



# The New Renaissance of Beauty and Wellness Through the Green Economy

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## Abstract

Beauty and wellness remain for both women and men an important target also because the global attractiveness is considered a cue indicating the ability to maintain beauty and wellness. Consequently, neuromarketing has born, as an innovative mean to interact with consumer's trend, actually looking for high-quality and natural cosmetics and food. By the biometric studies, in fact, it seems possible to verify the consumers' willingness to buy the right products they are looking for. On the other hand, customers are requesting cosmeceuticals and nutraceuticals which, acting positively on the superficial appearance of face and body, seem to be able to boost the immune system also, limiting the stress conditions. This general disease is induced by the actual way of living in a planet invaded by a great quantity of waste released from the human's activities. The consequent pollution alters the ecological balance of the body, influencing negatively the life of animals and plants also. Thus, the induced stress, further increased by the COVID-19 spread, could change the neural conditions of human brain. Consequently, in humans could decrease production of stem cells and cortisol from the neurons, while in plants the patterns of growth could affect both cuticle and stomatal conductance of the leaves. Thus, the brain, under condition of psychosocial stress, actively demands energy from the body eliciting a marked increase in eating by a major intake of carbohydrates, removed from the requirements of other organs. In any way, pollution provokes a wide-range of adverse health and social effects, further worsen by an increased worldwide aged population who, requiring more food and goods increases the waste production.

What the proposed solution?

To change the actual way of consumption and production, it is necessary to optimize the re-resources of raw materials, minimizing waste that should be recycled and reused by a green economic approach. Therefore, the need to realize a new industrial Renaissance reducing the use of natural material by the utilization of waste by-products and sustainable technologies at low consume of energy and water. So doing, it will be possible to maintain the human wellbeing in an environment in which the species' biodiversity could be assured. At this purpose, chitin nanofibrils(CN), nano-lignin (LG) and their derived compounds have been proposed to make nanoparticles (NPs) by the use of water as solvent. These NPs, loaded by different active ingredients and bound on the surface of natural bio-fibers may be used to make biodegradable carriers structured as innovative non-woven tissues and films. Depending on the polymers selected to make the micro-nanocomposites and the actives loaded into the fibers, these new vehicles may be used to produce smart cosmeceuticals, nutraceuticals or advanced medications. It is interesting to underline that all these innovative NPs and tissue/films can be produced by natural polymers and ingredients, obtained from waste materials, and produced by sustainable technologies at low consume of water and energy, according to the new green economy.

**Keywords:** Anxiety; stress; wellness; health; COVID-19; beauty; cosmeceuticals; nutraceuticals; chitin nanofibrils; nanolignin; nanoparticles; non-woven tissues; films; environment; green economy; pollution

## Introduction

Ten years ago, during the 7th Congress of the International Society of Cosmetic Dermatology [1], many scientists coming from East and West Countries discussed on the strict relation existing

between human wellbeing and health. In that occasion the free-thinking of the Chinese doctor Sun Simiao in IV century BC was remembered : "a good doctor first finds the cause of the illness,

and after finding it, he tries first to cure it with food, if the food doesn't give results then he prescribes medicine, because whatever helps the body can be considered medicine and at the same time nourishment". However, for Ancient Chinese, but for Romans also, food, exercises and the way of living, have to be regulated without anxiety by the continuous self-examination of the body, as practice of wellbeing. Thus, according to the concept of Wu-Wei as part of ancient Taoist tradition, humans are in state of harmony only when they move and operate in a dynamic, spontaneous way. Consequently, it is possible to control lost of stress over condition by meditation, breathing and exercises, as reported from Traditional Chinese Medicine (TCM) as well as from ancient Romans ,thinking and living by the principle: Mens sana in corpore sano (a healthy mind in a healthy body).

Ancient peoples, therefore, understood and considered important to limit anxiety and stress for maintaining wellbeing, without knowing the physiological body-immune system connections. Thus, during the last ten years many scientists have tried to better understand the inter-connections connecting the level of behavior to the level of neural activities and structures of the brain. The stress conditions, in fact, involve all the principles of learning and memory, including the decision-making mechanisms [2]. Coming back to the papers presented 10 years ago it seems necessary to put some questions. Have we sufficient knowledge on stress and the brain neural circuits? Can innovative neurocosmetics modify the stress condition acting on the Nervous, Immune, Cutaneous, Endocrine (NICE) systems, as reported from some scientists 10 years ago? [1] Does consumers reduce stress, ameliorating their appearance by the use of smart natural- oriented cosmetic and diet supplements? Have been developed new scientific knowledge on stress and aging to ameliorate beauty and wellness by innovative products?

## Environment and stress

During the last ten years it has been shown how the brain' organization and its neural circuits are changing, forced by the high increase of the many environmental and social stresses, caused by our modern industrialized society [3]. Thus, while the relative neuroendocrine responses are critical for the individual' survival, the repeated exposure to stress results deleterious for health and wellbeing also. These the reasons of the extreme increased rate of diabetes, heart disease, cancer, Alzheimer and autism and other diseases, registered as probably consequent to the control lost(stress) over the protective mechanisms of human body. Therefore, the capacity to survive for the entire species has been drastically reduced, continuing its rate year by year. But which the causes of stress and the consequences on our body? There is a growing evidence that pollution, doubled for every five years' time interval from 1950 up today, is no more a merely annoyance but a real plague of the modern society. The actual waste, in fact, causes numerous and increasing adverse health, social and economic effects on humans, animals and plants, disturbing their normal way of living. As a consequence, contaminants of the environment have a negative impact on health, leading to stress and skin aging [4]. Thus, according to the World Health Organization'(WHO ) report, indoor and outdoor air pollution kills worldwide and every year an estimated 7 million people (Figure 1) while 9 out of 10 people breathe air containing high level of many pollutants that exceeded the established healthy limits (Figure 2) [5]. Therefore, the consequent diseases may be considered as the result of maladaptation to a completely new environment of the last 2-3 generations, to which the population of the industrially developed countries was not genetically adapted [6,7]. Consequently, many illness-es, called civilization diseases, are the direct result of a continuous stress of the health of population, living in industrialized countries where the ecological balance seems irretrievably endangered.

