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Application of Nanoparticles in Cosmetics: Safety and Health Effects

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Introduction

Throughout the beginning of time, nanomaterials have been employed to create cosmetic items. Because gold nanoparticles contain liquid nail lacquer that was utilized as an anti-aging treatment in middle-aged women. It was increasingly being utilized to make cosmetics in the pharmaceutical business. By providing fresh approaches, nanotechnology has advanced by increasing the effectiveness of goods. The cosmetics industry is turning to nanotechnology to address some of the drawbacks of some conventional products. Nanocosmetic ingredients included in skin, hair, nail, and lip care products can be used to cure wrinkles, photoaging, hyperpigmentation, dandruff, and hair damage. The major areas of focus for nanotechnology research in the cosmetics industry include the many unique carriers used to carry cosmetics, their benefits and drawbacks, economic formulation, cytotoxicity, and nanocosmetic restrictions. The word "nanotechnology" is made of the word "technology" and the dwarf-like Greek letter "nano". Dendrimers, cubosomes, and nanoemulsions are examples of nanoform particles used in cosmetics. Sunscreen, anti-aging cosmetics, blades, and curling irons are a few examples of nanoscale items [1]. For hundreds of years, nanomaterials have been utilized in cosmetics (Figure 1) [2]. The ladies painted their nails with silver and gold nanoparticles. In the Medieval Ages, anti-aging liquid medicines using gold nanoparticles were also in use. Nanotechnology is concerned with manipulating material structures between 1 and 100 nanometers, or around 6 and 13. When a particle has one or more outward lengths or structural components at the nanoscale, it is referred to as a nanoparticle. Nanotechnology might produce different qualities from the same substance without nanoscale traits. Uniformly sized, shaped, and composed nanoparticles are being used more and more in tyres, sporting goods, exhaust systems, electronic parts, window sprays, paints, varnishes, coatings, food, cosmetics, and skin products for a variety of uses, including enhanced UV (ultraviolet) protection, deeper skin penetration, longer-lasting effects, controlled release of drug effects on the skin, epidermis attachments, specific cell populations of hair follicles, and transcutaneous drug delivery and transdermal Liposomes, microemulsions, and nanoemulsions are examples of labile nanoparticles that disintegrate into their biological macromolecules when applied to the skin. Examples of insoluble particles include TiO2 (titanium dioxide), fullerenes, and quantum dots [3].

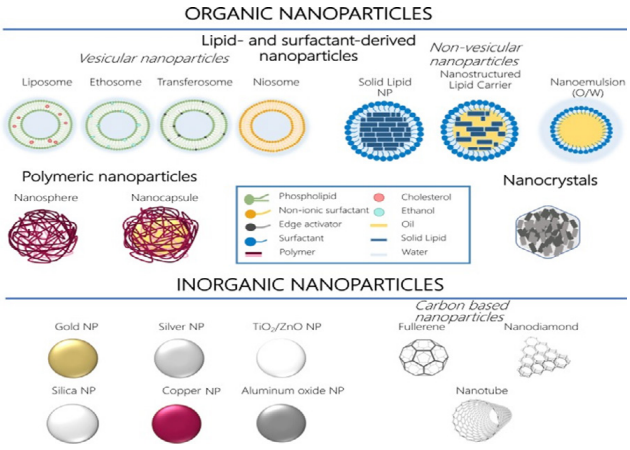

Figure 1: Several nanomaterials are employed in the preparation of cosmetics and cosmeceuticals [2].

Nanomaterial Types Applied to Cosmetics

Unquestionably, one of the most popular goods in the world is cosmetics. There are many different personal care items included in the wide area of cosmetics. Cosmetics for the face include lipsticks, powders, mascaras, and facial makeup. Nail care items, including paint and polish removers [4]. Fragrances like cologne, deodorants, aftershave, and perfumes are used in UV radiation prevention measures such as sunscreen products. Materials with a minimum of one dimension in the nanoscale range and distinct physicochemical characteristics are referred to as nanomaterials. Cosmetic nanomaterials are available in a broad range of sizes and forms, and each has unique features that define the kind of cosmetics they are most suitable for.

Bilayer vesicles known as liposomes are harmless, made mostly of organic or semi-synthetic phospholipids, and employed in the beauty industry. They offer several benefits, including the ability to transport cosmetic active components like nutrients, minerals, enzymes, and generally pro-active agents inside biological cells while fusing with the skin's two-layer architecture. Transferosomes, niosomes, and ethosomes are a few more vesicle types with higher skin permeability that have been created [5]. Liposomes provide several benefits for delivering cosmetic active substances to biological cells, such as vitamins, enzymes, minerals, and anti-aging agents, by adhering to the two systems of the

skin. Other vesicles with higher skin permeability include ethosomes, transferosomes, and niosomes.

Nanometals with good effectiveness and antibacterial qualities, such as nanoparticles and nanogold, have been used in toothpastes and deodorants. Due to their high efficacy and antibacterial properties in various beauty products, such as antiperspirants and toothpastes, nanometals, such as nanoparticles and nanogolds, have been employed in the composition of cosmetics. These materials are widely used in other industries; thus, they have a high market value among nanomaterials [6]. Solid lipid nanoparticles (SLNs) are lipid droplets at the nanoscale that have been stabilized with appropriate surfactants that contain active chemicals. The encapsulating active substances can be shielded against deterioration by these nanostructures. SLNs can also be utilized to distribute cosmetics in a regulated manner and to increase the penetration of the cosmetics' active components. These nanostructures can prevent deterioration of the enclosed active substances.

