It is also essential to remove soil (bacteria may include in soil) from the surface of the skin, acquired by the intentional application. For the skin disinfection and decontamination, silver nanoparticles are used [83].

Table 1. Marketed Product of Cosmeceuticals

Trade Name	Carrier	Brand	Use
Nano Gold® Energizing Cream	Nanoparticles	Neiman Marcus	Antiaging, Anti-inflammation
Nanorama™-Nano Gold Mask Pack	Nanoparticles	Laxon Nanotech Inc	Skin Tightening, Antiwrinkle
Royal Jelly	Liposome	Royalt Jelly	Antiwrinkle
Revita Lift® Line	Ninosomes, nanoparticles	L'Oreal	Skin Tightening, Antiwrinkle[67]
Hydro Flash® Broner Daily Face Moisture	Nanocapsule	Lancome	Self Tanning
Gold Future®	Colloid	Helena Rubinstein	Anti Free radical[68]
Happylogy® Glowing Skin Essence	Nanoemulsion	Guerlain	Antiwrinkle[69]
Platinum®	Nanoemulsion	Lancome	Antiaging
Renergie Microlift	Nanocrystals	Lancome	Antiwrinkle
Eye Tender	Nanosome	L'Oreal	Antiwrinkle
Eye Contour Nanolift	Nanosphere	Kara vita	Antiwrinkle
Nano Sun™	Nanoparticles	Micronisers Pt Ltd	Sun Sunscreen
Elixir Skin-up	Nanoparticles	Shiseido	Make-up Foundation
Radical Sponge	60 Nanoparticles	Vitamins C60 Bioresearch	Skin Treatment
Coside Whitening Mask	Nanocollids	Natural Korea	Face Mask
Cosile Nano Beauty Soap	Nanoparticles	Natural Korea	Cleanser
Lip Tender	Nanosphere	Kara Vita	Lip Moisturizer
Nanosphere Plus	Nanosphere	Dermoswiss	Antiaging
TEGO® SUN TS Plus	Nanoparticles	Degussa	Sun Screen
Nano Sal TM Moisture Key	Nanosphere	Salvonazs	Moisturizer
Capture	Liposome	Dior	Antiaging

Table 2. Patents on Cosmeceuticals

Title	Applicant	Publication Number	Publication Date	Ref.
Cosmetic composition containing retinol stabilized by porous polymer beads and Nanoemulsion	Act Co., Ltd.	EP 2583665A2	April 24, 2013	70
Multiactive microtargeted antiaging skincream polymer technology	NY Derm LLC	EP 20110798597	April 17, 2013	71
Biodegradable, biocompatible, and nontoxic material sheets consisting of said material and the use thereof in food, pharmaceutical, cosmetic, and cleaning products	Inis Biotech LLC	US 20130034638A1	February 7, 2013	72
Metal oxide nanocomposites for UV protection	BASF SEv	US 20130022655A1	January 24, 2013	73
Oil-in-water-type emulsion sunscreen cosmetic composition	Tomiko Takakura	US 20130011348A1	January 10, 2013	74
Synthetic collagen threads for cosmetic uses including skin wrinkle treatments and associated methods	Rebeccah Brown	US 20130018415A1	January 17, 2013	75
Preparation of cationic nanoparticles and personal care compositions comprising said nanoparticlesv	BASF SE	EP 2254545A2	December 1, 2010	76
Gel technology suitable for use in cosmetic compositions	Avon Products, Inc.	US 20100266649A1	October 21, 2010	77

Kojic acid has been utilised as a diet supplement, food additive, antibiotic, and skin lighting agent [84, 85, 86] Kojic acid has the ability to decrease depigmentation by promoting enzyme known as Tyrosinase [87]. At the concentration of 1.5 %, Kojolic acids treat hyperpigmentation condition. Hydroquinone, Glabridine, Arbutin are another skin lighting enhancer which will combine with Kojolic acid for a better response for e.g. Vitamin C has also been adjuvant with Kojolic acid, shows better activity over 2% hydroquinone to remove patchy discoloration and regulation of skin [88]. Presently, many marketed

products comprise of Kojolic acid along with skin lighting additives such as high potency lighting serum AHA skin gel, MelasofteR exhibit greater affinity towards skin disorders therapy.