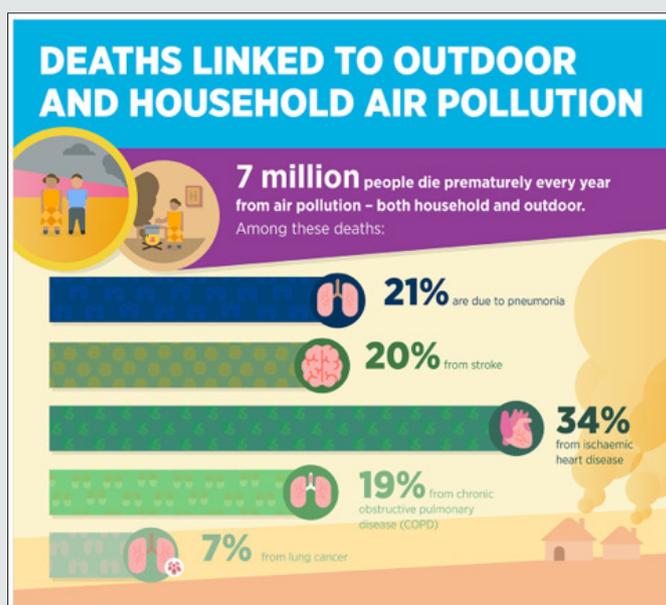


Figure 1: Indoor and outdoor air pollution as environmental risks for health (by courtesy of WHO [5]).



Figure 2: The major sources of air pollution (by courtesy of WHO [5]).

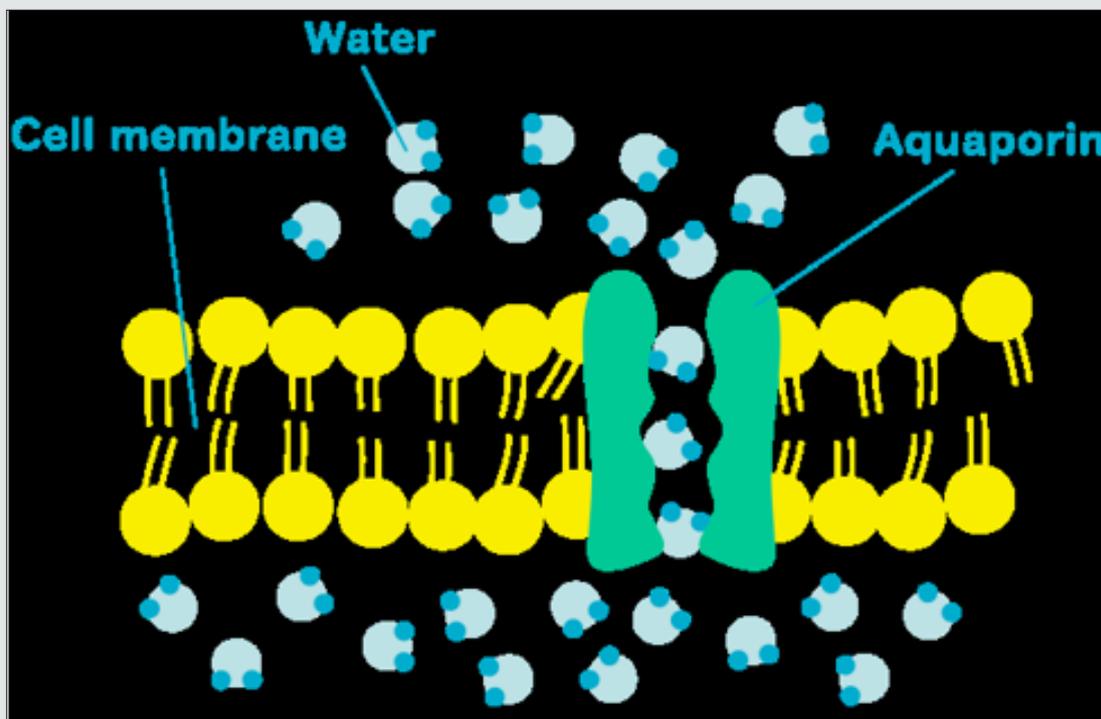


Figure 3: The Aquaporins' Chanel for water (by courtesy of Keyo University [11]).

Under the conditions of psychosocial and environmental stress, the brain demands more energy, in order to cover its increased energy needs for the body. It elicits, therefore a market increase in eating behavior during the post stress phase, so that cerebral glucose supply is enhanced, while its content into peripheral tissues is reduced [8]. Brain, in fact, occupies a special hierarchical position in human energy metabolism, characterized by a high energy consumption and a low energy capacity. Thus, under condition of stress or nutrient deficiency this fundamental organ safeguards its own energy supply. Activating, therefore, its regulation system by the aquaporins (AQPs) structure, the brain sacrifices the energy required from other organs [9]. Just to remember, AQPs are water channels of hydrophobic proteins, which, forming pores in the membrane' biological cells, facilitate the intercellular transport of water, small solutes and gas emissions, indispensable for all the biological reactions (Figure 3)[10,11]. By the same way AQP3, which decreases with aging, seems to be involved in skin hydration, skin elasticity and wound healing, as well as in cell migration of keratinocytes, underlining the importance of water for the entire body [12-14]. Thus, an ameliorated skin hydration, stimulated by the use of the right cosmetic products, increases the consumers' perception of attractiveness compared to no cosmetics, reducing probably anxiety and stress, often connected with a facial appearance considered not enough nice [15]. People, in fact, "feel better about themselves when they think they are attractive to others" [15].