Nanoemulsions are evenly distributed suspensions of liquid at the nanoscale in another liquid. These droplets can function as carriers for active chemicals in cosmetics because of the huge contact area they create with the skin. Because they have a vast surface area in contact with the skin, these drops can serve as carriers of the active components in cosmetic products. These ingredients are regarded as safe for use in creating cosmetic goods. The water or oil phases of nanoemulsions are composed of nanostructures made of polymer composites called nanocapsules, which are thought to be outstanding carriers for some delicate active substances like vitamin D or potent cosmetic ingredients. Nanoemulsions are more stable, transparent, and effective due to the small drop size [7–9]. In these formulations, certain active chemicals, such as vitamin D and potent active aesthetic components, are presumably ideal transporters.

Advantages to Appearance, Safety, and Health Issues

The peculiar characteristics of nanoparticles used in cosmetics can have positive and negative effects. Nanomaterials' toxicity, however, remains uncertain. The Food and Drug Administration's (FDA) Nanotechnology Theory, which recommended regulatory considerations focused on the security and non-falsification of cosmetic goods, brought attention to the need for the safety of nanoparticles in the United States. The FDA requires two basic data sets (strategies) to evaluate the safety of nanoparticles in cosmetic products. One of them is information about the properties of the substance, especially the nanoform in which it was used. Information on such materials and finished cosmetic products includes those properties as well as biological interactions and related contaminant characterizations, as nanoparticles can have different physicochemical properties. It is possible to manage poisoning, pollution, and allergy issues more successfully with such precise and accessible information [10]. The toxicity information of the nanoparticle's product is another component of this information. Acute, chronic, and subchronic systemic toxicity, skin irritancy and allergy, and photoirritation and photoallergy should all be assessed in cosmetic chemicals. A toxicological danger arises from the accumulation of nanoparticles on related items or from the use of certain goods. Inhalation, ingestion, and skin absorption via the body's surface are the three main ways that people are exposed to nanomaterials. Environmental risks are associated with nanomaterials. Environmental issues can arise when nanomaterials are produced, used, or disposed of and released into the water, air, or soil. In natural ecosystems, for instance, beneficial bacterial systems can be disrupted by nanoparticles with antibiotic activity. Certain nanomaterials can attach to and transport across long distances air contaminants like cadmium or petrochemicals. In conclusion, it is important to consider each of these concerns while creating, using, and discarding nanocosmetics (Figure 2) [11, 12].

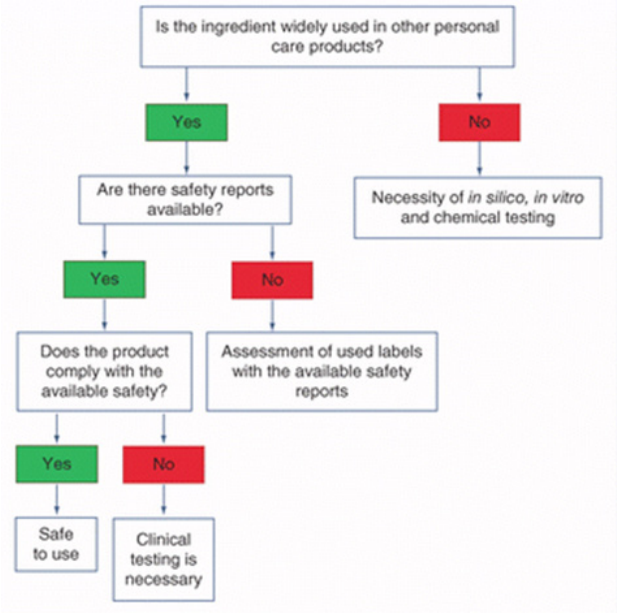

Figure 2: Decision making tree for safety evaluation of nano cosmeceuticals products [12].

Conclusion

The world's consumption of cosmetics is rising. Cosmetic preparations have evolved into nanocosmetic substances because of the ongoing development of cosmetic goods and nanotechnology. Nanotechnology is increasingly being used in cosmetics. SLN, lipid nanoparticles, and lipid-drug conjugates are examples of well-classified technologies used in the advancement of nanoparticle drug delivery to the skin during the past few decades for the safer and more precise administration of active components and cosmetics. Nanoparticles can alter the flow, control the position and size of the drug carrier, and even pass through the membrane only when they are specifically intended to. For formulations meant for patient treatment, it's crucial to assess the nanomaterial's toxicity and skin absorption capacity. Before they are authorized for usage, all nanoparticles utilized in the production of cosmetic goods must pass a test in a real-world setting. The safe components that may be utilized in the production of these cosmetic items, as well as the proper labeling and tracking of their effects, must be confirmed after this test. Also, consumers of cosmetic nanoparticles are required to report any unusual interactions to the appropriate authorities right away so that they can monitor and regulate the items on the market to guarantee consumer protection and public health.

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