
Nanotechnology In Cosmetics: Public Perception And Effect On Health And Environment

Introduction

The desire to preserve youth and beauty does not give rest to not only women, but also scientists. Physicists have been implementing their developments in cosmetology for several years in a row. The onset of the nano-cosmological revolution was predicted by science fiction writers long ago and was not mistaken. (Tungate, 2012) In spite of the fact that while we are at the beginning of our journey, already now a whole series of studies gives practical results that can be used in everyday life, in science and in cosmetology.

A nanoparticle has an interesting feature - up to a certain point, almost every atom of it has a surface formation participant, i.e. a small particle has a huge surface. One gram of substance in the form of nanoparticles is capable of covering 400 square meters. In addition, on the surface all atoms are in a special state - they have many unsaturated bonds, which, of course, tend to come into contact with everything that surrounds them. This explains the extraordinary properties of small particles: there are a lot of them, and they are hyper contact. It is all about the small prefix 'nano', which allows you to make a global transition, a qualitative leap from the manipulation of matter to the manipulation of individual molecules and atoms. Nanocosmetics is a product of nanotechnologies related to such production methods, in which materials with particle sizes from 1 to 100 nanometers are obtained or used. For a long time in cosmetology existed only the so-called surface cosmetics, the active components of which did not penetrate into the deeper layers of the skin. These cosmetics were characterized by a superficial effect, as a result of which all the useful substances remained on the surface of the skin, creating a certain protective film. Of course, the need for such cosmetics exists, because it protects the skin from harmful effects, forcing the inner layers of the skin to work independently. Nevertheless, the possibilities of such cosmetics in solving serious skin problems, including the problems of premature aging, are very limited. In order to improve the quality of the skin, remove deep wrinkles, achieve effective moisturizing of the skin, restore beauty and brightness to mature skin, it is necessary to improve the delivery of nutrients to the deep layers of the skin. Being very small, nanoparticles can penetrate even through the cell walls of living organisms. With the help of modern nanomachines it became possible to combine atoms of biologically active substances in a certain sequence and proportion so that the skin perceives these cells as familiars and instantly include them in the metabolic processes. (Tungate, 2012) Yet the use of relatively new technology in the manufacturing of cosmetics raises concerns about whether nanotechnology is safe and long-term. (Malsch, 2014) This dissertation will focus on question whether the nanoscale ingredients in cosmetics are safe for both human health and environment, and how consumers perceive nanotechnology and its use.

- Aim: To understand what nanotechnology is and how nanoparticles affect human health, explore the hazards for the environment from the production to the disposal. Inquire about customer awareness of the possible dangers of nanocosmetics.
- Objective 1: Study science books to understand the concept of nanotechnology and how impactful it is in cosmetics industry.
- Objective 2: Research cosmetic companies that use nanotechnology and if their

customers can easily learn about nanoparticle use from the product labelling.

- Objective 3: Study about risks of nanotechnology on health and environment.

Context

This proposal will mainly focus on nanoparticles used in cosmetics and their properties based on research from books and articles. Following will be investigated to gain basic knowledge about the potential risks of nanomaterials compared to ordinary cosmetics.

What is Nanotechnology and how it works?

In the laboratory, new nanotechnology can work wonders: on a special computer, you can program the creation of cosmetics with pre-known properties and absolutely identical to the cells of human skin. In other words, to allow the skin with a variety of properties to get exactly what it needs most. The composition of nanocosmetics is different from traditional cosmetics. Knowing what substances the skin needs for different people and conditions, nanotechnologists create whole bio-complexes containing the necessary active components related to human cells. The substances crushed to nano-size multiply their effectiveness and easily penetrate deep into the epidermis. Therefore, there is no need for huge concentrations of wanted substances, as in conventional creams, each molecule of the product will completely fulfil its function. (Morgan, Havelka and Lochhead, 2007) The main active ingredient in the formulas is silicon oxide. The properties of highly dispersed silica are well known. This absolutely safe trace element is present in body, while its effectiveness as a cosmetic ingredient has been tested for centuries. Israeli scientists managed to break up SiO₂ into nanoparticles: the size of the active substance in the formulas is one millionth of a millimetre. This allows to increase the area of ??interaction of the cosmetic product with the skin, increasing its effectiveness several times. (Knobloch and Kaminorz, 2004) It is the properties of nanosilica due to the mechanism of action, its effectiveness in correcting the external manifestations of aging and high performance in acne rashes. Scientists emphasize the fundamental properties of silica, which they adopted in the laboratory: it is an excellent antioxidant, has a high sorption capacity, hydrophilicity, i.e. ability to bind a significant amount of water, it also collects protein compounds (for example, dead skin cells, melanin, sebum, microorganisms) by three orders of magnitude more than all known sorbents. In the nanoscale range, virtually any material exhibits unique properties. (Shokri, 2017) For example, silver ions have an antiseptic property, however, a solution of silver nanoparticles has a significantly higher effect. Silver nanoparticles can be used to modify traditional and create new materials, coatings, disinfectants and detergents (including toothpastes and cleaning pastes, washing powders, soaps), cosmetics.