In conclusion, the actual way of living and the high pollution-level, have an important negative impact on beauty and wellness caused by the anxiety further increased from COVID-19 pandemic. This unknown virus pandemic, in fact, has shown to be very dangerous, not only because unusual and very contagious, but also for the waste pollution and waste created by the great quantity of non-biodegradable materials used to make surgical face masks and other protective equipments, necessary for the hospital 'personnel and normal consumers [16]. Unfortunately, COVID-19 until now has infected 107,588,515 people causing 2,356,198 death (Worldometer, 10 February 2021) with an estimated non-biodegradable plastic waste (129 billion Face masks, 65 billion Gloves and Gowns, etc) ranging more than 2000 billion tons monthly! [17]. On the other hand, the arrival of this new disease seems to push people into a movement incorporating elements such as safety, transparency, sourcing/manufacturing practices and other factors. However, the better knowledge on the products' efficacy and safety, will be surely useful to safeguard both human health and the environment [18]. The consumers, in fact, are seeking more holistic solutions which could underpin not only the obtained instant results but also the product' convenience, transparency and value. At the same time, it is growing the demand for specific drugs, diet supplements and cosmetics which, protecting skin and body from viruses and microbial aggressions, could be able to enhance life expectancy rather than simply make superficial skin' changes. Moreover, as stress became more recognized as a key health concern, consumers are encouraged to obtain products

that, dealing with the causes, may improve their individual immune response. Naturally, these products should be made by natural ingredients and packed in biodegradable containers to safeguard the environment from pollutants.

### Beauty, health and wellness today

Ten years later our meeting, beauty and wellness remain the consumer' more important target, because associated with global attractiveness and a higher reproductive success [19]. Physically attractiveness, in fact, is considered a "cue of person's health and fitness, which indicate the ability to donate good genes and successfully raise children", being therefore under the evolutionary selective pressure [19]. Also, if the research studies regarding the NICE approach haven't obtained a real success during these years, novel studies on the biometric technique called neuromarketing has been conceived to interact with consumers. Therefore, it has been possible to quantify the cerebral flow of blood response in the dorsolateral prefrontal cortex of the brain, for checking the product activity by a single-use application. By this methodology consumers may select the product, verifying their own willingness to pay. They, in fact, are looking for high-quality, high-performing and natural products which, according to their preferences, may be selected by biometric data. Thus, consumer has the possibility to personalize the cosmetic shopping, maintaining personal identity and lifestyle. Natural and effective products, therefore, are top-of-mind in women and men consumers "who become more conscientious of the ingredients used in beauty products" [18,21], considering them necessary to maintain a healthy condition. Consequently, they demand for personalized products able to maintain their freedom of identity, culture, economics and ecosystems, exploring the push-pull between nature and science.

However, also if "looking good" has been considered important for the majority of consumers of skin care products, the necessity to obtain longer-term physical, mental and emotional health benefits, is growing day by day. At this purpose the use of advanced technology, "copying nature" to produce innovative cosmeceuticals and nutraceuticals, is considered not only a solution to maintain beauty and health, but also to combat loneliness, anxiety and depression (Figure 4) [18,22]. Additionally, it is considered important to produce beauty products free of water, to eliminate the growth of microorganisms, such as viruses, bacteria and fungi which are living in a water environment. In such a way it will be possible not only to eliminate the microbial contamination and increase the consumer's safety, but also create a new and smart category of cosmetics realized, for example, by specialized non-woven tissues [22]. However, the technological progress and the recent effects of COVID-19 spreading will probably have important effects on the future economy function, and on the actual and future behaviors of worldwide consumers. They, in fact, changed the way of shopping becoming more active with digital engagements, because of self-quarantine and the other restrictions, as reported in figure 5 [23]. Particularly, Chinese consumers are now using more frequently Wet Chat Moments not only to connect themselves with

family and friends, but also to get information about healthy food and cosmetics [24]. In addition, according to a recent study near 3 in 5 Chinese are not only sharing their opinions and interests by digital devices but are also seeking their values through their appearance, hair styles, make-up and clothing [24]. On the other hand, 40% of Americans are worried about the impact COVID-19

could have on their work, economical state and lifestyle so that demand for safe and personal products is increasing. According to a 2015 study of American Psychological Association, money is considered, in fact, the biggest source of stress for American people, while work comes in second close (Figure 6) [20].

