Review Article

Nanotechnology: An Advance Tool for Nano-cosmetics Preparation

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ABSTRACT

Nanotechnology represents one of the most capable technologies of the 21st century. Recently Nanotechnology is emerging in the field of cosmetics and it offers a rev**o**lutionize treatment of several skin diseases. It is proved effective in attaining safe and targeted delivery of active medicaments as well cosmetic ingredients. Use of carrier system in nanotechnology has added advantage of improved skin penetration, depot effect with sustained release drug action. The trend toward therapeutic cosmetics will lead to a better understanding of modern ingredients and their assessment techniques. To obtain skin care formulations with real consumer-perceivable benefits and to optimize sensory attributes, formulators are resorting to technology that until recently was exclusively used in cosmetic products. Various formulations comes under special delivery systems like Vesicular, Particulate systems, emulsions type Particulate type and other delivery systems along with their applications are shown in this article. The applications of nanotechnology and nanomaterials can be found in many cosmetic products including moisturizers, hair care products, make up and sunscreen. Many modern cosmetic or sunscreen products contain nano-sized components. Nanomaterials are now being used in leading cosmetic products, most commonly as chemicals used to give the protection in sunscreens. This review paper looks into some of the nanotechnologies used in the cosmetic industry and provides an overview of current activity in this area. Thus, novel cosmaceutical delivery systems reviewed here possess enormous potential as next-generation smarter carrier systems.

Keywords: Application, nanocarriers, nano-cosmetics products, nanomaterials, safety data

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INTRODUCTION

Nanotechnology is nothing but the fundamental understanding about how materials react or works at nano scale (i.e. at atomic, molecular or subatomic level) in the creation and utilization of structures, devices and systems that have novel properties and functions. Nanotechnology deals with manipulation of structures of matter in the size range of 1-100 nanometers. Particles of these size ranges are called as nanoparticles which are having one or more external dimensions or an internal structure, on the nanoscale and could exhibit novel characteristics compared to the same material without nanoscale features [1].

Nanotechnology is a key technology leading to product innovation. Nanotechnologies use materials on an incredibly small scale so that they take on new properties compared to their larger form. The technology has the potential to transform many of the everyday consumer products that we use and a wide range of products are already on the market. Nano-cosmetics is one area of particular interest as new types of products can be made using nano materials. UV filters used in sunscreens produced in nano form, these materials could be more hazardous and behave differently in the body compared to larger forms.

Nanotechnology entered the field of cosmetics and health products nearly 40 years ago with liposome moisturizing creams. The increased usage of nanomaterials in cosmetic products is indicative of the huge potential

nanotechnology represents for the cosmetics industry and its consumers. A number of nanomaterials types are already in use, including nanoemulsions and nanoparticles of minerals present in our natural environment, such as titanium dioxide (TiO2), zinc oxide (ZnO), alumina, silver, silicon dioxide, calcium fluoride and copper. The unique properties and behaviour of nanomaterials mean that nanotechnologies could profoundly transform industry and everyday life [2].

Nanoemulsions, for example, are transparent and have particular rheological properties that have yet to be obtained by other formulation methods. This allows them to increase the content of nutritious oils while preserving not only the transparency but also the lightness of formulas. Certain mineral nanoparticles, such as TiO2 and ZnO, are highly efficient UV-filters, able to reflect and scatter the visible part of solar radiation while absorbing UV light. Given these properties, they are extensively used in sunscreens. Other examples of nanocosmetic products on the market include body firming lotion, bronzer, exfoliant scrub, eye liner, and styling gel, etc. Nanoemulsions have recently become increasingly important as potential vehicles for the controlled delivery of cosmetics and for the optimized dispersion of active ingredients in particular skin layers. Due to their lipophilic interior, Nanoemulsions are more suitable for the transport of lipophilic compounds than liposomes. Nano-pigments are custom built to stay on the surface of the skin and are a major component of some sunscreens. The third class of non-enhanced cosmetics includes fullerenes or fullersomes that are used as cages for active ingredients. Only two companies claim to use fullerenes in their cosmetics. Some fullerenes, specifically carbon based, might be hazardous when inhaled and they may oxidize some cells. In addition, they can be absorbed transdermally, i.e., through the skin. Nano-emulsions have attracted considerable attention in recent years as potential vehicles for the controlled delivery of cosmetics and personal care products [3, 4].