Is cosmetics industry hiding nanoparticles from consumers?

The cosmetic industry is one of the main players in the nanotechnology market. According to studies, the share of cosmetics accounted for most of the patents related to nanoparticles - toothpastes, sunscreens, shampoos, hair conditioners, lipsticks, eye shadows, shaving gels, moisturizers and deodorants. From the marketing point of view, one of the most promising sectors in the industry is anti-aging products. It is expected that new advances in the field of nanotechnology will significantly increase the profit of cosmetics. (Morgan, Havelka and Lochhead, 2007) For example, L'Oreal is ranked sixth in terms of the number of nanotechnology patents in the United States, company has developed polymer nanocapsules

that deliver the active substances to the deeper layers of the skin, making it stronger. But despite the fact that anti-aging products look the most profitable, L'Oreal and its rivals are also introducing nano into other designs, such as eye shadows with brighter colours, iridescent or metallic effects. Nonetheless, most of cosmetics manufacturers fail to inform customers about whether it contains nanoparticles, people do not even suspect that there are serious concerns about the safety of their health and the environment. (Mandavilli, 2019) The chart on the next page shows how well aware are people (mostly women, aged 16-45) of nanomaterials in the cosmetics and the potential risks. Most women were not familiar with nanotechnology, its effect on health or if it is used in their daily cosmetic products. Various surveys have shown that almost all major cosmetic manufacturers use nanotechnology in their products. Frequently, these companies do not use the whole nanoparticle complex and use only 1-2 nano components.

Some successful manufacturers using different nanoparticles in their products, on the contrary, fail to inform the customers about the nano ingredients that product contains. Many scientists, politicians and anti-advertising statements cause significant concerns and question the safety of nanoparticles, especially those used in daily cosmetics. Tests by Friends of the Earth Australia has identified the top ten brands, including Lancôme Paris, Clinique, By Terry, Clarins, L'Oréal, The Body Shop, Max Factor, Yves Saint Laurent, Revlon, and Christian Dior. The research conducted by the Australian microscopy and microanalytical study found that eight leading brands, foundations and concealers with particles below 100 nm were Clinique, Clarins, L'Oréal, Revlon, The Body Shop, Max Factor, Lancôme Paris and Terry; two more products contained particles measured at 100 nm in Yves Saint Laurent and Christian Dior. (Emergingtech.foe.org.au, 2009) Found nanoparticles are used to dissipate light, hide wrinkles, protect from sunlight or improve colour. In addition, Friends of the Earth found that seven of the tested cosmetic products contained ingredients that are known to act as 'penetration enhancers', so nanoparticles are more likely to penetrate deeper layers of the skin, three cosmetic products with no penetration enhancers were mineral bases that pose a higher risk of inhalation in powder form. Only one of the brands (Christian Dior) surveyed indicated that nanomaterials are used on the product label. Without nanomaterials indicated in the ingredient list, consumers are not given a reasonable choice.

Nanosized particles may possibly have an effect on health

For years, the cosmetic industry has earned a lot of money. People want to use beauty products, and companies produce them - just supply and demand. The only problem is that no one knows exactly whether new nanoproducts will be safe. Nanoparticles can have very unlike biological, physical and chemical properties than their usual equals. Despite the fact that there is no definite evidence that nanocosmetics are harmful to health, preliminary studies reveal that there is a serious risk that nanoparticles pass through the skin, enter the bloodstream and accumulate in tissues and organs. (Egorova, Kubatiev and Schvets, 2016) It is believed that healthy skin creates a barrier against the penetration of foreign particles, however, damaged or even just tense skin can pass them into the body. It turned out that titanium oxide, currently widely used in sunscreens, modifies the normal response of cells to foreign particles. Moreover, nanoparticles reduce the rate of productivity of reactive oxygen types, which is potentially dangerous for brain cells. (Mellowship, 2009) Biologist at University of Southern California Caleb Finch states that once nanoparticles gain entry to the brain, they damage cells there in a number of ways. (Stevens, 2014) There is no consistent evidence that such oxidative loads can