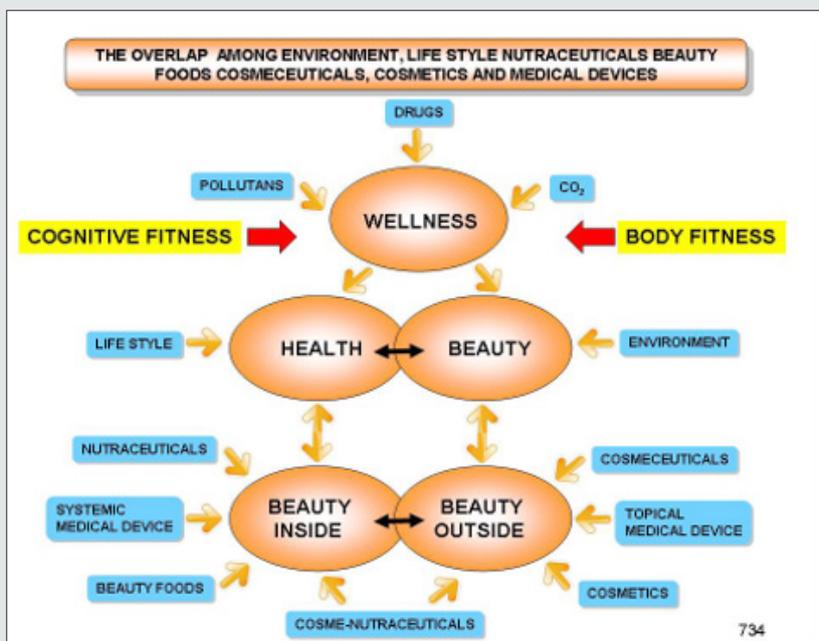


Figure 4: Cosmeceuticals and Nutraceuticals for a Beauty Wellness [22].

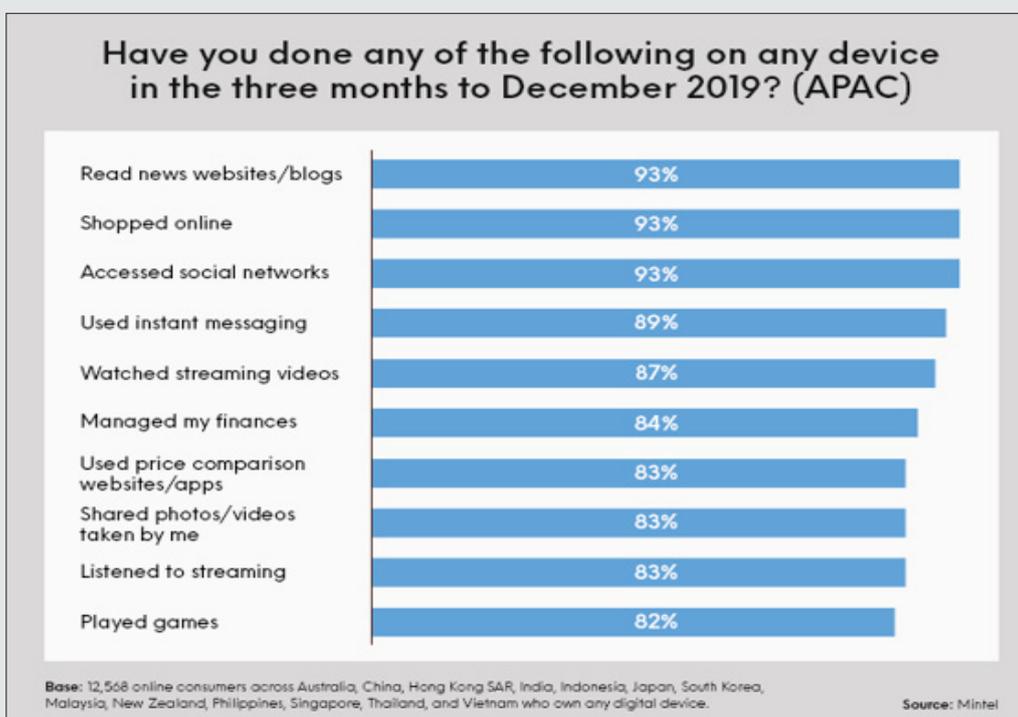
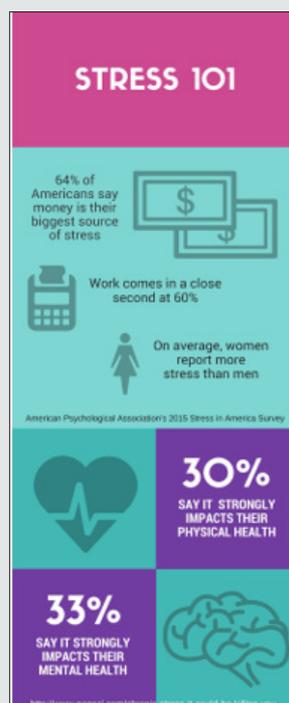


Figure 5: Consumer’s attitude to buy by the use of actual technological devices (By courtesy of Mintel [23]).



**Figure 6:** Cause of stress for Americans in 2015 as shown from a study of American Psychological Association (By courtesy of APA [20]).

However, while on the one hand, a better cleaning of face and hands to control the microbial growing seems to be the right key for improving the overall skin health, on the other hand the healthy bacteria balance, named microbiota, has not to be forgotten [26]. In conclusion, human health seems to be controlled not only from the global skin ecosystem, represented by a community of bacteria, viruses and fungi, but also from the continuous and direct body exposure to pollution. All these aggressions, causing the oxidative stress phenomena, contribute to the cells' daily aging processes which, as result of epi-genetic changes, may persist longer also after the harmful exposure has ended. Consequently, clean air and water with a safe environment are becoming worldwide a must for consumers together with wellbeing and longevity. Thus, people are forced to change their lifestyle, reducing production of waste and the consumption of energy and water. The different way of living is due to the increasing world population, predicted by UN to reach 9.8 billion by 2050 and 11.2 billion by 2100 [27] and climate crisis aggravated by the recent coronavirus infection. Thus, the re-evaluation of older traditions, centered around heritage, will bring communities to innovate more ethically, probably driving the future policy and economics [17-19]. Moreover, it seems necessary to create an immediate digital revolution and a new community-based organization to face COVID-19 and other future health crisis, looking to the great limitations of means recovered in the hospitals worldwide [23]. Therefore, better and more affordable tele-communication technologies together with a more worldwide collaboration between the different Countries will contribute to

create new products and services suited to all the local needs. Thus new and flexible work conditions could be allowed and consumers will have the possibility to become digital nomads, substituting the business traveling by video conferencing with a reduced consume of human energy and a lower production of greenhouse gas (GHG) emissions [22,23,27]. In conclusion during the last ten years, the world vision of a better appearance has been further evolved, so that health and beauty became a must for any consumer and cosmetic company [20-22,24-26]. Moreover, both consumers, women, and men, became increasingly aware of the cosmetic naturalness and impact on body and environment. They wish to know how the products are made and which is the raw material source of origin, controlling not only the prices but also their environmentally and ethically respectful practice.