Advantages:

- Use of nanotechnology in cosmetics is aimed to make fragrances last longer, sunscreens more effective and anti-ageing creams.
- To optimize manufacturing conditions for skin care formulation, a multi component system.
- To prevent hair from turning grey and also for prevention of in treatment of hair loss & used to preserve active ingredients, such as vitamins and anti-oxidants, and their lightness and transparency.
- To improve the UV protection in combination with organic sunscreens such as 2- hydroxy-4-methoxy benzophenone this allows a reduction of the concentration of the UV absorber.
- Nano materials used as UV filters in sunscreen products do have to be independently assessed, but we found nano zinc oxide in use, although it has not yet been fully assessed [5].

Another advantage is the small-sized droplet with its high surface area allowing effective transport of the active to the skin. Furthermore, nanoemulsions gain increasing interest due to their own bioactive effects. This may reduce the transepidermal water loss (TEWL), indicating that the barrier function of the skin is strenghthened. Nanoemulsions are acceptable in cosmetics because there is no inherent creaming, sedimentation, flocculation, or coalescence that is observed with macroemulsions. It is relatively recent but fast growing field of application: emulsion-based wet wipes for such applications as baby care and make-up removal [6].

Disadvantages:

- Smaller particles have a greater reactivity, are more chemically reactive and produce greater numbers of reactive oxygen species.
- It may result in oxidative stress, inflammation, and consequent damage to proteins, membranes and DNA.
- Nanomaterial has proved toxic to human tissue and cell cultures, resulting in increased oxidative stress and cell death.
- Photo-activated Nanoparticles titanium dioxide has been demonstrated to cause

oxidative damage to DNA in cultured human fibroblasts.

- Photo-activated titanium dioxide nanoparticles were toxic to skin fibroblasts and nucleic acids and to human colon carcinoma cells.
- Inhaled ultrafine particles induce pulmonary inflammation when the particles are quartz, minerals, dust, coal, silicate, and asbestos. These can induce pulmonary fibrosis, cytotoxicity, and even malignancy [6, 7].

ADVANCES IN COSMETIC FORMULATION TECHNOLOGY

There are number of innovative cosmetic delivery systems used in cosmetic products.

Nanoemulsion

The aesthetic properties, i.e. low viscosity and transparent visual aspects of nanoemulsion with droplet sizes below 200nm, its high surface area allowing effective transport of the active ingredient to the skin make them especially attractive for their application in cosmetics. Nanoemulsions are acceptable in cosmetics because there is no inherent creaming, sedimentation, flocculation or coalescence that are observed with macro emulsion. The incorporation of potentially irritating surfactants can be avoided by using high energy equipment during manufacturing. Nanogel technology to create miniemulsion from oil-in water concentrate suited to minimizing trans-epidermal water loss, enhanced skin protection and penetration of active ingredient. It would be useful for sun care products, moisturing and anti-ageing creams. It helps to give skin care formulations a good skin feels [8].

Nanoparticles

Solid lipid nanoparticles (SLNs) are nanometre sized particles with a solid lipid matrix. They are oily droplets of lipids which are solid at body temperature and stabilized by surfactants.

Nanoparticles of silver are now used in toothpastes, soaps and face creams, food packaging, clothing, household appliances, disinfectants and wound dressings. Silver nanoparticles have a potent ability to kill bacteria. Other examples of nano cosmetic products on of the Earth as far as starting that “[their] research demonstrates that nanoparticles have entered just about every personal care product on the market, including deodorant, the market include body firming lotion, bronzer, exfoliant scrub, eye liner, and styling gel. Friends soap, toothpaste,

shampoo, hair conditioner, antiwrinkle cream, moisturizer, foundation, face powder, lipstick, blush, eye shadow, nail polish, perfume and after-shave lotion [9].