damage neurons, but additional studies already suggest that titanium oxide can lead to the death of neurons. (Malsch, 2014) The Royal Organizations in their report recommended, according to and European regulation, to consider nanoparticles as 'new chemicals', to conduct relevant tests and approve or ban them by an independent committee before using these particles in consumer products. (Ngarize, Makuch and Pereira, 2013)

Industry and activists clash over health and environmental risks of nanotechnology

Meanwhile, numerous cosmetics containing nanoparticles are already on the market. One of the manufacturers of cosmetics with zinc oxide particles is Advanced Powder Technologies (APT). According to company, the nanoparticles contained in sunscreens do not penetrate through the skin and therefore are safe. (Ewg.org, 2019) APT agrees that further particle studies are necessary, but it is believed that they will only confirm their safety, since zinc oxide has been used in cosmetics for many centuries, no problems with it appeared.

Future impacts of Nanopollution

In addition to medical risks there are also environmental. Due to the fact that it is not entirely clear how nanoparticles behave, it is also unclear how dangerous they are for the environment and how much they can pollute it. The cosmetics industry is one of the dirtiest in the world, the production volumes are enormous. There are various ways in which nanomaterials can pollute the environment. They can be released during production or accidentally. (Egorova, Kubatiev and Schvets, 2016) For example, a sunscreen containing nanomaterials that has been washed off while taking a shower or swimming would go to wastewater system or surface waters. After the sunscreen is finished, the packaging would be disposed and either incinerated or landfilled. Nanoparticles in petroleum are expected to be released into the air. (Shokri, 2017) There is no sufficient amount of information about the fate of nanomaterials at the end of their life cycle. Nanomaterials can be discharged directly from landfills by incineration or waste water cleaning. For instance, most of the nanoparticles used in cosmetics, paints and coatings eventually end up in the wastewater, either during their direct use, or slightly after the product has worn out. Reuse can be a long-term goal, but it is very little known at present that would make this possible. Materials such as carbon nanotubes used in plastics, sports equipment and electronics are likely to remain in the product until they enter a landfill or incinerator, where they can be discharged into the environment or released into the air. (Koehler et al., 2008) The effects of nanomaterials released into the environment may be different from those used for their intended purpose. Activists constantly protesting against use of nanotechnology and the effects of it on environment. Photo below of 'No Nano' Graffiti, protesting against the establishment of nanotechnology laboratories, on the Bastille fortress in Grenoble, France. Grenoble is known as European capital of leading research centers in nanotechnology. Nearly all funding is for exploring how nanotechnology may successfully be used to fix current environmental issues but one rather different than that of how nanotechnology could have a destructive effect on the environment. The debate whether the nanoscience is safe on both sides continues to be divided and defensive. "There is virtually no data on chronic, long-term effects on people, other organism or the wider environment", says John Lawton, a scientist and author from the Royal Commission on Environmental Pollution. (Mitchell, 2019) Photo by David Monniaux

Methodology

The dissertation will include both primary and secondary research. Quantitative and qualitative data will be collected by using an anonymous survey, it will focus on people's (mostly women, aged 16-40) perception on nanoparticles in cosmetics, whether it is safe for the health and environment in their point of view. In addition to that, it will ask people who used any cosmetics with nanomaterials if they saw any positive or negative change in their skin, teeth, etc.

Conclusion

Nanocosmetics is already conquering the world. Scientists and cosmetics manufacturers are optimistic about the future possibilities of nanotechnology and continue their successful developments in the field of nano-cosmetology. In fact, the entire revolutionary nature of nano-cosmetics makes it possible to deliver directly to the skin, precisely to the right layers of it, a precisely dosed amount of the smallest particles of substances that are the most helpful to the skin. But most importantly, scientists managed to program the nanoparticles to perform pre-determined actions at the right time and in the right place.

But is it worth risking health and environment for the sake of smooth skin or white teeth?

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