First of all, they are looking for cosmetic effectiveness and eco-sustainability, well knowing that around 120 billion units of cosmetic packaging produced today are not recyclable [20-22,24-26]. Consequently, consumers are increasingly demanding zero waste, 100% recyclable packaging and fair-trade practices. Moreover, it is mandatory that most of the cosmetic active ingredients have to be of natural origin, coming from plant and herbs extracts from sustainable sources, also if the actual definitions of cosmetic as "natural, green, safe, organic, non-toxic", are not clear enough. Thus, by a 2019 study [20,21] it has been shown that nearly 70% of women in USA read on the label the beauty product' ingredients, prior to make its purchase, also if it is nearly impossible to distinguish their specific real effects, without knowing the dose used. Moreover, it is

interesting to underline that actually and differently from 10 years ago, the demand for personal care products, such as cosmeceuticals and nutraceuticals, is increased in the same way between women and men so that it has been estimated that the global cosmetic & toiletries market only [28-31] (Figure 7). According to Global Data, 81 % of men say that “health and wellness influence their personal care and grooming purchase decisions” [31]. In 2018, 58% of EU men claim to use between 1-5 facial skincare product daily to slowdown the wrinkles formation, and 1-5 use hair care product to ameliorate their global appearance. Thus, use of face mask(78% men!) as skin care routine has overwhelmed the women skin care category [29,30]. Additionally, 38% of men are looking for products packaged without any plastic at all. To further confusing the consumers understanding, it has also appeared in the market the so-called Athleisure, as a mainstream in the skincare and makeup categories. This new niche of beauty products, compatible for

any kind of exercises, are marketed to consumers who, in search for cosmetics before and after workouts, are active in maintaining their lifestyle [30-33]. However, as previously reported, consumers today are more concerned with impact of pollution and stressful lifestyle on the skin and their global wellness and, therefore, are looking for cosmetics and nutraceuticals which, of high quality and environmentally and ethically friendly also because plastic-free, are able to improve both body (skin) and mind. They, in fact, are thinking that the interplay of physical, mental and nutritional factors contributes to a healthier- looking appearance. Therefore, customers are disconnecting themselves from technology to protect their mental wellbeing, thus prioritizing what they truly want and enjoy doing: the fear of missing out (FO-MO) are giving place to the joy of missing out (JOMO) [30-33]. So doing, they have the possibility to take control over what they put on their skin and what they are eating, “customizing and personalizing the beauty products and food to buy” [32].

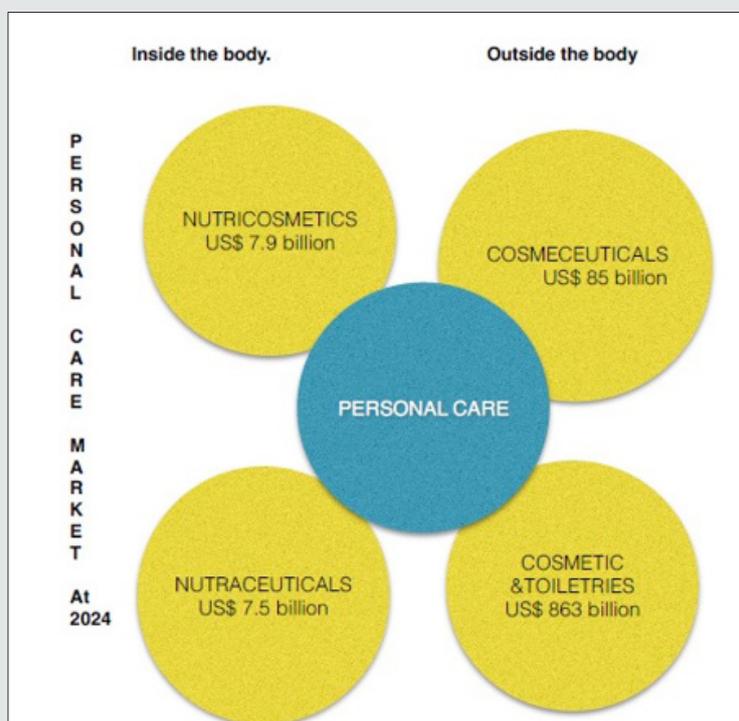


Figure 7: The provisional global personal care market in 2024.

### The green economy today: Nanoparticles and biodegradable tissues

Ten years ago, in occasion of the reported ISCD international congress, it was focused and discussed the necessity to consider innovation and culture indispensable sounds for the progress representing “the basis for a sustainable chemistry veering towards the green economy” [1,34]. Today, according to the EU report on green economy (Figure 8), we are going on the same direction evidencing the necessity to change the actual way of living. Thus

“whereas a circular economy focused on optimizing material resource by minimizing waste, the green economy approach extends the focus to how water, energy, land and biodiversity should be managed”, securing eco-system resilience and human wellbeing [34]. Thus, both production and consumption have to be integrated across the supply chain to ensure their efficiency improvement. Following this approach, our lab dedicated the majority of the research studies to develop green films and non-woven tissues by the use of two natural polymers: chitin and lignin, obtained from fishery’s by-products and plant biomass respectively [35-37].