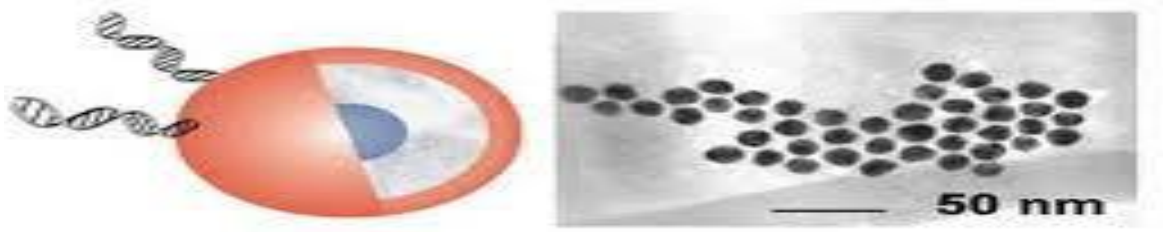


Figure 1: Nanostructure Lipid Carrier

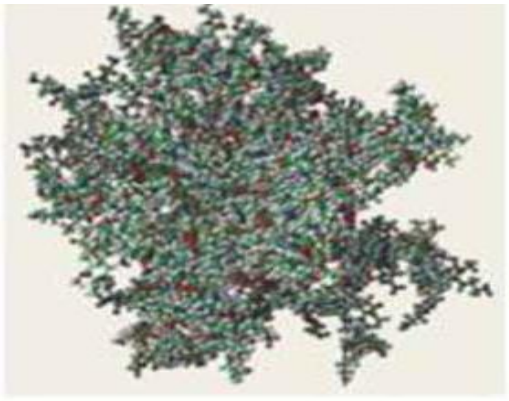
Nanocrystals

Nanocrystals are crystals having size less than 1µm. They are aggregates comprising several hundred to tens of thousands of atoms that combine into a "cluster". Typical sizes of these aggregates are between 10-400 nm. Nanocrystals of poorly soluble drugs can also be incorporated in cosmetic products where they provide high penetration power through dermal application. The first cosmetic products appeared on the market recently; Juvena in 2007 (rutin) and La Prairie in 2008 (hesperidin). Rutin and hesperidin are two, poorly soluble, plant glycoside antioxidants that could not previously be used dermally. Once formulated as nanocrystals, they became dermally available as measured by antioxidant effect. The nanocrystals can be added to any cosmetic topical formulation, e. g. creams, lotions and liposomal dispersions. Nanocrystals may be able to reduce the dose to be administered, provide a sustained drug release and increase patient compliance [10, 11].

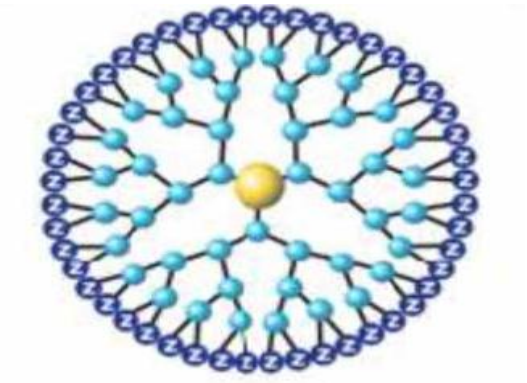
Dendrimers

Dendrimers are unimolecular, mono-disperse, micellar nanostructures, around 20 nm in size, with a well-defined, regularly branched symmetrical structure and a high density of functional end groups at their periphery. A dendrimer is typically symmetric around the core, and often adopts a spherical three dimensional morphology. One of the very first dendrimers, the new kome dendrimer, was synthesized in 1985. Dendrimers have also been considered for use in the cosmetic industry [12].

Several patents have been filed for the application of dendrimers in hair care, skin care and nail care products. Dendrimers have been reported to provide controlled release from the inner core. However, drugs are incorporated both in the interior as well as attached on the surface. Due to their versatility, both hydrophilic and hydrophobic drugs can be incorporated into dendrimers [13]. L'Oréal have a patent for a formulation containing hyper branched polymers or dendrimers which form a thin film when deposited on a substrate. This formulation could be used for a wide variety of cosmetics e.g. mascara or nail polish. They have also developed a formulation comprising of a tanning agent and dendrimers for artificial skin tanning. Unilever have a patent for hydroxyl-functionalized dendrimers from polyester units to create formulations for use in sprays, gels or lotions [14].



2D Graphical Diagram



3D Chemical Structure

Figure 2: G4 PAMAM Dendrimer

NANOMATERIALS USE IN COSMETICS PREPARATION

Nanotechnology manipulates materials on an incredibly tiny scale so nano materials are used in cosmetics to give them new characteristics. Nanotechnology has the potential to be used in different ways in the cosmetics sector, creating nano materials with different properties and therefore different risks and benefits [15].

The types of nano materials that are used include:

- Sunscreens – UV filters, such as titanium dioxide and zinc oxide, are used in nano form rather than bulk form to make the sunscreen transparent rather than white. It is also claimed that they are more effective when used in nano form [16].
- Nano emulsions and nanosomes – used to preserve active ingredients, such as vitamins and anti-oxidants, and their lightness and transparency.
- Fullerenes – new types of materials can be produced using nanotechnology, such as carbon fullerenes. It is claimed that these tiny carbon spheres have anti-aging properties.
- Other materials used in nano-size – a whole range of materials can be used in nano size in order to give them different properties when compared with their larger form. We found, for example, an 'energizing' moisturiser using nano gold and products using nano silver because of its anti-bacterial properties.
- Nano titanium dioxide is also widely used in sunscreens, although the EU's scientific committee wants to re-assess its safety when used on sunburnt and other damaged skin several other companies are using nano materials. It also indicated

that while some of the big brands are restricting their use of nano materials to nano emulsions and UV filters in sunscreens, many smaller companies are using a more diverse range of nano materials [17].

