Crimson Publishers
Wings to the Research

Mini Review

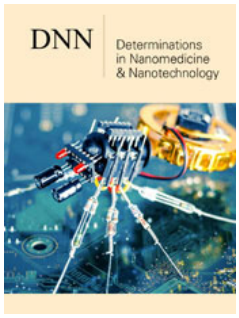
Smart Tissues Skin-Friendly as Carriers for Natural Cosme-Nutraceuticals

Pierfrancesco Morganti[1]* and Maria Beatrice Coltelli[2]

[1]R&D Center, Nanotechnology Unit, Academy of History of Healthcare Art, Italy and Dermatology Department, China Medical University, China

[2]Department of Civil and Industrial Engineering, University of Pisa, Italy

ISSN : 2832-4439



Abstract

Today Polymers and Composites natural-derived are preferred worldwide from consumers and scientists to make skin- and eco-friendly products in substitution to petrol-derived ones. By this paper we are proposing innovative and smart tissues as novel carriers for cosmeceuticals, nutraceuticals and medical devices. Fibers of these tissues, made by natural polymeric composites, have been bound to nanoparticle-complexes of chitin nanofibers and nanolignin encapsulating different active ingredients, selected for characterizing the final designed cosmeceuticals, nutraceuticals and medical devices. Effectiveness and safeness of the realized smart tissues have been also investigated.

Keywords: Emulsion; Carriers; Natural ingredients; Environment; Biosostenibility; Eco-sustainability; Tissues; Electrospinning

***Corresponding author:** Pierfrancesco Morganti, R&D Center, Nanotechnology Unit, Academy of History of Healthcare Art, Rome, Italy and Dermatology Department, China Medical University, Shenyang, China

Submission: February 12, 2025
Published: March 21, 2025

Volume 3 - Issue 3

How to cite this article: Pierfrancesco Morganti* and Maria Beatrice Coltelli. Smart Tissues Skin-Friendly as Carriers for Natural Cosme-Nutraceuticals. Determ in Nanomed & Nanotech. 3(3). DNN. 000564. 2025.
DOI: 10.31031/DNN.2025.03.000564

Introduction

Scientists and consumers are looking for products natural-derived considered skin- and environmentally-friendly, retained important not only for their health and beauty, but also to maintain the natural raw materials and the Earth's Biodiversity (Figure 1) [1-4]. Unfortunately, the majority of cosmetics and diet supplements, used together to obtain the so-called Beauty from Within (i e. health and beauty from outside and inside) (Figure 2) [5-7], are made by petrol-derived carriers. Consequently, our actual way of living and consuming these and other products are made by emulsified-carriers characterized by a difficile biodegradability and packed by not biodegradable plastic containers, provoking the production of waste invading lands and the oceans, by the dangerous so called microplastics [8,9] Which are the consequences? Fish and sea mammals are eating these microparticles as food so that, as they were entered into the human alimentary chain (Figure 3), they have been recovered in tea cups, placenta and human blood [10-12].

Figure 1: The Earth's biodiversity.