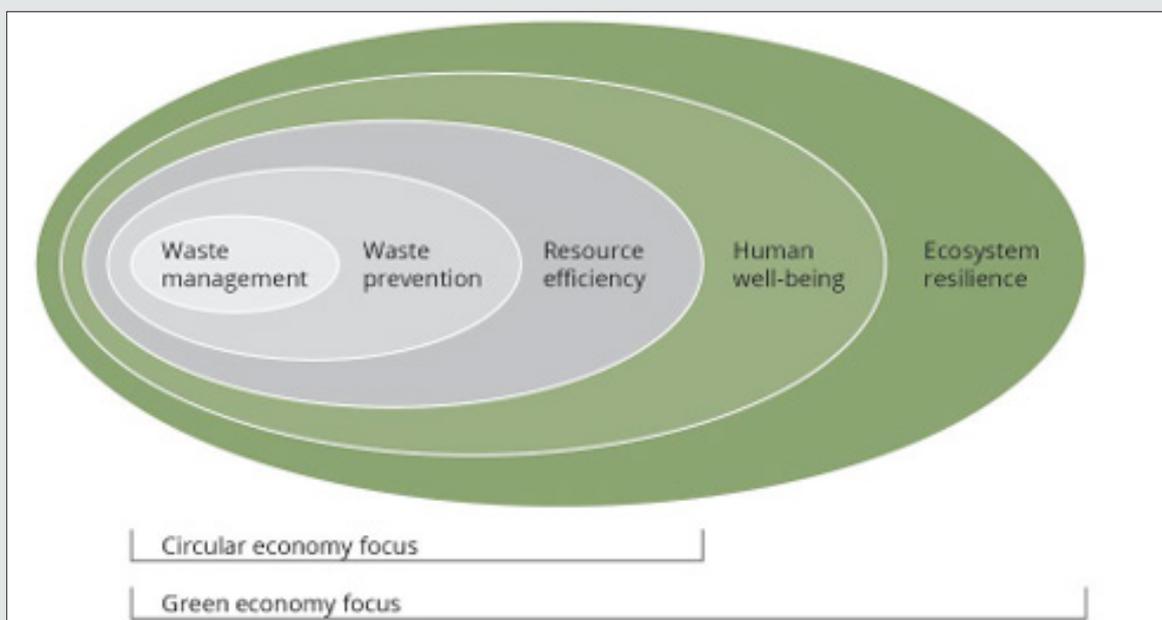


Figure 8: Start of circular economy and green economy respectively (by courtesy of EU [34]).

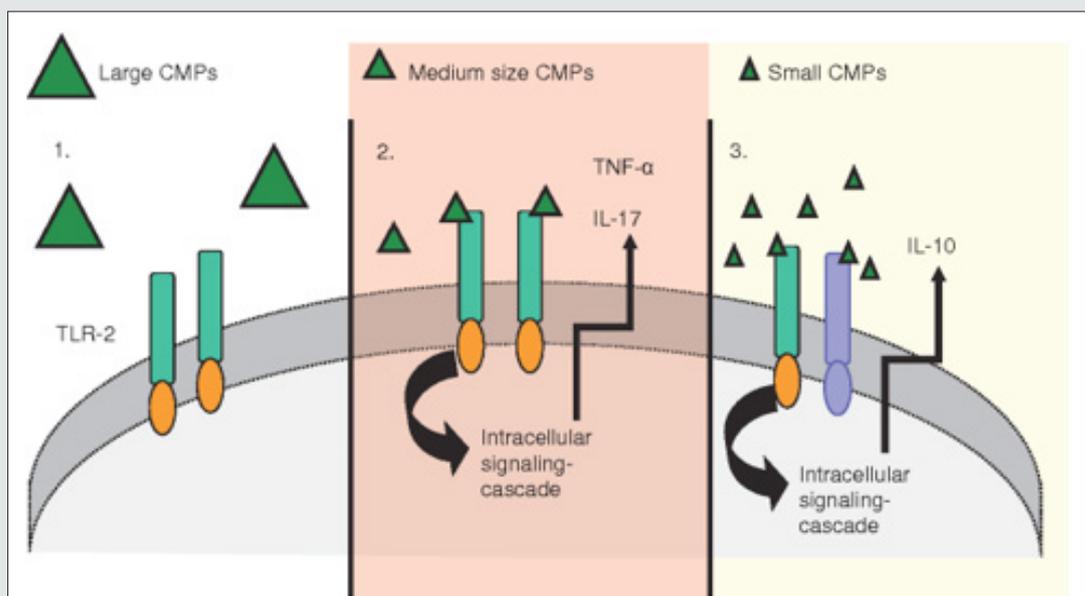


Figure 9: Depending on size, chitin stimulates the release of anti-inflammatory or pro-inflammatory cytokines (by courtesy of [44]).