Lip Care:

It is an another class of cosmeceuticals. Extraordinary nanoparticles have been added into the lip gloss and lipstick which gives smoothness and softness appearance. Korea Research Institute of Bioscience and Biotechnology have a patent that demonstrated

that pigments which exhibit a wide variety of colours using gold or silver nanoparticles are possible by mixing in different compositional ratios maintaining colour for a longer period of time [89]. Homogenous disturbance of pigments has been improved with the help of silica nanoparticles. Silica nanoparticles used in lipsticks improve the homogenous distribution of pigments. To avoid bleeding and migration of fine line of lips silica nanoparticles have been added to prevent the pigments [90]

Nail Care:

Nanotechnology based nail products provide an edge over conventional nail products. Cosmeceuticals have various advantages over conventional products. In a study, it was discovered that nanotechnology-based new products have more strength, and more resistance of mammalian nails [91] Nanotechnology research and development company developed and patented nano nail polish and lacquer which becomes very hard after drying and also have a better shock, scratching, cracking and chipping. These nail paints with nano-size particles have a good elasticity which can be applied easily without cracking [92]. Nanoparticles can be used to deliver antifungal agents on nail paints to treat a fungal infection of the nails.

Routes of exposure to nanoparticles

Health hazards depend on the route of administration and degree of disclosure of the substance. Nanoparticles intended into the body through three routes i.e. inhalation, ingestion, and dermal routes [93].

Inhalation:

National Institute of Occupational Health and Safety explained that the inhalation is the commonest way of exposure to airborne nanoparticles [94]. As nanoparticles are of small size they are easily prone to intracellular and cellular compound through the air in alveolar spaces. It causes toxicity so that deposition over NP's has been necessary to prevent pulmonary toxicity [95]. During the production of nanoparticles, there should be a safety protocol for workers who worked in manufactured area as harmful gases can be inhaled by workers leads to cause respiratory associated diseases [96]. In a study, it was observed by the National Institute of health that inhaled nanoparticulate pass through the nasal to brain and without difficulty enters into the blood, nervous system and other organs [97].

Ingestion:

Intake of nanoparticles possibly received from accidental hand to mouth transmission or from those type of cosmeceuticals which applied in the environ of mouth or lips for eg. Lipsticks, lip balm, lip gloss etc. After ingestion, the large size of nanoparticulate quickly eliminated from the body as well as small sized particulate might be absorbed by the body and thoroughly moves into the body [98]. In a study, different doses of nanoparticles range from 20 nm and 120 nm ZnO were given to mice orally which, on the basis of dose-response, showed the relationship between spleen and liver [99].

Dermal route:

Intracellular, trans follicular and transcellular are the three pathways of infiltration. There are three pathways of infiltration across the skin and these have been recognized as intercellular, trans follicular and transcellular [100]. The physicochemical properties of nanoparticles or carriers, the nature of drugs and the skin conditions linked with the movement of the nanoparticulate across the skin. Cosmeceuticals have been used in normal, healthy skin and also applied on the broken or damaged skin. A Recent experiment showed that nano products are applied topically and penetrate through pores of the skin and hair follicles.

Conclusion:

After the suggested use of nanotechnology in cosmetics, we mainly focus on nanomaterials as active substances, carriers and formulation aids. The new functionalities these materials are claimed to introduce were also described. The comparative data of the marketed products are shown for the formulation design. The developmental use of the nanoparticulate system in the cosmeceuticals mainly targets the affected area and led to a drastic makeover. Its flexibility of use and effect helps to prevent the upcoming disorders as well as skin related issues.

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