ROUTES OF EXPOSURES

1) Dermal absorption

Three pathways of penetration across the skin have been identified: intercellular, transfollicular and transcellular. The passive transport of nanomaterials through intact stratum corneum is considered highly unlikely because of the matrix of corneocytes, lipid bilayers within the intercellular spaces and the physiological environment below the stratum corneum containing high levels of proteins. If the skin is damaged, and the normal barrier disrupted, then the probability of entry of particles may be substantially increased. Follicular openings are compatible with particulate dimensions [18, 19].

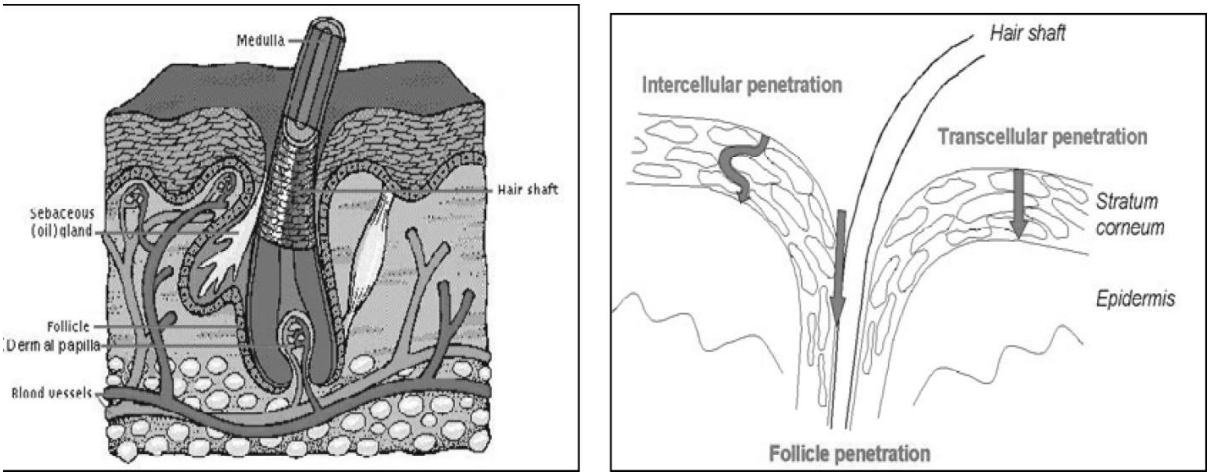


Figure 3: Skin permeation

2) Respiratory tract

The alveolar macrophages reside as free cells within the alveolar air spaces, from where they may migrate to the bronchioles and then, via the mucociliary escalator, to the lumen of the conducting airways. The alveolar macrophage plays an important role in the response of the lung to inhaled dusts and in the development of inflammatory lung disorders. Their essential function is phagocytosis and clearance of particulates and micro-organisms. The type II cell is a secretary cell and is considered to be the progenitor cell for type I cells [20].

3) Intestinal tract

Particulate uptake occurs not only in the gut-associated lymphoid tissue (GALT), but also in the normal intestinal enterocytes.

4) Eye

The eye only provides only a small surface area for potential exposure but be indirect exposure to Nanomaterial may occur through it by cosmetics intended for use in the vicinity of the eye or from other types of cosmetic products.

APPLICATIONS OF NANOTECHNOLOGY IN COSMETICS

1) Nanoemulsion for cosmetics

NEs have recently become increasingly important as potential vehicles for the controlled delivery of cosmetics and for the optimized dispersion of active ingredients in particular skin layers. Due to their lipophilic interior, NEs are more suitable for the transport of lipophilic compounds than liposomes. NEs gain increasing interest due to their own bioactive effects. This may reduce the trans-epidermal water loss (TEWL), indicating that the barrier function of the skin is strengthened. Several cosmetic products are available that use nanoemulsions, including Korres' Red Vine Hair sunscreen [21].

Several companies supply ready to use emulsifiers for creating stable nanoemulsions for cosmetic applications, including Nanocream® from Sinerga and Nano Gel from Kemira. Nanoemulsions are transparent due to the droplets tiny size and they also remain stable for a longer

period of time. They are mostly used in deodorants, sunscreens, shampoos, and skin and hair care products. The nanoemulsions are easily valued in skin care because of their good sensorial properties i.e. rapid penetration, merging textures and their biophysical properties especially, hydrating power. A significant improvement in dry hair aspect (after several shampoos) is obtained with a prolonged effect after a cationic nanoemulsion use [22].

NanoGel One of the example includes New Jersey –based TRI-K Industries and its patent company Kemira have launched a new Nano-based gel aimed at enhancing the efficacy of a wide range of skin care products. Kemira Nanogel is said to be a unique nanoemulsion carrier system that has been designed around easy formulation, combined with the added benefits brought about by its nanotechnology properties.

NanoGel technology provides a simple process and system to create submicron emulsions from an easy-to-use, oil-in-water concentrate. The formula is particularly suited to minimizing trans-epidermal water loss, enhanced skin production, and penetration of active ingredients. These characteristics suggest it would be particularly useful for sun care products as well as moisturizing and anti-aging creams_ particular areas where nanotechnology is already being incorporated into a host of products currently on the market. Likewise, it is also highlighted that it helps to give skin care formulations a good skin feel, an increasingly important characteristics of formulators [23].

2) PEG- free Nanoemulsions for Cosmetics

Another example includes manufacturing and processing of low-viscosity oil-in-water nanoemulsions that are free from emulsifiers based on polyethylene glycol (PEG). Such blends are highly attractive in the growing market for impregnating emulsions for moisturized tissue. It is relatively recent but fast growing field of application: emulsion-based wet wipes for such applications as baby care and make-up removal. The key components in these products are low viscosity O/W emulsions with good storage stability. Classical emulsions have typical particle radii of between 0.5 and 10 micrometers which causes their typical white appearance, and usually show viscosities of over 1,000 m Pas. They are kinetically stable, and can be manufactured with help of a homogenizer. Because their particles are relatively large, however, comparable viscosity systems are unstable and cream up. Alternatively, O/W microemulsions are easy to produce because of their thermodynamic stability. They are translucent, and their typical particle radii range between 10 and 40 nanometers [24].

3) Vitamin and gold loaded nanofibre facial mask for topical delivery

Conventional beauty face masks existing in the market are cotton masks that are pre-moistened with skin nutrients. The aqueous phase of the pre-moistened mask can raise the degradation rate of the unstable ingredients such as ascorbic acid. To overcome this problem a novel polymeric face mask have been developed that can accommodate several skin nutrients such as ascorbic acid, retinoic acid, gold, and collagen. Many marketing tactics include the inclusion of antioxidants and other skin nutrients into cosmetic products. The strength and function of the skin depends upon an important factor i.e. Collagen which also play an important role in skin rejuvenation and wrinkle reversal effect. The quantity of collagen in the skin decreases along with age; therefore, it is extensively used as a moisturizer in cosmetic creams and products. Generally Vitamin C (L-ascorbic acid) has been used in cosmetic and dermatological preparations for its photo protective action, ability to destroy free radicals and oxidizing agents. It can also encourage collagen synthesis and suppress the pigmentation of the skin. Vitamin C is chemically unstable, and can be oxidized very easily; therefore, more stable derivatives (with ability to convert into active compound i.e. ascorbic acid after ingestion) like ascorbyl palmitate, ascorbyl tetra isopalmitate, and magnesium ascorbyl phosphate formulated as a emulsion are extensively used in pharmaceutical industry [25]. Retinoic acid can be used in treatment of acne and also promotes the repair of skin damaged by ultraviolet and can decrease

wrinkles caused by photo-aging. Gold nanoparticles have been studied as potential vaccine carriers and in transdermal delivery. Nowadays Gold facial masks are being used in beauty clinics and saloons. It works by improving the blood circulation, skin elasticity, and thereby revitalizes the skin and also reduces the formation of wrinkles. Skin permeation studies demonstrate that spherical gold nanoparticle not inherently toxic to human skin cell [26].

4) Nanoparticale for cosmetics

Nanogold Facial Mask treatment of hair diseases

Particulate drug delivery systems rather than aqueous alcohol solutions are gaining importance in the treatment of hair disorders like alopecia androgenetica and alopecia areata. 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. Examples of nanoparticles used to treat hair disease are poly(lacticco- glycolic) acid, poly (e-caprolactone)-block polyethylene glycol, neutral liposomes, solid lipid nanoparticles. Due to lack of other therapeutic options, gene therapy of hair and the novel particle based drug delivery systems for a promising active follicular targeting of disease-related cell populations in the hair follicle are gaining importance [27].

Topical dermatotherapy

As nanoparticles drug delivery system had been developed firstly place for controlled drug release, it could be easily postulated that their use would prove beneficial for local treatment of inflammatory skin diseases as well. Glucocorticoids are key drugs in dermatology, but with side effects like skin atrophy which limits their chronic use. It has recently been shown that a targeting of the epidermis, where the inflammatory process takes place, instead of the dermis, can be achieved by using liposomal formulations, thus minimizing skin atrophy. Several other studies indicate that various drugs such as podophyllotoxin, cyclosporine A, tacrolimus methotrexate, psoralen, dithranol, clotrimazole and other antifungal drugs could be integrated in nanoparticles to achieve a better tolerability, an increased safety and an optimal therapeutic effect [28].

NANO COSMETICS PRODUCTS

Other products making nano claims include: [29- 32]

- Agera Nano Eye Lift claims it "provides the delicate eye area with the latest in anti-ageing skin care technology".
- Bionova Tennis Player Sun & Wind Protection for Dry Skin claims it "enhances facial skin resistance against harmful sun radiation, using specially developed nanocomplex of naturally existing UV Chromophores & UV Protectants". Bionova also offer tailored skin care products using nanotechnology.
- Chantecaille Nano Gold Energizing Cream claims that "nanoparticles of 24-karat gold are bound to moisturising, anti-oxidant and anti-inflammatory silk microfibre".
- Leorex Hypoallergenic Anti-Wrinkle Nano-Booster claims it "creates a silica nanoparticles network, which straightens and reinforces the skin matrix to protect the skin and improve appearance and that "the nano particles scavenge free radicals and toxins". It also produces a Neck & Decollete Hypoallergenic Anti-Wrinkle Nano Formula.
- Purelogicol Instant Lip Plumper claims to be based on "the breakthrough MVS LIPS™ nano-technology".
- Rosactive Biomixyl treatment claims to be "an advanced anti-wrinkle collagen treatment that stimulates the natural collagen production without using external collagen. Based on nano proteins".
- Salcura Zeoderm Skin Repair System claims that "Zeoderm+ is a unique blend of nanominerals and vital nutrients, suitable for adults and children who may be prone to dry and irritated skin symptoms like eczema, psoriasis, dermatitis and skin allergies".
- StrVectin-NE Hand Kit claims that its "thermo-active NanoExfoliating technology delivers substantial dermabrasive properties without causing lasting redness or damaging the skin".
- Tracie Martyn Shakti Resculpting Body Cream claims to be "using nano-technology to deliver natural black

currant lipids deep into the skin for moisturization.

- Breast cream: St Herb Nano Breast Cream claims it is a combination of "nanotechnology and the timeless Thai herb, Pueraria Mirifica" and that nanosomes "expands the cellular substructure and development of the lobules and alveoli of the breasts", with increased size from one to three cups.
- Hair care: RBC Life Science's Nanoceuticals Citrus Mint Shampoo and Conditioner are made with NanoClusters TM, "nanoclusters to give your hair a healthy shine".
- Make-up: Serge Lutens Blusher's Nano Dispersion technology "creates an extremely fine and light powder with extraordinary properties: excellent elasticity, extreme softness and light diffusion".
- Moisturisers/anti-wrinkle creams: Lancôme Hydra Zen Cream with "nano-encapsulated Triceramides renew skin's healthy look"; L'Oreal Revitalift Double Lifting anti-wrinkle cream is their "first double-action cream that instantly re-tautens the skin and reduces the appearance of wrinkles", and contains Nanosomes of Pro-Retinol A.
- Toothpaste: Singe's Apagard claims to be the world's first 're-mineralizing' toothpaste, promoting oral health by supporting natural healing, using "nanoparticle hydroxyl-apatite", "the same substance as our teeth"; Ace Silver Plus Nano silver toothpaste is manufactured and available in Korea.

SAFETY DATA FOR COSMETICS PRODUCTS

The safety of personal care and cosmetic products must be substantiated through peer-reviewed scientific publications or publicly available industry studies, to a reasonable certainty of no harm from aggregate exposures to the product and its component ingredients including impurities, taking into account factors that may increase toxicity or penetration of the product or its component chemicals through the skin, including the presence of penetration enhancers and the effects of particle size including nanoparticles, and including all anticipated cosmetic exposures and all other exposures for which there is reliable information, taking into consideration vulnerable populations such as infants and pregnant women. Safety cannot be substantiated in the absence of data [33, 34].

Safety substantiation for a cosmetic product must explicitly account for risks posed by impurities, ingredient degradates, and reaction products of ingredients, and must be based on an assessment of risk that incorporates) information about product use patterns including among vulnerable populations such as infants and pregnant women; and) analysis of the cumulative effects of ingredients, impurities, ingredient degradates, and reaction products of ingredients with common health effects or target organs. In the case of threshold effects, an additional ten-fold margin of safety shall be applied in assessments of risk for pre- and post-natal toxicity for infants and pregnant women. A different margin of safety may be used only if, on the basis of reliable data, such a margin will be safe for infants and pregnant women [35].

FDA should request from the cosmetics industry all available studies on nano-scale materials use to adequately substantiate ingredient and product safety, including but not limited to all studies in the industry's new Safety Information Summaries in addition to the information recently submitted to FDA by CTFA on nano-scale sunscreen ingredients. FDA should review these studies and make determinations on the safety of nano-scale ingredients in personal care products, and should require warning labels on products which cannot be substantiated for safety [36].

REGULAIONS OF NANOCOSMACEUTICALS

The development and commercialisation of nanotechnologies has become an important adjunct for traditional industries due to the increasing consumer demand for improved products. A new European regulation will require cosmetics manufacturers to list any nanoparticles contained in products marketed within the European Union. The nanoparticle decree is part of a new 397-page cosmetics regulation approved on 20 November 2009, by the Council of the European Union, which includes ministers from all EU nations and is the EU's main

decision-making body. The cosmetic regulation states that all ingredients present in the product in the form of nanomaterials should be clearly indicated in the list of ingredients, by inserting the word 'nano' in brackets after the ingredient listing. By July 2013, the regulation also requires that all marketed cosmetics and sunscreens using nanoparticles be individually tested for safety [37].

After the European Commission's (EC) Scientific Committee on Consumer Products (SCCP) expressed their concern over the use of insoluble nanoparticles in topically applied cosmetic products. As the nanoparticls penetrate in both healthy and unhealthy skin, toxicity of these particles has also been raised. In their Opinion, the SCCP believe that 'it is necessary to review the safety of nanosized TiO2 in the light of recent information and to consider the influence of physiologically abnormal skin and the possible impact of mechanical action on skin penetration [38].

As per the guidelines of the Scientific Committee on Consumer Products (SCCP) and the United Kingdom's Royal Society & Royal Academy of Engineering, safe Nano-Cosmetics must meet specific Soft Particle regulations. The US Environmental Protection Agency (EPA) has issued a new research strategy to more proactively examine the impacts of manufactured nanomaterials on human health and the environment. Nanomaterials which are generally between one and 100 nanometers in size - are increasingly being used in common consumer products such as paint, sunscreen, cosmetics and sports equipment. Under EPA's new plan, revealed on 29 September, the agency is focusing its research on seven manufactured nanomaterial types: single-walled carbon nanotubes, multi walled carbon nanotubes, fullerenes, cerium oxide, silver, titanium dioxide, and zero-valent iron. The materials were also selected for scrutiny based on the their current use in products, EPA's near-term needs, research underway at other US government agencies, and the recommendations of the OECD (Organisation for Economic Cooperation and Development) working party on manufactured nanomaterials, which was established in March 2007 to provide advice on the responsible development of nanotechnology [39, 40].

Table 1: Cosmetic Formulations Currently Available in the Market

COMPANY	BRAND	PRODUCT	NANO SIZE INGREDIENT
Acne treatment			
Celazome New Zealand Limited	Celazome	Target Acne Spot Treatment	LYPHAZOME NANOSPHERS
Wilma Schumann	Wilma Schumann	Acne Kit	VITAMIN E NANOPARTICAL
DS Laboratories, Inc	DS Laboratories	Anti-Acne Gel	ARNICA NANOSOMES
After sun product			
L'Oreal	Lancome	Cooling sun spirtz	VITAMIN NANOCAPSULE
Anti-aging [41]			
Sircuit Skin Cosmeceuticals Inc.	Sircuit Skin	Anti-Oxidant Serum	FULLERENES
Cosmetic Dermatology, Inc.	Dr. Brandt	Dr. Brandt Laser Tight	NANOENCAPSULATED INGREDIENTS
ProCyte Corporation	Neova	Dual Action Lotion	NANOENCAPSULATED RETINOL
DS Laboratories, Inc.	DS Laboratories	Cream for Wrinkles & Expression Lines	NANOSOMES OF VITAMIN A
DS Laboratories, Inc.	DS Laboratories	Viterol. A (viatrozene gel) 16%	NANOSOMES OF VITAMIN A
L'Oreal	Lancome	Lancome Soleil Soft-Touch Anti-Wrinkle Sun Cream SPF 15	VITAMIN NANOCAPSULES

Around-eye cream [42]			
PerfectRx	PerfectRx	Eye Perfect Serum	NANODELIVERY SYSTEM
Ciba Vision Corporation	Eye	Eye Treat with Lyphazome Technology	LYPHAZOME NANOSPHERES
Body firming lotion			
Nutra Luxé M.D.	Nutra Luxé M.D.	Nutra Luxé M.D. Lipo Reduction Anti-Cellulite Crème	NANODELIVERY
Osmotic Corporation	Osmotic	Osmotic Lipoduction Body Perfecting Complex	NANO-TECHNOLOGY DELIVERY SYSTEM
Body wash/cleanser [43]			
DS Laboratories, Inc.	DS Laboratories	DS Laboratories Hydroviton.CR Liquid Normalizing Soap 80g	NANOSOMES OF VITAMIN A
Bronzer/highlighter [44]			
ColoreScience	ColoreScience	Colorescience Genie Sparkle Bottles (Flower Power)	NANO-VITAMINS
ColoreScience	ColoreScience	Colorescience Genie Sparkle Bottles (Sea of Love)	NANO-VITAMINS
Revlon	Revlon	Revlon Skin Lights Color Lighting for eyes & cheeks, Rosy	MICRONIZED TOPAZ POWDER, MICRONIZED ROSE QUARTZ POWDER
Facial cleanser [45]			
Fancl International, Inc.	Boscia	Boscia Make Up Break Up Cool Cleansing Oil	NANOTECHNOLOGY
Facial moisturizer/treatment			
Ferndale Laboratories, Inc.	Ferndale Nouriva	Nouriva Repair Moisturizing Cream	NANOPARTICLE
Ferndale Laboratories, Inc.	Ferndale Nouriva	Ferndale Nouriva – Nouriva Repair Moisturizing Cream	NANOPARTICLE
Lip balm/treatment			
DERMA doctor	DERMA doctor	DERMA doctor POUT Landis Hyper Moisturizing Lip Paint & Treatment SPF 15 With Nanotechnology, 2 ml, Clear	NANO ZINC OXIDE
Vortex Health & Beauty Ltd.	Luscious Lips	Luscious Lips Rejuvenation Duo	NANO ZINC OXIDE
Moisturizer			
Celazome New Zealand Limited	Celazome	Celazome Spoil Me Body Lotion	LYPHAZOME
Nail treatment [46]			
Celazome New Zealand Limited	Celazome	Celazome Tip Treat Cuticle Exfoliator	LYPHAZOME
Skin fading/lightener			

Awake International	Awake	Awake Nano Lotion Whitener	NANO LOTION
Can Do Spirit, Inc.	TYK	TYK White Glow Retinol, Kojic (MagC Absolute Skin Brightener)	NANO-RETINYL
Sunscreen/tanning oil [47]			
Korres Natural Products Ltd.	Korres Natural Products	Korres Natural Products Red Vine Year Round Hair Sun Protection	NANOPARTICLES
DERMA doctor	DERMA doctor	DERMA doctor Fun in the Sun Kit	NANOTECHNOLOGY
L'Oreal	Lancome	Lancome Soleil Soft-Touch Moisturising Sun Lotion SPF 15	VITAMIN NANOCAPSULES
Hair-loss treatment [48]			
DS Laboratories, Inc	DS Laboratories	DS Laboratories SPECTRAL DNC Hair Loss Treatment	NANOSOMES

CONCLUSION

Nanotechnology is a rapidly expanding and potentially beneficial field with tremendous implications for Society, Industry, Medicine, and Cosmeceuticals. Nanomaterial has been incorporated into a number of skin care products to take advantage of the unique properties of matter on a nanoscale. It is critical for dermatologists intimately involved with the health of the skin to be aware of this new technology, to educate our own colleagues about it, and to play an active role in evaluating this technology and setting policies and guidelines for its safe and fruitful use. A great advancement had been reported in case of nanoemulsion used for cosmetics. Scientists had invented PEG-free emulsions because consumers increasingly prefer natural ingredients in cosmetics. These cosmetic wet wipes are particularly useful for make-up removal, face care, body care & baby care products. It is also highlighted that it helps to give skin care formulations a good skin feel, an increasingly important characteristic for formulators. Nanoemulsions have attracted considerable attention in recent years for application in personal care products as potential vehicles for the controlled delivery of cosmetics and the optimized dispersion of active ingredients in particular skin layers.

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