These two polymers, used in their micro/nano-size, were complexed by the gelation method to obtain micro/nano particles (NPs) [38,39]. NPs, loaded by different ingredients were linked to the polymeric fibers before starting the electrospinning or casting process to produce non-woven tissues or films respectively [40-43]. Moreover, the activity of the obtained tissues/films have been characterized by the ingredients loaded into the respective fibers used and, of course, by the polymers selected. Thus, it has been possible to obtain tissue/films which, for their different

effectiveness and safeness, may be used as advanced medications or facial/hair beauty masks [43]. However, all the tissue/films obtained are skin-friendly and eco-friendly because easily metabolized to safe molecules by human and the environment's enzymes. Both chitin, lignin and their derived compounds have been used in their nano-size showing, therefore, different properties if compared to the normal counterpart's dimensions. At this purpose it is to remember, for example, that medium size chitin interacts with the macrophage receptor TLR-2 to produce pro-inflammatory

cytokines, such as IL-17, IL-23, TNF and TB4, while small size chitin, as chitin nanofibrils (CN), induces the production of the anti-inflammatory IL-10 (Figure 9) [44], contributing to increase the skin repairing effectiveness. This activity of the advanced medications realized by these CN-tissues has been confirmed by our group both in vitro on human keratinocytes cultures [45] and in vivo on human burns of 1st and 2nd grade [46,47]. In conclusion by our research studies on these innovative tissues, it has been shown the interesting impact the natural polymeric material may have in today's health and beauty technologies. The different structure of chitin nanofibrils (CN), nanolignin (LG) and their complexes seem to have the ability to govern morphology and property of the obtained tissues, creating a molecular architecture able to repair wounded and burned skin as well as photo-aged skin altered from the UV and pollution aggression [48,49]. Assuredly, the antioxidant and immunomodulatory effectiveness of both CN and LG seem to be increased by their CN-LG complexes, also if the two polymers are totally different in their structure.

However, for a better knowledge of the biological activity it results essential to know and understand their own structure-property relationships in relation to their interaction with the different skin tissue' layers. It should be also interesting to verify the antimicrobial properties of these complexes to know the type of pathogen microorganisms on which they are acting, for the necessity to don't disturb the natural and physiological equilibrium of the skin microbiota [50]. Moreover, it is also important to know and understand the final physicochemical and biological structure of the realized tissue/films. Tissue engineering of biomaterials, in fact, are emerging as promising solution for both regenerative medicine and cosmetic research to restore the skin integrity after injury, such as wounds and burns or after the aggressive action of UV and air pollutants, primary cause of photo-aging [51]. This the important strategy followed by our and other study-groups during the 2010-2020 period. However, the majority of studies have shown that, for living in a healthy state without anxiety, it seems necessity to maintain a clean air free of pollution, following an equilibrated diet with right periods of relax . Moreover, further increased from the actual COVID-19 diffusion, it has been underlined the overall necessity to ameliorate the actual healthcare system by a multidisciplinary field of research studies, necessary to realize materials, products and scaffolds which, characterized by their biomimetic activity, may lead to develop high quality tissues, skin and environmentally-friendly. By these biodegradable tissues, made by natural bio-polymers and obtained by waste materials, such as the reported chitin and lignin, it will be possible to realize and produce innovative surgical face masks and protective daily-use equipment totally skin- and eco-friendly, safeguarding human health and the environment.

## Conclusion

With the actual climate and regulatory pressure, the sustainability has to be at the core of every business strategy. It has to address the right technology and innovation, necessary to solve

the intolerable increasing of waste and GHG emissions, cause of the environmental disasters which are rushing the planet. On the other hand, diseases and traumatic injuries are increasing worldwide because of the increased aging population [52] where, the aged over 60 years numbered 962 million in 2017, is expected to double by 2050, reaching nearly 2.1 billion people [53]. Thus, the necessity to increase our knowledge on the tissue regeneration processes and the consequent applicability of specific scaffolds made by selected and electrospun natural fibers, which seem to have the same structure of the natural ECM. The mechanism by which cells adhere on nanofibers, in fact, is not completely understood, also if skin-friendly molecules seem to have the capacity to be easily adsorbed, adhering selectively on human structures [54]. However, adhesion is the first biological event that take place when a cell seed onto a substrate as, for example, the fiber, and is attached on it. Soon after the cell, specifically enhanced by the presence of collagen, may begin to migrate, proliferate, differentiate or synthesize ECM [50]. Natural ECM scaffold, in fact, supports cell fate, providing a substrate for cell signaling, thus activating proliferation, differentiation, matrix production and eventually its apoptosis [54,55].

## But how ECM is working?

This natural structure dictates the cell activities by the content of fibers, such as collagen, acting as a protein mediator within the cellular microenvironment. Thus collagen, regulated by the structural curvature of its fibrils, adheres to the cell surface via specialized receptors, providing biological signaling and tensile strength [56]. These could be the nano topographical features of CN and LG, by which they have the capability to enhance the cell adhesion ,thanks to their small size and the increased surface-to-volume ratio. Therefore, due to their nano-structured organization, the chitin and lignin' complexes could carry molecules (for both therapeutic or cosmetic applications) by the use of specialized tissues with the ability to target and release the loaded molecules in predetermined spatially-and temporally-controlled man-ner.

However, the innovative nanoparticles of the cationic chitin nanofibrils and the anionic nano-lignin or hyaluronic acid, due to their different electrical charges, may be easily complexed by the gelation method in water solution (Figure 10) [35-43]. The NPs, used as a water suspension or obtained as powder by the spray dryer technology, may be enclosed into emulsions or linked to the fibers' surface for producing non-woven tissues or films. Moreover, according to the de-sired and designed activity, it is necessary to characterize the NPs' effectiveness, encapsulating into their structures different active ingredients for obtaining cosmeceuticals or medical products, as previously reported. It is interesting to underline that the encapsulated active ingredients may be easily released at different time, according to the structure of the emulsion and/or the tissue realized. Thus, on the one hand these innovative emulsions/tissue-cosmeceuticals could promote a healthy barrier for an aged skin, preventing water loss and dryness, thus slowing down the wrinkle's formation.