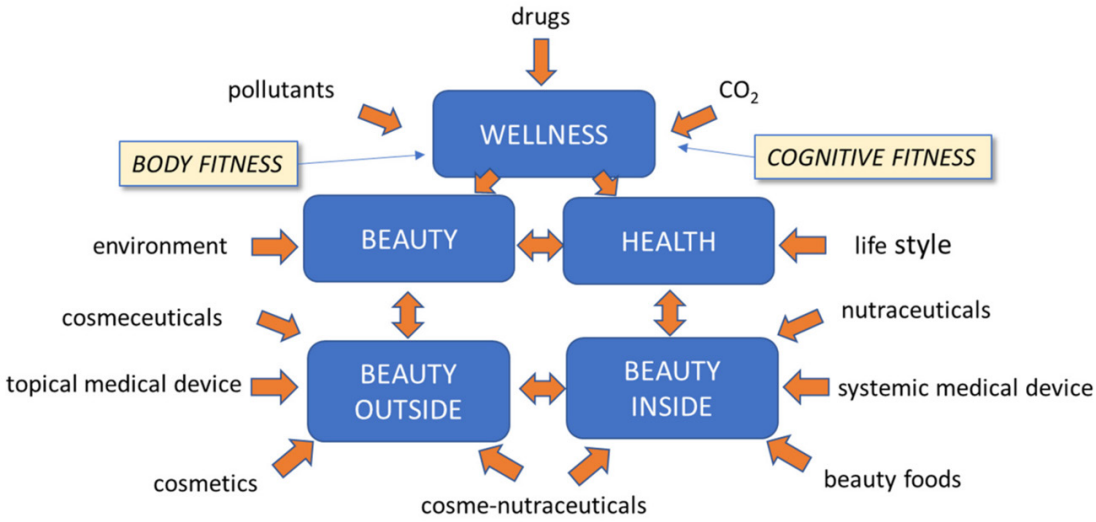


Figure 2: Components of the so-called Beauty from within (courtesy of Morganti et al).

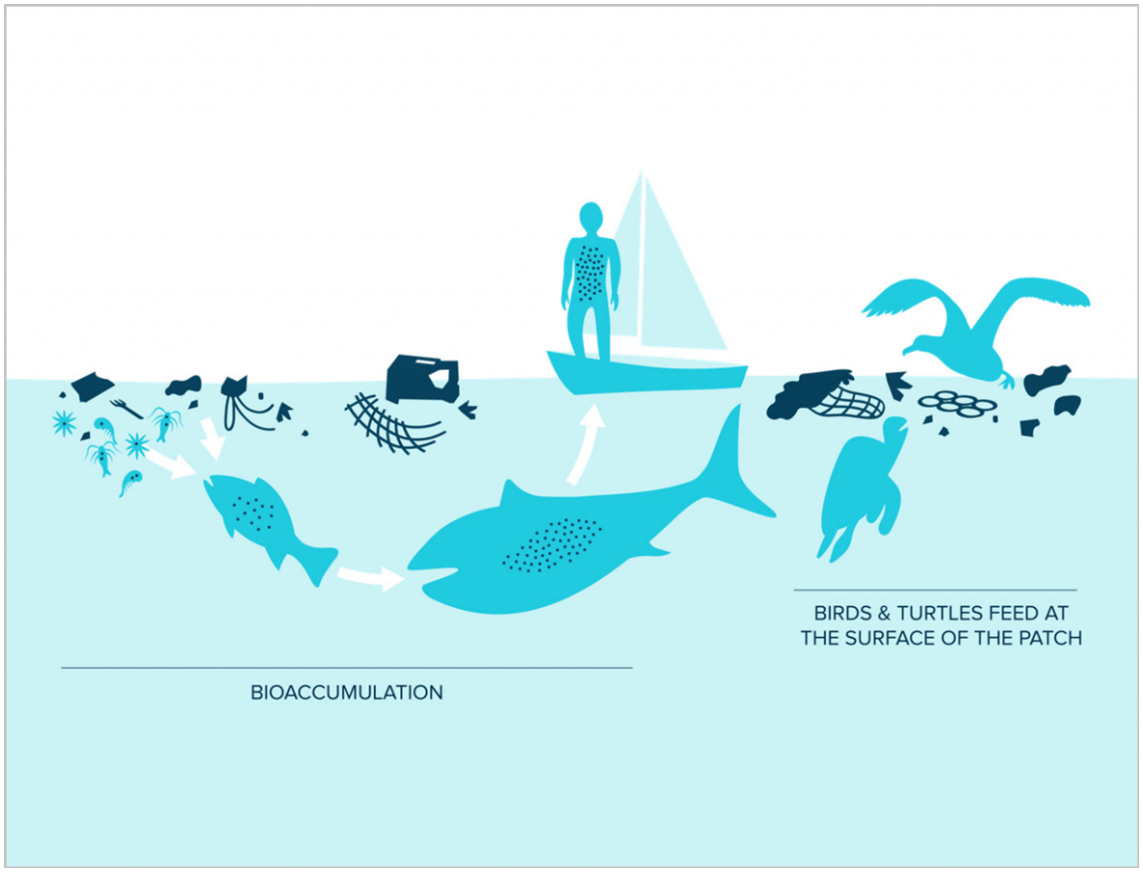


Figure 3: Microplastics into the human body.

At this purpose it is to remember that the petrol-derived plastic packaging's, containing toxic ingredients, such as Phthalates, BPA and BPS, and PVC fragments (Figure 4), result dangerous for human being linked to hormone disruption, infertility and cancer, while emulsifiers, preservatives and other chemicals necessary to produce the emulsion-carriers are often cause of allergy and skin sensitizing phenomena [13,14]. Thus, considering the quantity of the marine plastic debris recovered into the oceans estimated today to be more than 150 million tons with a yearly entering from 4.8 to 12.7 million tons, it results necessary to change our lifestyle [15,16].

Figure 4: The toxic ingredients found in some plastic packaging (Courtesy Made Safe).

However, how long we wish to go on? (Figure 5) On the other hand, it is necessary to consider the global cosmetic market that, ranged around USD 617,2 billion by 2023 is increasing each year by a CARG of ~9%, supporting 2 million jobs across EU only (Figure 6 & 7) [17,18]. Consequently, looking to the values registered in 2018, in the last 5 years 2024-2028 the beauty industry has increased its market of 19.9%. It is interesting to underline that the natural-based specialized cosmetics represent more than 10% of the global market and have reported the major increase.

Figure 5: An example of different plastic debris'source recovered into the oceans.

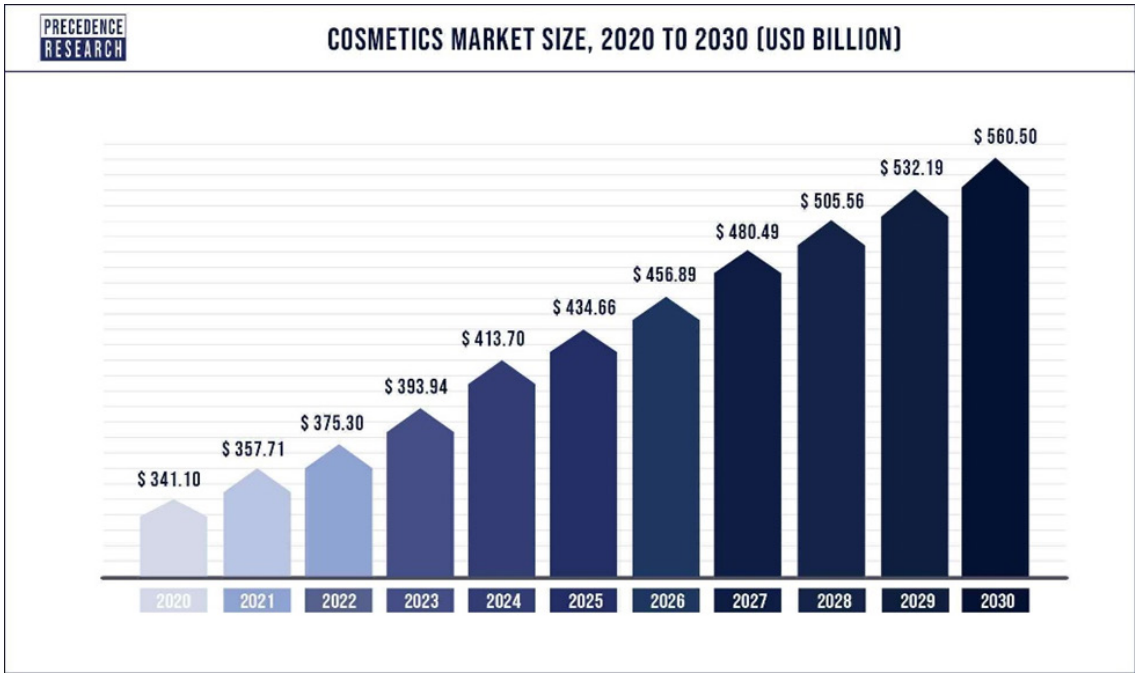


Figure 6: The Cosmetic market increase courtesy of Precedent Research Co [18].

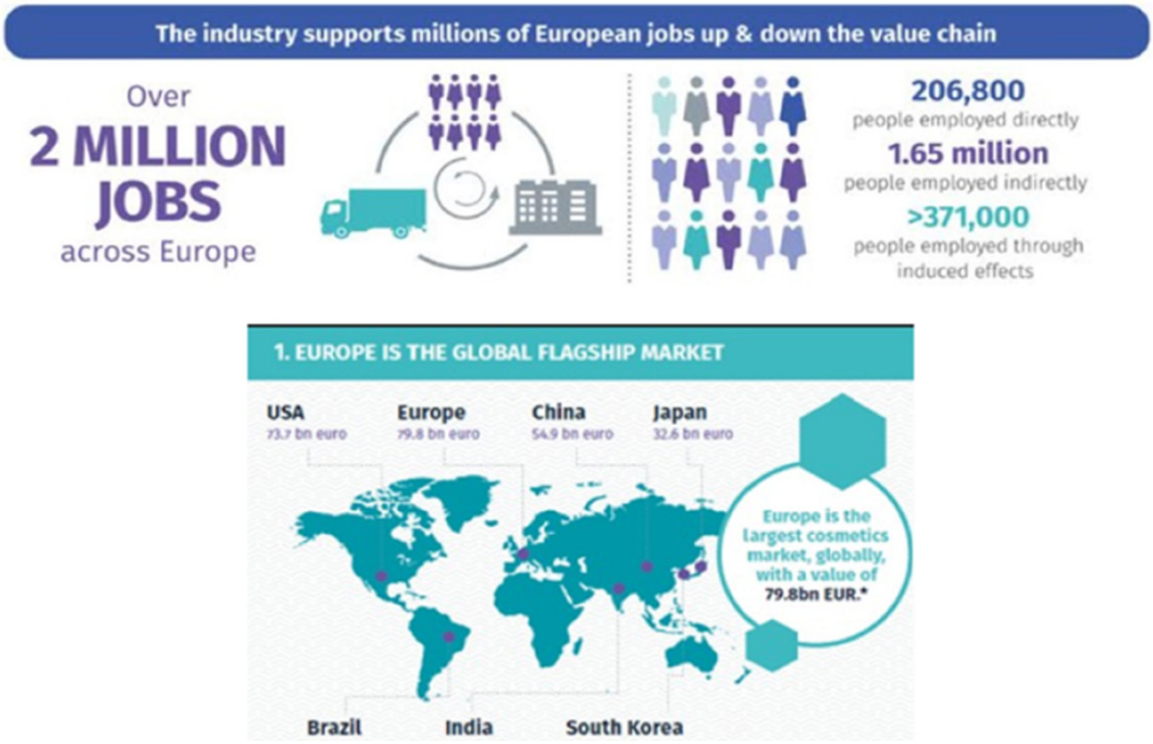


Figure 7: Cosmetic jobs and worldwide market (courtesy of Cosmetica Italia [17]).

However, because of the today great consume of Cosmeceuticals and Nutraceuticals by both women and men, it is increasing the so-called eco-anxiety. It is based on the necessity to maintain beauty and wellbeing, respecting both environment and the Earth 'biodiversity [19]. Consequently, the Environment' respect is requested from all the customers, which are worrying for plastic pollution, water scarcity and extreme weather conditions (Figure 8) [19-21].

Figure 8: The actual worries of consumers and producers (courtesy of GWI).

What the proposed solution to reduce water consuming and the worldwide invasion of plastic?

In our opinion it will be necessary to reduce the use of non-biodegradable plastics and polymers, by increasing the use of natural biopolymers [22]. Thus, as an example, it seems possible to produce both Cosmeceuticals and Nutraceuticals utilizing as carriers specialized tissues instead of the actual emulsions [22] (Figure 9). These innovative cosme-nutraceuticals (Cosmetics and Diet supplements) are not only biodegradable, but they may be packed into biodegradable container also [23]

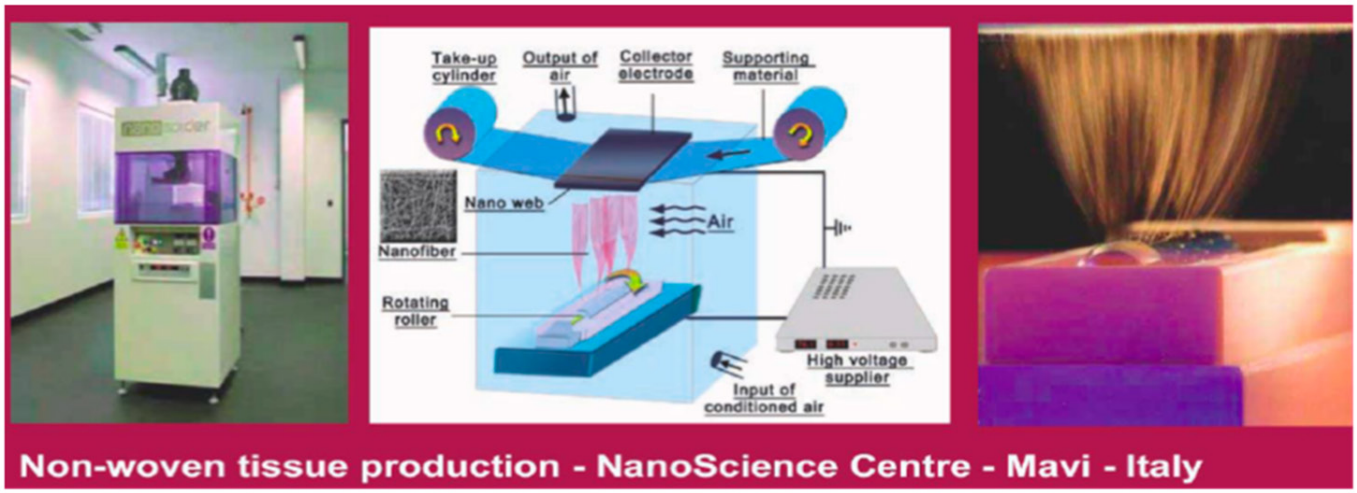


Figure 9: Example of machine to produce these new tissues (courtesy of Morganti et al.).

Which the modality for making these tissues-carriers?

Different natural polymers have been selected to produce non-woven tissues by the electrospinning technology. During this process different active ingredients have been selected and encapsulated into the patented chitin nanofibrils-nanolignin complex (CN-LG), obtained by the gelation method encapsulating different active molecules (Figure 10) [23]. Before going on by the electrospinning, active ingredients and polymers have been selected for making and characterizing effectiveness and safeness of the different smart tissue-carriers and the innovative cosme-nutraceuticals ingredients (Figure 11) [24,25].

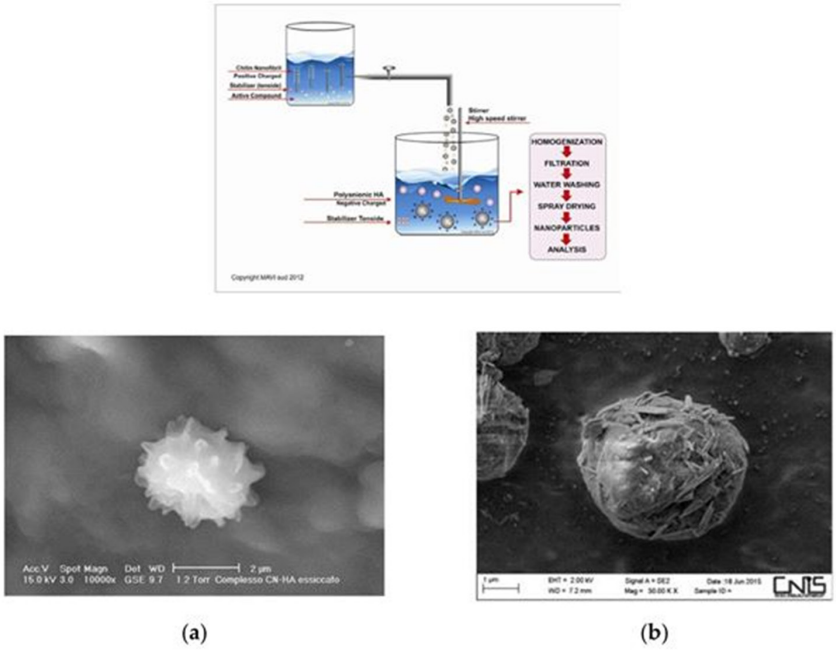


Figure 10: Gelation method used to make the micro/nano particles (a) CN-Hyaluronan complex and (b) CN-Nanolignin (courtesy Morganti et al.).

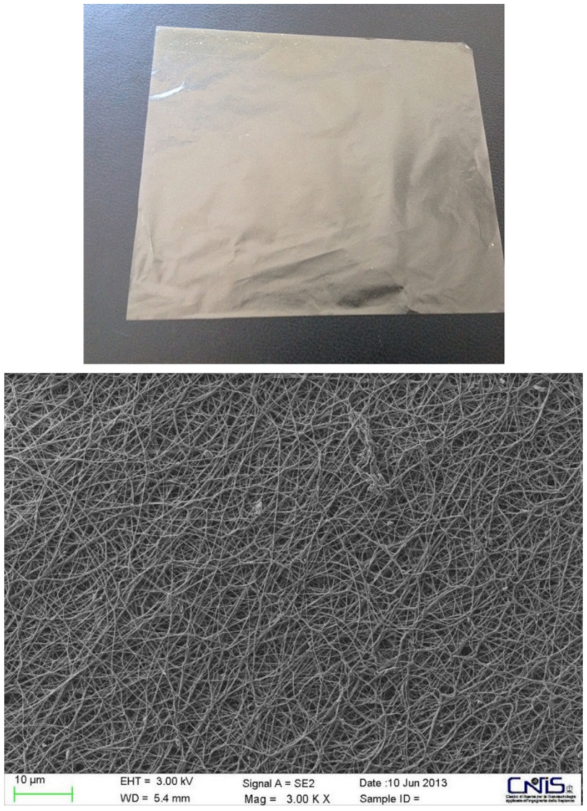


Figure 11: Example of carrier-film (up) and carrier-tissue at SEM (below) (courtesy Morganti et al).

Naturally it has been controlled the similarity between the realized tissue-carriers structure scaffolding and the natural skin's Extra Cellular Matrix (ECM) (Figure 12) [26] as well as the right encapsulation of the active ingredients (Figure 13) Finally, controls were organized both in vitro and in vivo to verify effectiveness and safeness of the final obtained cosmeceuticals and nutraceuticals [27-29].

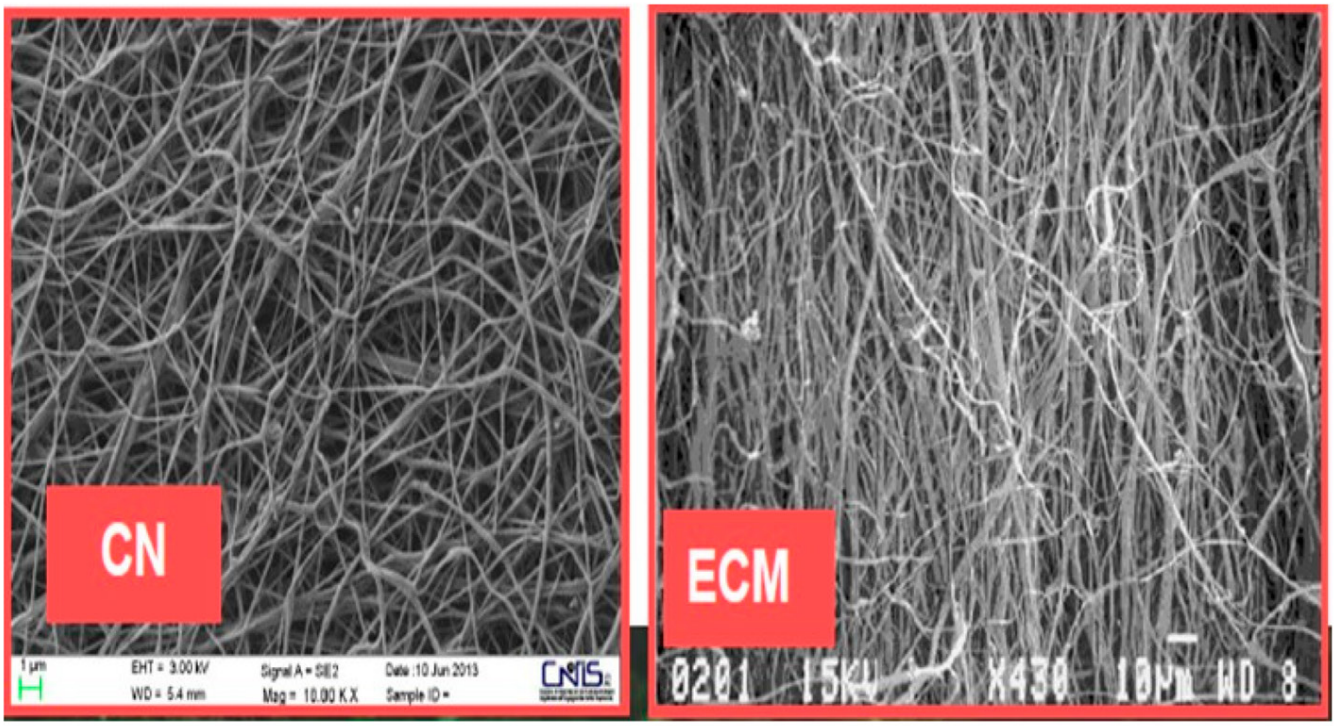


Figure 12: CN-tissue structure compared to the skin EC (courtesy Morganti et al).

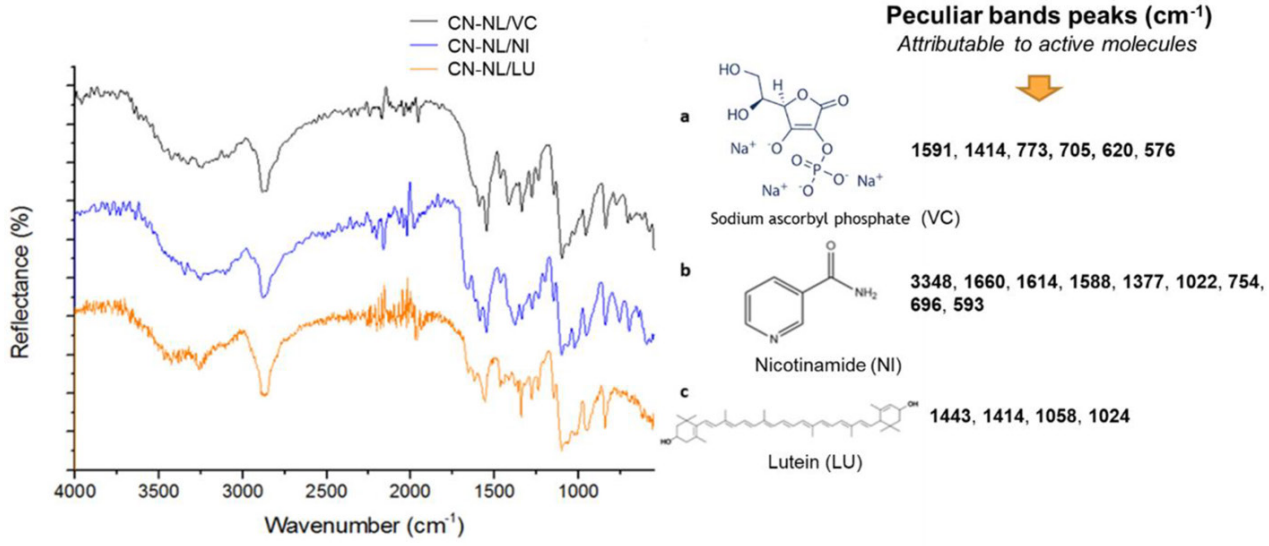


Figure 13: Example of some active ingredients encapsulated (courtesy of Coltelli et al.).

Conclusive Remarks

In conclusion by this new technology, it is possible to realize smart tissue-carriers reducing the great consumption of water and the use of petrol-derived polymers and ingredients necessary to make the normal cosmetic emulsions as well as the production and use of plastic packaging's, thus safeguarding human health and the environment. In fact, these tissues, made by natural polymers encapsulating natural active ingredients, are free of water, emulsifiers, preservatives, fragrances, colours and other chemicals necessary to produce the emulsified cosmetics and may be packed

by paper, thus resulting 100% biodegradable. Last but not least, polymers and ingredients may be obtained from food and the agro-forestry waste, thus introducing the circular economy request worldwide from scientists and consumers [26-31].

References

1. Willis KJ, Bhagwat SA (2009) Biodiversity and climate change. Science 326(5954): 806-807.
2. UN. Change of Climate Change Imprints, Climate Technology Centre &, United Nations Environment Programme, New York, USA.
3. MGI. Climate Risk and Response in Asia (2020) The MacKinsey Global Report institute.www.makinsey.com.
4. Shivanna KR (2022) Climate change and its impact on biodiversity. Proc. Indian Natl. Sci. Acad 88(2): 160-171.
5. Waeraas A (2014) Beauty from within: What bureaucracies stand for. American Review of Public Administration 44(6): 675-692.
6. Kolawole KA, Togonu-Bickersteth F (2022) Beauty is in the eye of beholder: self-perception of physical attractiveness among secondary school adolescents. Sciendo 15(24): 2286-2102.
7. Kolar MH (2009) Urbancic S and Dimitrijevic. Nature Knows best: where nature and beauty meet. In: Nutritional Cosmetics KU (Eds.), William Andrew Publishers, Oxford, UK.
8. Morganti P (2008) Reflection on cosmetics, cosmeceuticals and nutraceuticals, Clinics in Dermatology 26(4): 318-320.
9. Morganti P, Lohani A, Gagliardini A, Morganti G, Coltelli MB (2023) Active ingredients and carriers in nutritional eco-Cosmetics. Compounds 3(1): 122-141.
10. Hernandez LM, Xu EG, Larson HGE, Tahara R, Mhisura VB, etc.al. (2019) Plastic teabags release billions of microparticles and nanoparticles into tea. Environ Sci Technol 53(21): 12300-12310.
11. Ragusa A, Svelato A, Santacroce C, Catalano P, Notarstefano V, et al. (2021) Plasticenta first evidence of microplastcs in human placenta. Environ Int 146: 106274.
12. Leslie HA, vanVelzen MJM, Brandesma SH, Vethaak AD, Garcia-Vallejo JJ, et al. (2022) Discover and quantification of plastic particle pollution in human blood. Environ Int 163: 107199.
13. Rafa N, Ahmed B, Zohora F, Bakya J, Ahmed S, et al. (2024) Microplastics as carriers of toxic pollutants source, transport and toxicologjcal effects. Environment Pollution 343: 123190.
14. Weis JS, Alava JJ (2023) (Micro)Plastics are toxic pollutants. Toxics 11(11): 935.
15. Kundo A, Shetti N, Basu S, Reddy KR, Nadagouda MN, et al. (2021) Identification and removal of micro and: Basic efficient and costbeffectjve. Chemical Engineering Journal 421: 129816.
16. