# Nanotechnology In Cosmetic And Cosmeceutical Health Science

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**Abstract:-**
**Nanotechnology is the science of manipulating atoms and molecules in the nanoscale - 80,000 times smaller than the width of a human hair. Particles of size $10^{-9}$m is seen to find application in all fields like medicine ,textile, electronic to industries like cosmetics. The world market for products that contain nanomaterials is expected to reach $2.6 trillion by 2015. The application of nanotechnology in cosmetics has been shown to overcome the drawbacks associated with traditional cosmetics and also to add more useful features to a formulation. Nano cosmetics and nanocosmeceuticals have been extensively explored for skin, hair, nails, lips, and teeth. This is leading to the replacement of many traditional Cosmeceuticals with nanocosmeceuticals. Nanoscale-sized chemicals are used in cosmetic formulations to achieve a variety of beneffits, including enhanced UV protection, deeper skin penetration, long-lasting effects, heightened colour, improved finish, and more. A role for oil in water nano emulsion a significant function as an efficient formulation in cosmetics like makeup removal, face cleanser,Sunscreens, and other cosmetic products made from water. The distinctive Nanosomes, liposomes, fullerenes, and other forms of nanomaterials are used in beauty products.Nanoparticles of solid lipids, etc. Concerns over the safety of these Nano cosmetics have recently elevated .This page discusses the uses, beneffits, and many types of nanomaterials, opportunities and problems of nanotechnology, and is applied in the cosmetics industry.Review of whether nanotechnology is harmful or helpful .**
**Keywords: Liposomes, Skin Care, Cosmetics, and Nanotechnology.**

**Introduction**:–
The word "nano" reffers to a Greek prefix that means "dwarf" or "extremely small" and represents a thousand millionth of a metre ($10^{-9}$ m) [14]. Nanotechnology is a term was delivered in 1974 by Norio Taniguchi.Eric Drexler elaborated on the terminology in 1986[4] when he published his book Engines of Creation: The Coming Eraof Nanotechnology. Nanotechnology has the capacity to lead to improvements and new formulations, delivery methods. Innovative scientific fields such as nanotechnology and nanodelivery systems involve the creation of materials, devices, and systems at the nanoscale as well as their design, characterization, manufacture, and application (1–100 nm). The inclusion of Cosmetic science has advanced as a result of nanotechnology, increasing consumer demand on a global scale.

Currently, nanomaterials are gaining popularity in this field,as they provide more benefits than cosmetics traditionally used[6]. Around 4000 BC, Egypt was the first place in human history to utilise cosmetics[5]. The term "cosmetics" was first used in 1961 by Raymond Reed, a founding member of the US Society of Cosmetic Chemists. According to reports, Egyptians are said to have first used cosmetics circa 4000 BC.then came the use of cosmetics by the Greeks, Romans, Chinese, Japanese, and Americans[7]. US, Japan, and Germany are three significant nations that have started research and development [4]. Between medications and personal care items, there is a gulf called cosmetics.Humans have used cosmetics for a long time, mostly for aesthetic purposes.Both sexes find them appealing and they serve restorative purposes[5]. Likely the most frequent enhancing the distribution of cosmetics is a claim made for the use of nanoparticles in cosmetics substances into the skin. The small size of lipid vesicles may make it possible for these substances to more easily absorbed into skin[6].Cosmetics are substances that are "designed to be applied to the human body for cleansing, beautifying, boosting beauty, or altering the look without harming the body's structure or functions," according to the US Food and Drug Administration (USFDA)[5]. Using drugs A cosmetic is defined as "any article intended to be" by the Cosmetics Act 1940 and Rules 1945 as injected into, rubbed, poured, sprinkled, sprayed, or otherwise applied to the human body or any component thereof for enhancing attractiveness, cleaning, or modifying the any item designed for use as an aesthetic component, and look [5].The term "cosmeceuticals" reffers to formulations that include therapeutically active the ingredients. These products are used to treat a variety of conditions, including damaged hair, wrinkles, photoaging, dry skin, light spots, and hyperpigmentation. They have quantifiable restorative effects on the skin and hair. It offers some benefits over other, larger objects. Components including a better texture, more stain resistance, improved looks, and longer extended shelf life and enhanced UV defence. As a result, these nanoparticles are widely utilised in pharmaceutical and cosmetic items. Three areas have a significant impact on the market:businesses like manufacturing (coatings, composite for goods like autos) and materials technology (displays and batteries), as well as the fields of medicine and biological sciences. Due to many more advantages which give protection as well long life to the product increases such technology more in the cosmetic market rather than any other market. The nanoparticles are mostly used as UV filters[3].Materials used in cosmetic products should be ensured that the creams or powders used for necessities like UV protection or anti-aging are easy to penetrate skin, should overcome the insolubility problem and protection of physical and chemical decomposition over a periodof time[7].

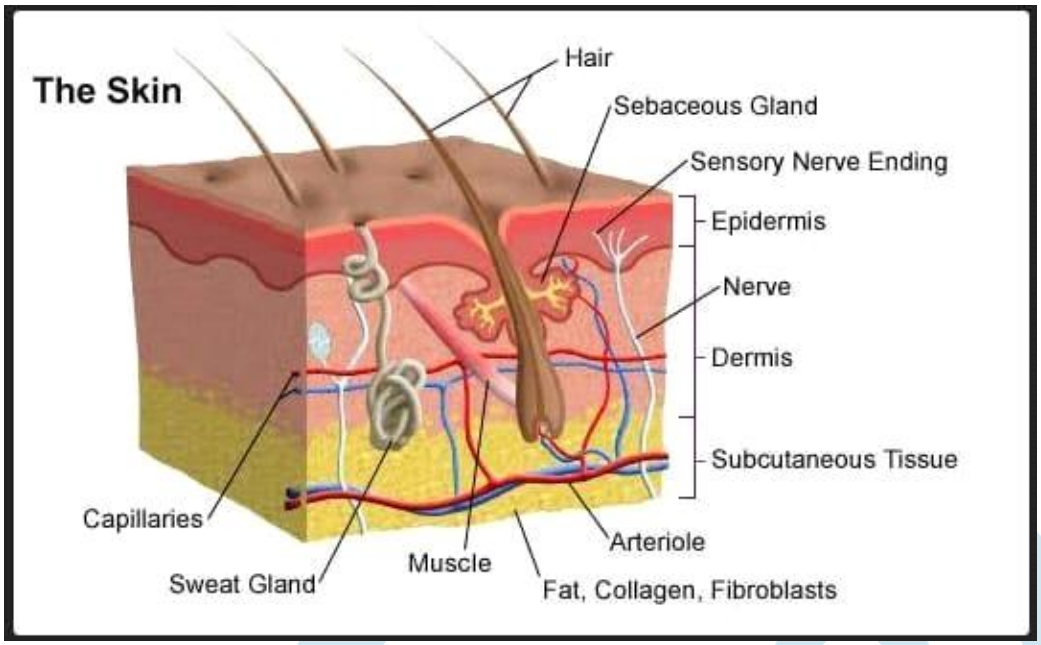



**Fig (1) :- Human Skin Layers**

With a total surface area of nearly 20 square feet, the skin is the biggest organ in the body. The skin keeps us safe from germs and the weather, helps control body temperature, and allows us to feel touch, heat, and cold. Multiple layers make up the complex organ that is the skin (i.e.Dermis, hypodermis, and epidermis)[8].

Epidermis, dermis, and hypodermis are the three separate layers that make up human skin.

I. The epidermis, the top layer of skin, serves as a waterproof barrier and determines the colour of our skin.
II. Under the epidermis, in the dermis, are hair follicles, tough connective tissue, and other anatomicalstructures salivary glands.
III. Fat and connective tissue comprise the deeper subcutaneous tissue (hypodermis)[8].

Sebaceous, apocrine, eccrine, and hair glands are further components of the human body skin. Skin layer thickness varies depending on the body part, age, and gender. Skin acts a significant part in shielding the human body from external factors such preventing the preventing the destruction of essential organs from UV radiation and other airborne toxins bodily fluids from leaving the body while simultaneously removing harmful substances. Despite being tasty, the body offers mechanical support and regulates body temperature and promotes vitamin D production when sunshine is present[6].Two primary skin types Diagrams of penetration routes are shown. Through hair follicles, the nanomaterial I enters the body) and (ii) diffuses through the spaces between corneocytes (follicular penetration pathway). (The intercellular channel of penetration). (a) A diagram showing the composition of human skin.Five thin layers make up the epidermis, with the outermost layer, the stratum corneum,being the most prominent. Supplying the skin's essential barrier function.

Consequently, it is crucial to take better care of skin than any other body part, according to [11].Skin is a vital component of the body that, if improperly cared for, may prematurely age and develop wrinkles ,discoloration and, in rare cases, skin cancer[6]. Certain items come in which In order to increase the penetrating power of lotions, creams, and other Nano emulsions are skin moisturisers. The L'Oreal product used for anti-sunscreen, anti-wrinkle cream, and hair products. Zinc oxide and titanium dioxide are the major used compounds .[1]. Many different kinds of nanomaterials are employed in cosmetics, including Solid lipid nanoparticles, nanoemulsions, nanocapsules, liposomes, nanocrystals,Hydrogels, Buckyballs, Dendrimers, Nano-silver and Nano-gold, and Cubosomes. These Nanomaterials are used in many ways and have various effects[4]. On the other side, it is becoming more common to see allergic reactions to cosmetics. In rare cases, acute type reactions are also possible with contact allergies to cosmetics, such as photo allergic contact dermititis ,contact urticaria is what it is.The most crucial contacts are those with preservatives and fragrances irritants [5].The potential skin-contact routes for the involved cosmetic allergies include:by direct contact, by passing sometimes across an allergen- contaminated surface, by transferring airborne contaminants (such as vapours or droplets) from the hands to more sensitive parts (such the eyelids), caused by a substance used by the partner (or anybody else), leading to from exposure to sunshine, particularly UV-A, and contact with a photo-allergen light.The reactions also occurs to category specific product such as hair dyes and other hair– care products,nail cosmetics, sunscreens, as well as to antioxidants, vehicles ,emulsifiers and in fact any possible cosmetic ingredient[15]. India's adoption of nanotechnology as a concept can be attributed to its status as a developing nation. Although the term was first coined in 1974, India has made mention of the idea.The establishment of national facilities and core groups was part of the 9th Five Year Plan (1998- 2002), which was encourage S&T-related research in the fields of superconductivity, robotics, neurosciences, and both nanomaterials and carbon.A was the first step in the "Nano Science and Technology Initiative. “funding of 60 crores rupees. The government began a five-year initiative named Nano in 2007.mission with broader goals and $250 million in more funds. It covered more ground of goals and significantly greater financing. Basic research in the following fields was involved in the mission:globalisation, nanotechnology, infrastructure improvement, human resource development collaboration.

For the project, numerous institutions and departments were enlisted, including the Department of Biotechnology, Council of Scientific and Industrial Research, Department of IT, and DRDO (CSIR) research, etc. IISC Bangalore and IIT Bombay both have National Canters for The fields ofnanofabrication and nanoelectronics were founded.

The nanotechnology mission has the following goals:

- Building the infrastructure needed for research in nanoscience and nanotechnology.
- Centers for the development of nanotechnology applications and public-private partnerships.
- Development of human resources.
- International Partnerships.
- The development of Academy-industry ties through these initiatives.

During the implementation of the 12th Five Year Plan (2012–2017), the government mission to support application-focused R&D so that specific practical things emerges[4].In India, the government has taken the lead in fostering R&D in nanotechnology. It has taken numerous steps to encourage and advance R&D in India through a number of programmes departments. There are numerous plans and programmes for infrastructure and human resource creation. The government has also carried out several initiatives with several nations on a bilateral, multilateral, and regional level to advance nanotechnology innovation, development, and research (RDI). It has additionally encouraged the PPP model to product development using nanotechnology. Theprincipal departments that have participated in Below, we examine RDI in nanotechnology in India [9].

**Nanotechnology's use in cosmetics:**

Enhancing cosmetic performance with nanoparticles is probably the most prevalent claim made for their application.the process of skin-care ingredients being delivered. Small lipid vesicles may make it possible for scientific studies that support these materials to be absorbed more easily into skin Claims have produced varying outcomes[5]. These may be a result of things like study conditions,Because of the stability and small size of nanoparticles, it is challenging to obtain reliable results even within the identical labs. Different physicochemical characteristics of vesicles may have an impact on how they interact with skin. Some vesicles may not enter the skin, instead releasing their contents onto the skin's surface to encourage uptake and penetration into the skin's outermost layers.Nanomaterials can also be employed to make compositions more stable.These contain components that could degrade as a result of oxidation and other factors [5]. However,When applied to the skin, carrier nanoparticles may not be stable.Nanoparticles Compounds zinc oxide and titanium dioxide are mostly used in sunscreen non- prescription medication.They may however, also be utilised in cosmetic products (when the final product is cosmetic).depending on the product's claims, might be both a medication and a cosmetic) [5]. These nanoparticles produce a translucent composition that is appealing to consumers while still functioning as effective UV radiation blockers. Silver nanoparticles are utilised in consumer goods like preservatives or antibacterial agents. In the US, cosmetic goods cannot create antimicrobial claims, since this claim is connected to a physiological function and is therefore only applicable to pharmaceutical items. It should be noted that the EU currently does not contain Nano silver in Annex 5 of the Cosmetic Directive, which is the approved list for preservatives permitted to be used pertaining to cosmetics[4].

**Major Classes of Nanocosmeceuticals:-**

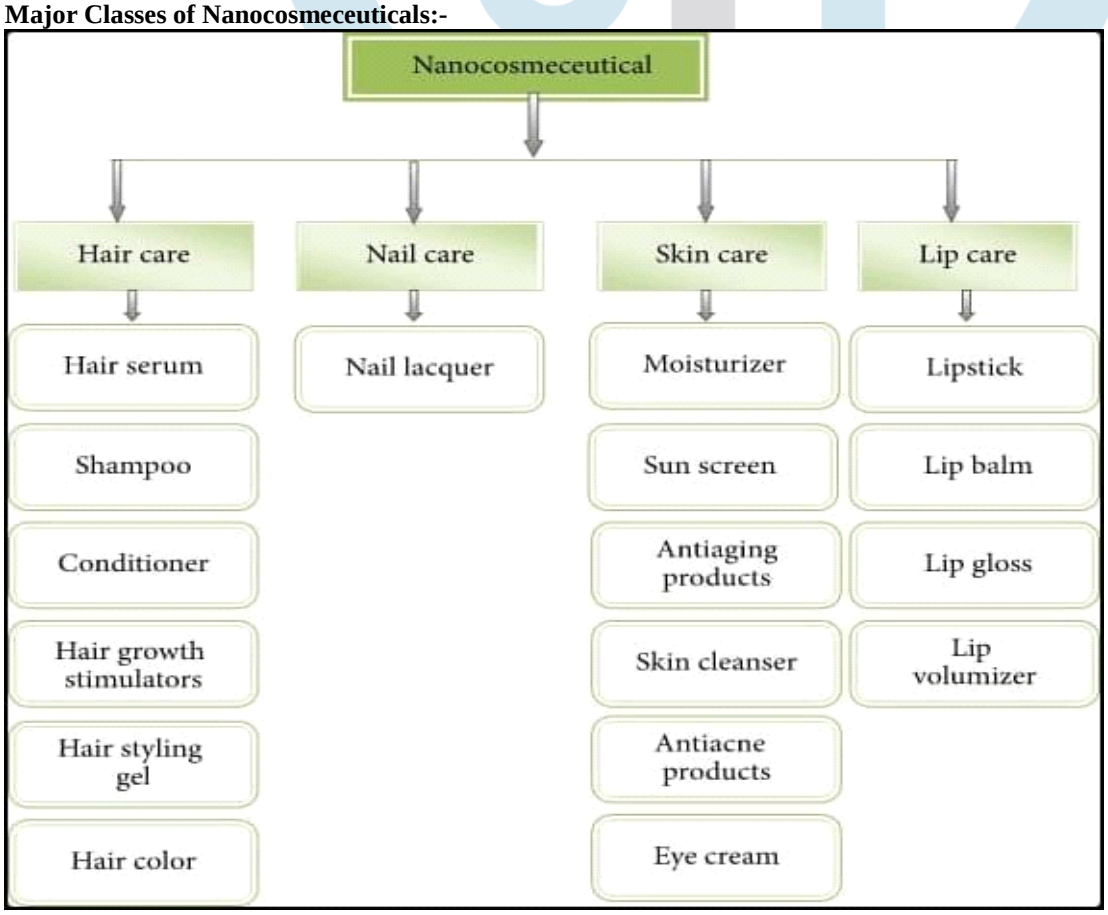



**Fig (2) :- Major Classes Of Nanocosmeceuticals**

**Skin care**: - Cosmeceuticals for skin care products improve skin function and texture by promoting collagen formation and fending off the damaging effects of free radicals. They make the skin healthy by preserving the keratin's structural integrity[2].Nanoparticles of zinc oxide and titanium dioxide are the most efficient in sunscreen products. Elements that make their way into the skin's deep layers and protect the skin product less greasy, odorous, and opaque. Nano emulsions, SLNs, liposomes, and noisome are extensively used in moisturizing formulations as they form thin film of humectants and retain moisture for prolonged span [7]. Marketed antiaging nanocosmeceutical products assimilating nanocapsules, liposomes, nanosomes, and Nanospheres manifest benefits such as collagen renewal, skin rejuvenation, and firming and lifting the skin [7].

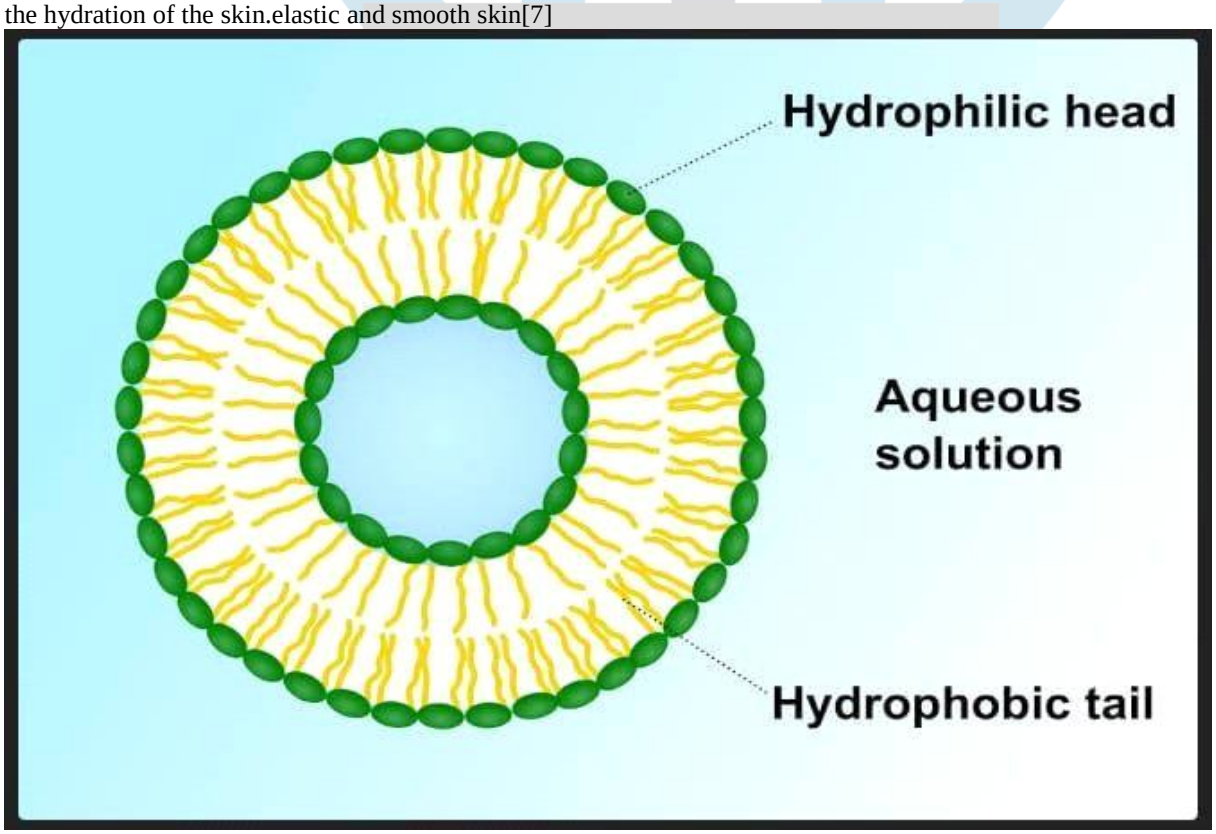
**Hair care** :- Shampoos, conditioning agents, hair growth boosters, colouring agents, and style products are among the hair nanocosmeceuticals' product offerings. targeting the hair follicle, shaft, and Increased amounts of the active substance are made possible by intrinsic and distinctive qualities. Nanoparticle size[9].Shampoos with nanoparticles in them lock moisture in the cuticles by building protective barriers to extend resident contact with the scalp and hair follicles film [3]. Agents for conditioning nanocosmeceuticals serve the purpose of improving hair disentangling and adding softness, shine, silkiness, and gloss.Nano spheres, microemulsions, nanoemulsions, and niosomes are new carriers. Liposomes' primary job is to restore texture, heal damaged cuticles, and gloss, making hair less brittle, less oily, and lustrous [5].

**Lips care :**–Nanocosmeceuticals lip care products include lipstick, lip balm, lip gloss, and lip volumizer. Lip gloss and lipstick can include a variety of nanoparticles to soften the colours from transferring from the lips by reducing trans epidermal water loss.move away from the lips and keep their colour for a longer time. Lip splurge contains liposomes, which improves lip volume, moisturises, defines, and fills the lips increases on the lips[1].

**Nail care :-** The superiority of nanocosmeceuticals-based nail care products over traditional ones is greater[5].Nanotechnology-based nail polishes provide advantages like enhanced toughness, quick drying, durability, chip resistance, and application ease due to flexibility. innovative techniques like amalgamating silver and metal oxide In nail paints used to cure toe nails, nanoparticles have antifungaleffects [6].

**Types of nanomaterial used in cosmetic**

**1)Liposomes:** – Liposomes are concentric bilayered vesicles in which the aqueous volume is entirely enclosed by a lipid bilayer composed of natural or synthetic phospholipids which are GRAS (generally regarded as safe) products. The lipid bilayer of liposomes can fuse with other bilayers such as the cell membrane, which promotes release of its contents, making them useful for cosmetic delivery applications[5]. Their ease of preparation, enhanced absorption of active ingredients by skin .They function as an incredibly adaptable nanomaterial in the cosmetics industry due to their biodegradability and biocompatibility. Liposomes are not easily wiped off, therefore cosmetic formulas using them have increased durability on the skin. These are the best cell providers likewise biomembranes. They can also be used for delivering and fixing nutrients, for giving body wash, lipsticks, and antiperspirants pleasant fragrances. Using nanoliposomes Due to the smaller size of the particles used in cosmetics, they improve the hydration of the skin.elastic and smooth skin[7]



**Fig(3) :- Liposomes** These can serve as a transdermal medicine delivery mechanism since they can carry active molecules into the deeper skin layers and even the systemic circulation (TDDS ). They are typically used for moisturising and anti-aging purposes in the cosmetics industry. Ageing objectives. In an experiment, Kocic et al. compared the moisturising impact of sold creams and nanoliposome creams that contain donkey milk that has been skimmed. They determined that deeper strata may be penetrated by the cream with nanoliposomes,resulting in an unreasonably high capacity for hydration and, as a result, it may have anti-aging properties[7].

Table[1] :– Positive and Negative aspects of Liposomes[6]

| Positive aspects | Negative aspects |
|---|---|
| 1)Increased stability | 1)High production cost |
| 2)Biocompatible and biodegradable | 2) Low solubility |
| 3)Increased efficacy | 3)Leakage of drug |
| 4)Reduced toxicity | 4)Occupatinally oxidation and hydrolysis reaction |
| 5)Ease of penetration in dermal layer | 5)Osmotically sensitive |

**2) Niosome**:-

Surfactant has a high degree of chemical stability, necessitating neither particular preparation nor storage conditions nor purity issues. Due to the presence of beneficial functional groups on the hydrophilic surfaces, surface development and modification are quite straight forward head Anti-aging cream contains niosomes [1].

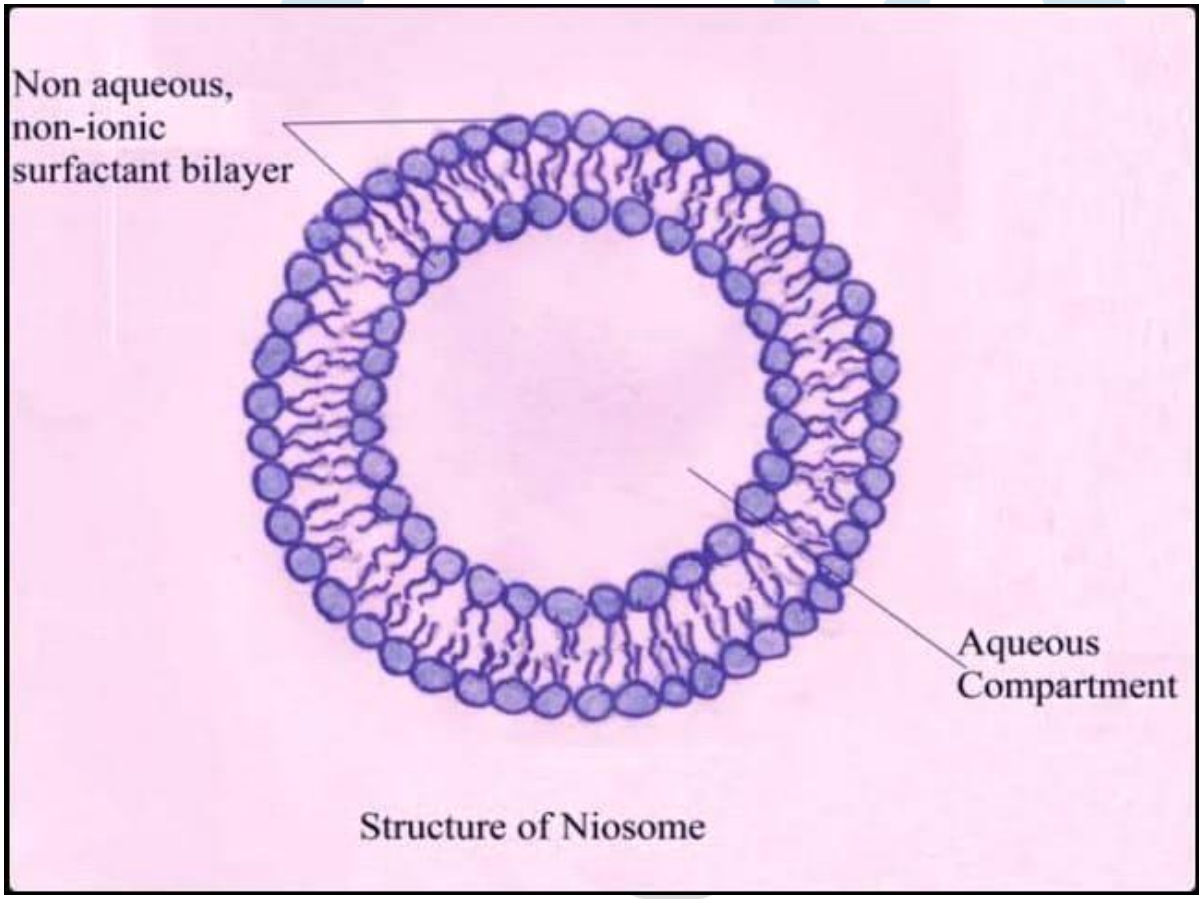



**Fig (4) :- Niosome**

A**dvantages** :– Increase efficiency, penetration, bioavailability, and stability of drugs[6].

**3)Nanocapsule :-** When the first cosmetic product based on nanocapsules was introduced by the French business L'Oreal in 1995, the potential dermatological applications of these tiny particles were researched. To increase the effectiveness of their cosmetics [5].Nanocapsules are tiny particles with an aqueous or oily centre encased in a polymeric shell. It has the penetration of UV filter octyl nanocapsules has been discovered to be reduced by their use. Comparing methyloxycinnamate in pig skin to traditional emulsion[3]. Those are used in beauty care products to protect components, cover up unpleasant scents, and reducing compatibility problems between different formulations' ingredients. Polymeric You can directly apply nanocapsule suspensions to your skin or combine them to form semisolids used as transporters and in systems[4].

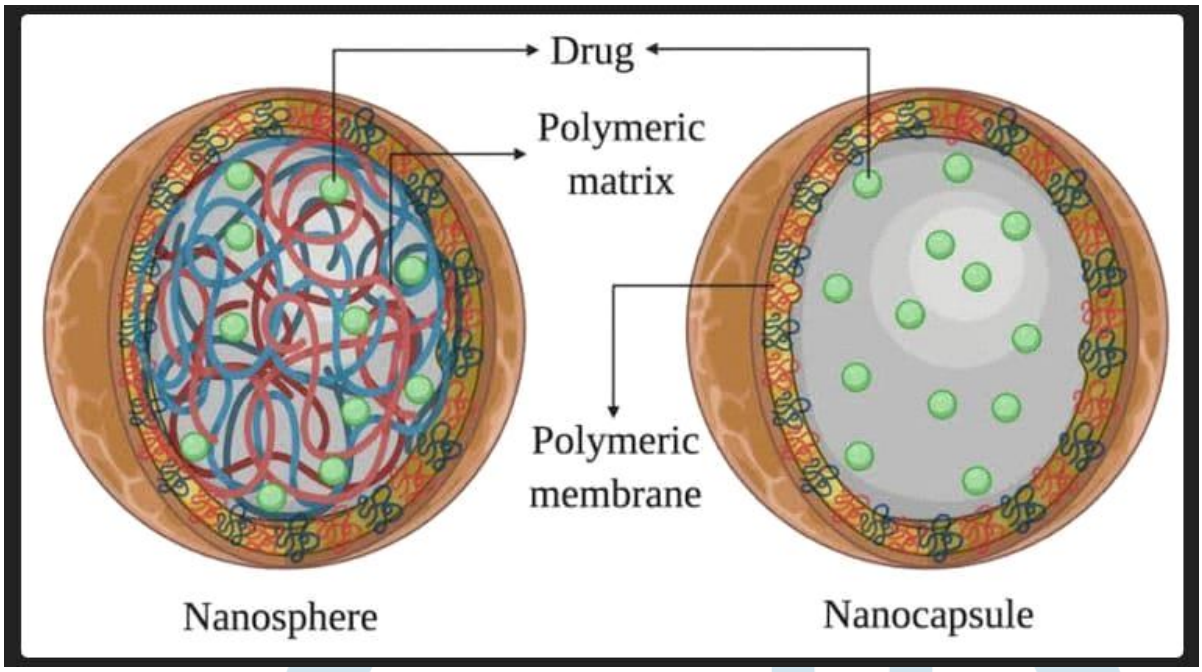



**Fig (5):- Nanospheres and Nanocapsule**

**Advantages**: – Protection of ingredients, masking of undesirable odors, resolution of incompatibility issues between formulation components, sustained release formulation [6].

4 )**Nanosphere** :–

Nanospheres are the spherical particles which exhibit a core-shell structure. The size ranges from 10 to 200 nm in diameter. In nanospheres, the drug is entrapped, dissolved, attached, or encapsulated to the matrix of polymer and drug is protected from the chemical and enzymatic degradation. The drug is physically and uniformly disperse in the matrix system of polymer.Nanospheres can be divided into two categories: biodegradable nanospheres and nonbiodegradable nanospheres[7]. Biodegradable nanospheres include gelatin Nanospheres, modifed starch nanospheres, and albumin nanospheres and nonbiodegradable nanospheres include polylactic acid, which is the only approved polymer. In cosmetics, nanospheres are used in skin care products to deliver active ingredients into deep layer of the skin and deliver their beneficial effects to the affected area of the skin more precisely and efficiently[6]. These microscopic fragments play a favorable role in protection against actinic aging. Use of nanospheres is increasing in the Feld of cosmetics especially in skin care products like antiwrinkle creams, moisturizing creams, and antiacne creams[5].

**5) Dendrimers :-**

The formation of dendrimers, which are widely branched three-dimensional nanostructured macromolecules, is what gives them their remarkable plasticity. Dendrimers are 20 nm-sized, unimolecular, monodisperse, micellar nanostructures with a well-defined structure. A well-defined,symmetrically branching structure with a high density of functional end groups along the edges ofthem[5].

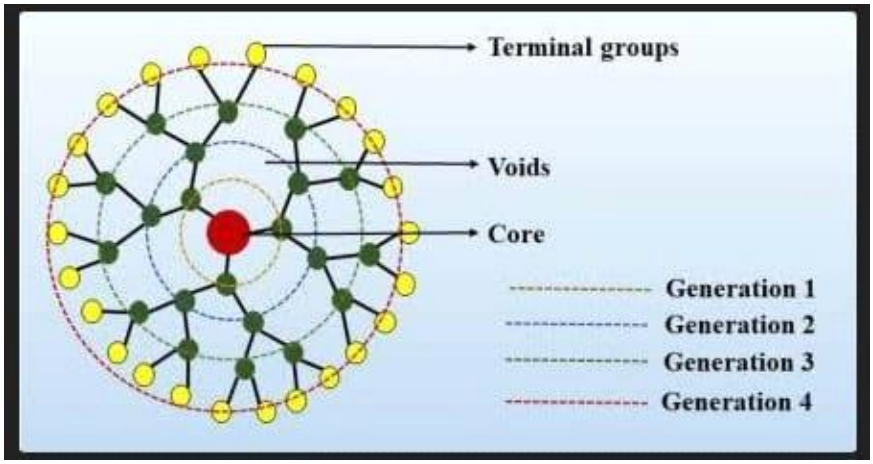


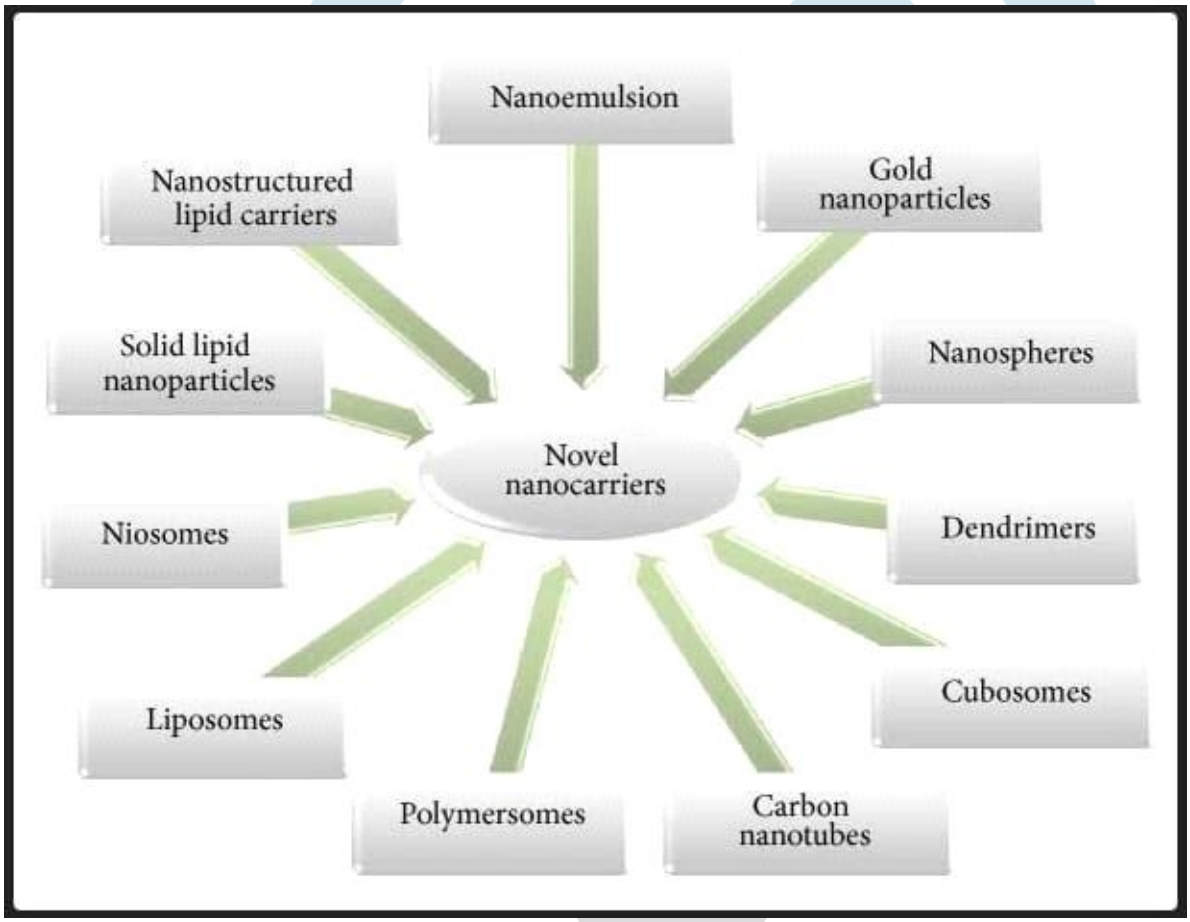

**Fig (6) :- Dendrimers**

They have a significant number of external groupings that can be multifunctionalized. They are often polymers and assist transport active substances through the skin because of their stability. These substances can be utilised in creating more effective shampoo

and deodorant formulas .A dendrimer. Antioxidant and anti-aging properties of resveratrol have been discovered. Helped increase skin penetration and overall solubility, which afterwards stimulated the scale-up[7].
**Advantages**: –Increase solubility of the lipophilic drug ,controlled- release drug formulation, and maintenance the stability of the drug in cosmetic formulations[4].

**6)Nanocrystals** These clusters, which range in size from 10 to 400 nm and are typically used for the administration of poorly soluble medicines, are made up of thousands of molecules arranged in a predetermined configuration. [9] .Nanocrystals mostly contain bioactive molecules. chemicals and speed up the rate of their disintegration. Juvena created "Juvedical" in The first commercially available formulation with rutin-containing nanocrystals came out in the year 2000. A study claimed that nanocrystals of rutin showed higher bioactivity as compared to the normal rutin glycoside. They allow safe and effective passage through skin [8].
**Advantages**: – Increase drug solubility, particle distribution, adhesiveness ,dissolution rate,skin penetration of poorly water soluble drugs[5].

**7) Nanosilver and Nanogold** :–
Nanosilver's increased antibacterial qualities are being used by cosmetic producers for a variety of purposes. Some producers of underarm deodorants already market their products with the promise that the product's silver content will provide up to 24-hour antibacterial protection.. Like nanosilver,nanosized gold is said to be extremely good at disinfecting. Toothpaste has also been infused with thebacteria in the mouth[3].




**Fig**

**Fig(7) :- pictorial presentation of various nanocarriers used in cosmetics[1]**

- **Properties of Nanomaterials :–**

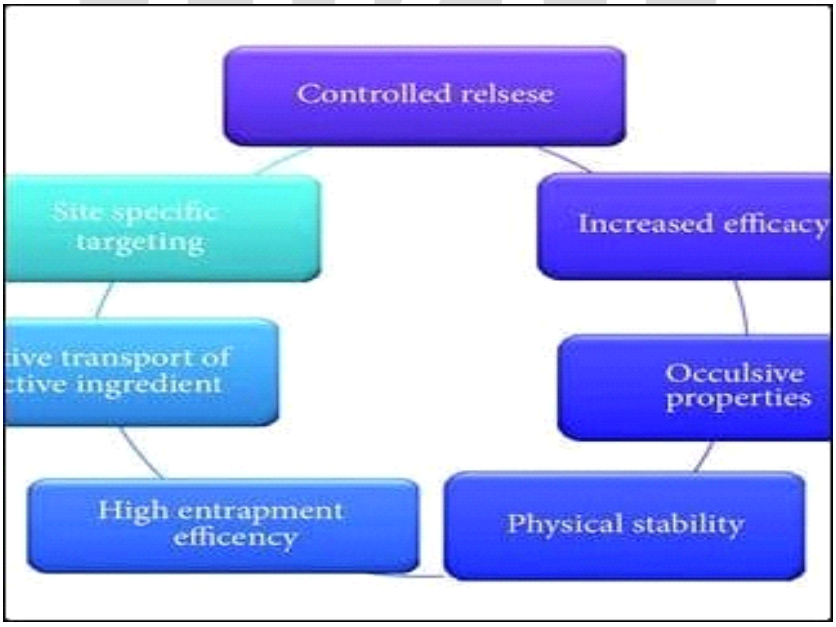
To improve the transport of cosmetic components into the skin, researchers and manufacturers frequently cite this as a possible justification for the rising interest in and usage of nanomaterials in cosmetics. This is a valid justification and result of the qualities of nanomaterials[13]. Research findings, however, don't seem to support this theory.This could be as a result of non-reproducible outcomes from different study circumstances [4]. For example, Given that lipid vesicles in nanoemulsions are tiny, it may be possible for cosmetic products to more easily absorbed into skin[6]. In contrast, Fellipe et al. (2009) employed human skin biopsies to examine the skin penetration of titanium dioxide and zinc oxide nanoparticles used as sunscreen products and found that, in contrast to previous research, unlikely penetration beyond the stratum corneum surface was found Manufacturers' statements[6]. However, it is safe to say that nanoscale materials have the differ from their large particle sized cousins due to unusual properties. Presents a few of these attributes Particle sizes affect a material's characteristics. Nanoscale particles thus possess altered properties from their parent or larger size counterparts in terms of colour, structural integrity, transparency,

optical activity, solubility, and chemical reactivity. For instance, the distinctive size of nanoscale materials enables greater solubility, size matching of cosmetic chemicals with biological structures of skin cells, and ease of contact, all of which allow for the selective control of cellular processes at their source. Scale that exists naturally [7]. These characteristics of nanoparticles used in cosmetics improve UV protection, long-lasting results, increased finish quality, and improved skin penetration[5].The increased surface area of nanoparticles is another priceless characteristic linked with them. Compared to larger-sized particles, the area to mass or volume ratio[3] .

One of two particles with equal volume is said to have larger surface to volume ratio, if it has more numbers of molecules or atoms present on the surface of the particle than the other. Size reduction increases the surface area to volume ratio of particles. In 2010, Sivanskar and Kumar attempted to calculate the percentage increase in surface area of a sphere-shaped nanoparticle when it is shrunk from a micrometre. Dispersibility is enhanced by increased surface area (sedimentation rate is Ingredient dissolution rates (which are almost nil) for drugs or cosmetics[8] more surface area. Additionally, nanoscale materials have more surface imperfections, which encourage strong adherence. Because van der Waals attraction is supported by a greater number of contact sites. Good adhesion to the skin will achieve better cosmetic effect. More significantly is the effect of surface area on reactivity of the particles. These unique chemical properties may result in unique bioactivity and may help to predict possible biological response obtainable from nanomaterials used in cosmetics[7].

Even materials with a high solid density that are nanoscale in size generate evenly dispersed systems in suspension that do not settle when subjected to Brownian motion. This suggests that cosmetics' nanoscale components will remain suspended longer than their microscale counterpart. Such nanosized skin preparations are given a certain level of stability by this characteristic. Longer shelf life because unstable characteristics including creaming, breaking, and phase inversion or Ostwald ripening to be observed or actually take place. Little surprise, then, that urge for the acquisition and application of nanoparticles in cosmetic manufacturing. Extensive surface area increases reactivity by providing more active areas to encourage chemical reactions. Nanoscale substances Nanomaterials' optical activity and transparency provide cosmetic products an appealing appearance. This is especially noticeable in numerous lotions and sunscreens[4]. Zinc The major ingredients in sunscreens are oxide and titanium oxide. When their bigger particles are used render the skin noticeably white, but nanosized particles behave similarly. Product leave no such traces, improving the nanoproduct's attractiveness.Due to their cheap production costs compared to other materials, nanoparticles have an economic benefit. Another justification for choosing to employ large sized equivalents has been mentioned. Nanoparticles found in cosmetics. This is particularly prevalent when nanoparticles are involved. Without making a concerted effort, are obtained as a result of the reduction of bigger sized particles to make them [5].

- **Positive aspect of nanocosmetics :-** Nanocosmeceuticals have a variety of advantages. Specifically, they do so by regulating the release of drugs from carriers using a variety of mechanisms, such as physical or chemical interactions between the constituent parts.Drug formulation, polymer and ingredient content, dosage, and preparation technique. In addition to enhances the compound's effectiveness and physical attributes.They exhibit vigorous movement of active component to a particular target site[6]. They are utilised in hair care products as Identik Masque Floral Repair, Origem hair recycling shampoo, and Nirvel hair-loss control shampoo that are used to treat hair loss and stop hair from going grey. The fragrances last longer because to nanocosmeceuticals, such as in Allure Perfume and Allure Spray Eau de Partum by Chanel. Using nanomaterials in the preparation of Anti-aging products, moisturisers, skin-lightening products, and shampoos that repair damaged hair serums and conditioners. There are several advantages of usingnanocosmeceuticals within figure[4].




**Fig[8]:–Pictorial presentation of positive aspects of nanotechnology[1].**

- **Negative aspect**

As is the law of nature, everything in the cosmos has both positive and negative sides. The following are some negative aspects of nanocosmeceuticals. Large-scale oxygen species generation, oxidative stress, inflammation, and damage Nanoparticles may harm DNA, proteins, and membranes. a few fine ultra nanomaterials like copper, titanium dioxide, and carbon-based fullerenes Silver nanoparticles in particular may be hazardous to the tissues and cells of people. Titanium It has been proven that the dioxide in sunscreens harms DNA, RNA, and inside of cells. No stringent scrutiny was imposed by the regulatory agencies for the approval and regulation of nanocosmeceuticals. Nanocosmeceuticals may be harmful to environment as well. No clinical trials are required for the approval of nanocosmeceuticals, thus raising a concern of toxicity after use . Negative aspects of nanocosmeceuticals are discussed in Figure[1].

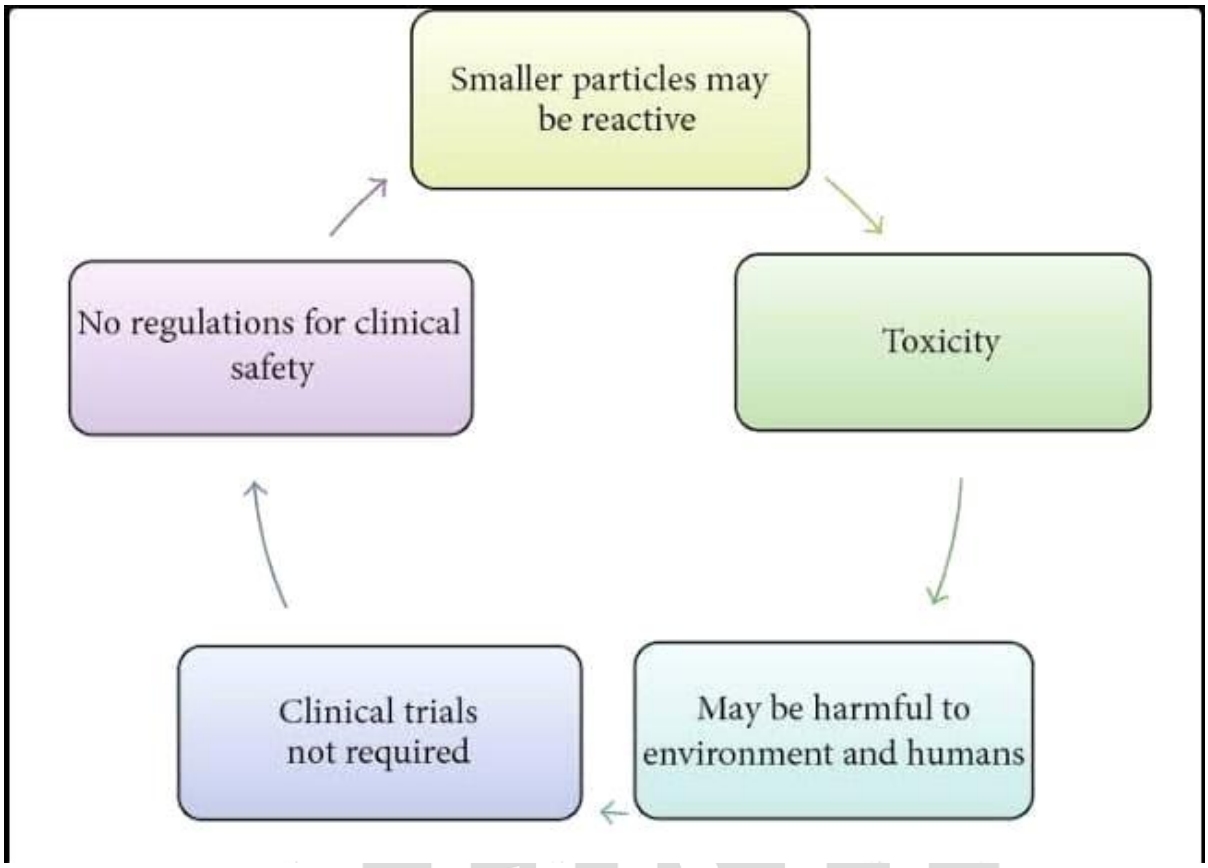



**Fig (9):- –Pictorial presentation of negative aspects of nanocosmeceuticals[1].**

- **Environment risk of Nanoparticle :–**

Due to the exposure of nanoparticles through release into the water, air, and soil during the creation, use, or disposal of these materials, the environment is also at danger. If these nanoparticles have antibacterial properties and are discharged in large enough quantities, they could disrupt the good bacteria in sewage and waste water treatment facilities and several of the research looked at, might also pollute water meant for reuse .U.S. GAO[1]. For instance, research has demonstrated that TiO nanoparticles are hazardous to the rainbow trout's primary organ systems. During research at the University of Toledo, the Nano-titanium dioxide, which is utilised in personal care products, decreased After less than an hour of exposure, bacteria begin to play biological roles[16]. These results imply that these particles, which are discharged at municipal sewage treatment facilities, could eradicate bacteria that are essential to ecosystem function and aid in the treatment of wastewater. In one of the researches on It has been discovered that carbon fullerenes can harm the brains of largemouth bass a species used as a reference by regulatory bodies to define the impacts of ecotoxicology.Additionally, it has been discovered that fullerenes are bactericidal and kill water fleas Rice .The Centers for Biological and Environmental Nanotechnology at the University has highlighted the tendency of nanoparticles to adhere to contaminants that are already common in the environment such as petrochemicals and cadmium in the environment. Due to this propensity, nanoparticles would be a probable method for widespread and long-distance pollution transmission in groundwater. Even some research have highlighted the possibility of bio magnification via nanoparticles. An innovative finding on how nanoparticles are able to interact with molecules was made by an interdisciplinary team of researchers from the University of California, Santa Barbara. In a straightforward microbial food cycle, biomagnify. The effects of nanoparticles on the environment their use in the workplace and segregation have an impact on the environment. Mechanism in various media (including soil, water, and air), as well as their mobility and stability[4].Additionally, transportation and environmental nanotechnology exposure are the basic variables that shape the environment's total influence. Nanoparticles are necessary. ingredients in different biogeochemical processes, therefore any global effects of particular Consideration should

be given to nanoparticles on elemental cycles. Furthermore, the environmental These particles' effects rely on various conditions, including solution chemistry, biological reactions, redox potential, temperature, pressure, presence of coating, etc., which should also be taken into consideration[7].

- **Products using Nanotechnology: –**

**1)Anti -Aging Creams:–**

These are the creams that people use to reduce visible wrinkles, lines, blemishes, pigmentation changes, and other skin-related issues to make them look younger[7].Nanotechnology is utilised to package active ingredients that are difficult to permeate the skin and water-soluble, such as retinol, peptides, and vitamin C drive them deeper into the skin so they can rejuvenate it more effectively .Some formulators alter the shape of these molecules so they anchor onto specific targets such as melanin, wrinkled skin. Salicylic acid has been nanoscaled to make solutions that fight acne without completely drying the skin's surface[5]. Studies have revealed. That the process of skin ageing is affected by both endogenous and external influences.Changes in the epithelial layers cause intrinsic ageing, whereas extrinsic ageing is caused by generated by an unusual build up of elastic fibres in the middle layer of the dermis. Intrinsic Aging is influenced by an individual's genetic makeup, as well as modifications to their hormonal systems and cellular processes. Several benefits of nanocosmeceuticals improved stability and efficacy of the skin product's active components [1].Antioxidants are commonly found in skin care products to reduce the effects of ROS and make younger-looking skin[6].

**2) Sunscreens**: —

It provides protection to skin form sun rays. It includes UVA and UVB. The high level of UVA radiated is in association with ageing effects such as wrinkles, and mostly used because of ant ageing formulation. Traditional inorganic sunscreens have been made with UV filters, such as iron, titanium and zinc[4]. These active ingredients were selected because of their ability to block UVA (320–400 nm) as well as UVB (280–320 nm) radiation. These older generation inorganic sunscreens block a broader spectrum ofUV light and confer greater photoprotection than other agents, such as octyl cinnamate[4].

**3)Moisturizers**:—

To combat dryness, it is a crucial ingredient in all creams[2]. If the water content drops, the skin becomes dehydrated, loses its suppleness, and becomes dry as it ages as a result of UV exposure. lotions that provide nutrition using ethosome nanoparticles encouraging hair growth[3].

**4)Depigmentation Agents :–**

It has corrective properties and is a skin-lightening agent. Such cream contains hydroquinone, ascorbic acid, kojic acid, and liquorice extract among other components. Depigmenting substances limit melanogenesis, the process by which cells produce pigment,produce melanin) and support the damagedarea [3].

- **Toxicity of Nanoparticles Used in Cosmeceuticals :–**

The vast variety of cosmeceuticals goods that contain nanomaterials are being produced and used at a faster rate, which is increasing the number of employees and customers who are exposed to nanoparticles. Despite its enormous potential benefits, little is understood about discusses the environmental and biological effects on short- and long-term health Due to health hazards, product functionality, and environmental concerns, there may be possible constrains. Concerns have been raised on the possible dangers which may arise on the skin penetration of nanomaterials after their application to the skin [6]. Concerns have been expressed about the potential risks that nanoparticles may present when they penetrate the skin after being applied to it [6].Nanoparticle toxicity is greatly influenced by a multitude of parameters, including surface variables that can be changed include characteristics, coating, structure, size, and capacity to aggregate and modified during the production process. Poorly soluble nanoparticles have been proven to be carcinogenic and may display more extreme toxicity. Health risk may occur because nanoparticles have more surface area than a given mass large particle concentration[11]. Toxicity also depends on the chemical composition of nanoparticles which is absorbed on the skin . Tere is a relationship between particle size and toxicity: the smaller the size of the nanoparticles, the greater the surface area to volume ratio, due to which there is higher chemical and biological reactivity[6].

- **Routes of exposure of nanoparticles.**

**a) Inhalation :-**

The National Institute of Occupational Health and Safety states that inhalation is the most typical method of exposure to airborne nanoparticles. The nanoparticles could be inhaled by consumers, who could also be exposed through their respiratory system. Products like scents, powders, and aerosol can cause workers to become exposed to nanoparticles as it was being produced. Evidences from the studies conducted on animals suggest that vast majority of nanoparticles inhaled enter the pulmonary tractand some may travel via nasal nerves to the brain and gain access to other organs via blood. According to a study on the toxicity of silicon dioxide inhalation, particles between 1 and 5 nm produce a greater toxicological reaction than doses of 10 nm or smaller[3]. Research on carbon nanotubes has shown that long-term exposure Lungs are affected by interstitial infammation and epithelioid granulomatous lesions. Some fullerenes with carbon bases may oxidise cells or be dangerous to breathe in. Results of inhaling TiO2 ultrafine particles as opposed to TiO2 fine Particles demonstrate that ultrafine particles caused greater lung damage[5]. Gold nanoparticles of sizes 2, 40, and 100 nm, when exposed to intratracheal route, were found in the liver and macrophages. It has been demonstrated that the exposure to TiO2 of particle size 20 nm even at low doses causes complete destruction of DNA, whereas 500 nm TiO2 have small ability for DNA strand breakage[4].

**b ) Ingestion :–**

Nanomaterials can enter the body by accidental or deliberate transmission from hand to mouth. Lipsticks, lip balms, lip gloss, and other cosmeceuticals that are applied to the lips or mouth might contain nanoparticles. based on the studies, Nanomaterials

quickly leave the body after consumption, but occasionally a small amount that could move to the organs taken up. studies carried out on pig layers skin demonstrate the 24-hour penetration of certain nanomaterials into the skin's layers exposure [14]. Spleen, heart, liver, bones, and pancreas became the target organs when mice were orally fed with zinc oxide nanoparticles with 20 nm and 120 nm at various doses. Various commercially available products contain copper nanoparticles accessible cosmetics[3]. Mice showed toxicological effects and severe wounds being exposed to copper nanoparticles, internal organs. Uses for silver nanoparticles are numerous .Antibacterial compounds and wound dressings are now used in soaps, face creams, and toothpaste are examples of cosmeceuticals. Uses for silver nanoparticles include their ability to fight bacteria in cosmetics. The deadly concentration of silver the same dose of bacteria that is fatal to both fibroblasts and the keratinocytes [4]. Several rat studies indicate that silver nanoparticle exposure to rat neuronal cells caused size reduction and irregularities in shape. Additionally, mouse germline stem cells were shown to be sensitive to silver even at low concentrations .The viability of cells and mitochondrial activity were significantly lowered by nanoparticles. When Mice were ingested with 13.5 nm gold nanoparticles, which significantly reduced the amount of Observed variables included RBCs, body weight, and spleen index[6].

**c ) Dermal Routes :–**

These three pathways—intracellular, transcellular, and transfollicular—are used for penetration across the skin. Lesser size particles with a penetration depth of less than 10 nm are more harmful to the skin than larger ones with a depth of more than 30 nm. There are options that skin barrier changes like scrapes could have an impact on nanoparticle penetration, dermatitis-related conditions and wounds. Oedema, eschar development, and persistent erythema reported to contain nanoparticles smaller than 10 nm[4]. According to a report by Professor Robert F., fullerene-containing face creams have been proven to harm fish brains and have hazardous effects on human liver cells [2]. Several research showed that Intact skin could be penetrated by fullerene-based peptides, and their traverse due to mechanical stressor, entry into dermis might be simple. Quantum dots applied topically potentially reach local lymphatics and lymph nodes. Studies have shown that Quantum dots and single- or multiwall carbon nanotubes are examples of manufactured nanoparticles. Nanoscale titanium and surface coatings can change gene or protein expression and have harmful effects on fibroblasts and epidermal keratinocytes[5].Currently, not many problems exist about the effect of titanium dioxide and zinc oxide nanoparticles in sunscreens on health,safety, and environment. Greater surface area, greater chemical reactivity, and smaller size are the causes of the increased creation of reactive oxygen species (ROS), including free radicals. Production of free radicals and reactive oxygen species is the main toxicity of nanoparticles mechanism. ROS are produced by zinc oxide and titanium dioxide.when exposed to ultraviolet (UV) radiation, and free radicals, which have the potential in oxidative stress and inflammation can significantly harm proteins, membranes, and other structures. Cellular RNA, DNA, and lipids. a study on the toxicity of TiO2 nanoparticles revealed that when pregnant mice were administered these nanoparticles subcutaneously, they were passed on to the progeny, and male sperm production was decreased.children as well as brain damage. Cobalt-chromium nanoparticles have potential that they can harm human fibroblasts by crossing the epidermal barrier[12].

- **Contact Urticaria :–**

Contact urticaria appears immediately (mostly within 5 to 20 minutes , exceptionally later)Upon contact with the causal agent . The skin reaction is clinically characterized by redness and oedema ( sometimes urticarial papules ),and may ,when immunologically mediated ,be accompanied by extracutaneous symptoms such as conjunctivitis, respiratory problems , dizziness, and even anaphylaxis. This is referred to as the “contact urticaria syndrome “in which 4 stadia can be recognized Cutaneous symptoms:

Stadium 1: localised urticaria

Stadium 2: generalised urticaria ,extracutaneous symptoms,

Stadium 3: bronchial asthma ,rhino conjunctivitis otolaryngeal ,gastrointestinalSymptoms.

**Diagnosis :-**

The diagnosis of contact urticaria consists of a careful history ,inspection of the clinical history, inspection of the clinical symptoms, and the performance of immediate tests : the suspected materials are tested as such (open ) , but mostly with prick testing .Reading are performed immediately and up to 1 hour.Also a provocation or usage test can be performed. However, if the anamnesis or the clinical symptoms observed point to a severe extracutaneous reaction ,attention is to be paid not to elicit a severe reaction on testing ,which should be performed in hospital environment only.In case of an immunologic mediated urticaria, specific IgE- antibodies can be searched for.

**The Allergens :-**

Cosmetic examples of substances to which also severe reaction have been reported are permanent hair dyes containing PPD ,the sunscreen agent benzophenones and hair bleaches[15].

**Conclusion:-**

In recent years nanotechnology has been used as a significant tool for growth in different fields. Nanotechnology has become a principal tool in developing a variety of industries, including agriculture, food,paints, medicine, and textiles. The use of several nano systems as an active cosmeceutical ingredient by cosmetic industries is due to its ease of manufacturing[4].Its application in formulating anti-ageing creams, sunscreens, deodorants, hair care products, and improving damaged skin is due to its ability to penetrate the skin layers, biocompatible nature, stability, and the antioxidant property. The extensive use of nanotechnology by major companies like L’Oreal, Dior, and Shiseido has opened doors for their potential use in the cosmetic industry[9]. The number of research that is being carried out clearly depicts the power it has on the cosmetic industry and market[5].

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