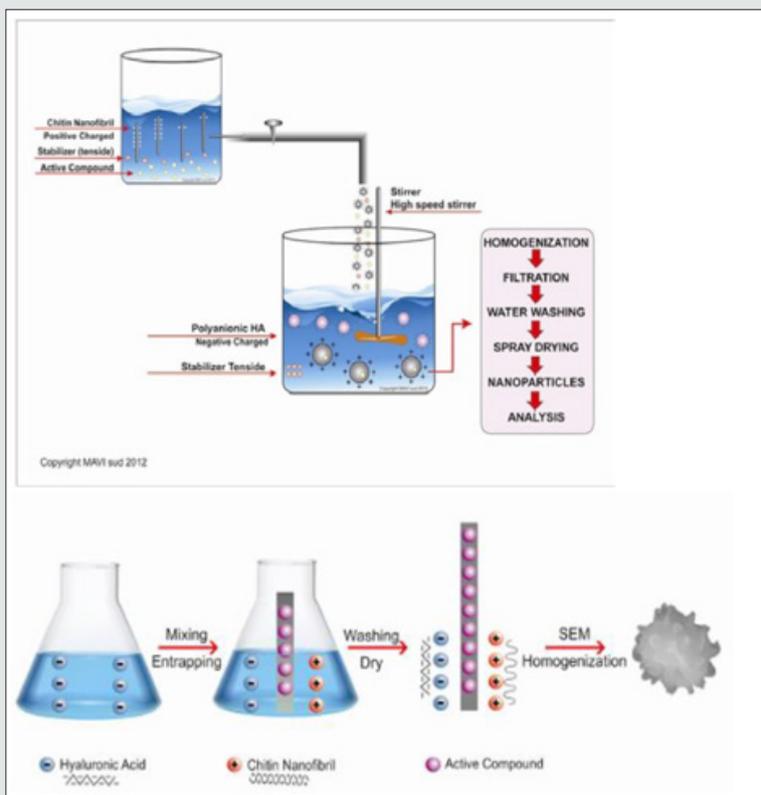


Figure 10: The gelation method to obtain the CN-Hyaluronic acid complex.

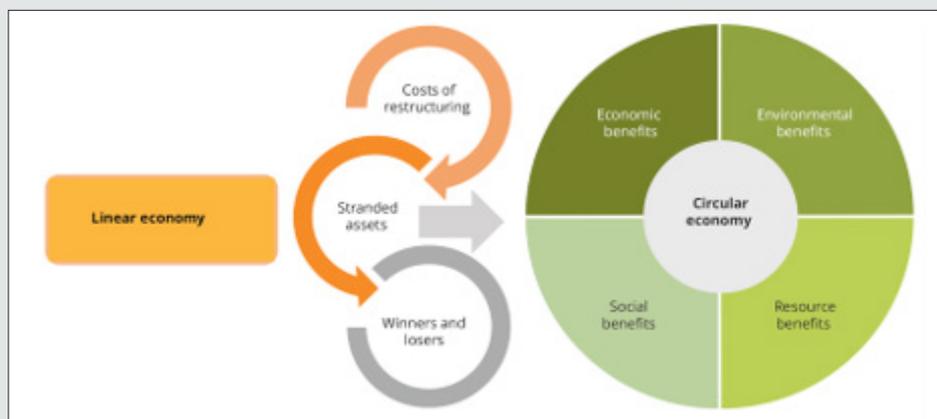


Figure 11: Linear versus circular economy according to EU (by courtesy of EEA).

Source: EEA Report No 2/2016

On the other hand, the obtained advance medications could modulate the granulation tissue of a wounded skin, promoting a more regular cells turnover, thus activating a more rapid skin repairing effectiveness. At this purpose it is to underline once again the importance of the polymers used to realize the designed tissue-structure, that could be useful for trying to minimize the microorganism's aggression. Just as an example, the duration of virus on cloths seems to depend on the fabric porosity because more porous material could catch more virus particles. Thus, for example the man-made poly-ester polymers retain germs longer than, for example, the natural breathable cotton-based fabric.

According to thousands of research study of the last ten years, therefore, it appears necessary to leave the linear economy to go on by the circular/green economy (Figure 11) [57], for satisfying the consumer requests and saving human health and the planet' ecosystem. At this purpose, it is, necessary to underline again that 91% of the world's population lives in place where air pollution exceeds healthy limits because of the increasing pollution and a non-recycled waste, cause of many diseases and the recent environmental disasters. Thus, the necessity of a green/bleu revolution able to change production and consumption, following new smart and eco-methodologies [58]. This new economy is

named green for the necessity to use the agroforestry biomass and blue for the utilization of waste coming from fishery's by-products, just as the reported lignin and chitin [57]. Therefore, for living in a world more nature-oriented and trying to solve quickly, not only the great problem of food and plastic waste, but also a new and unsuspected future crisis, such as the actual COVID-19 pandemic, it will be necessary to change the consumer/ market behavior and the global way of thinking and living. As consequence all the developing and developed technologies coming from universities and industries have to be quickly utilized, accepting the emerging knowledge. In conclusion, evaluating, anticipating and, solving all the problems by sustainable bio-nano- technologies at zero waste, would be considered a must of our society to maintain human wellbeing and the planet biodiversity [59].

### Author Contribution

conceptualization PM; writing-original draft preparation PM and MBC; writing review and editing author contribution PM, MBC and GM; supervision HDC and AM.

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### Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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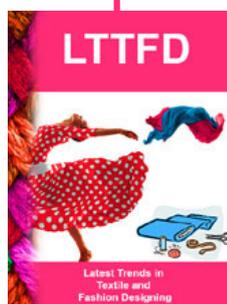


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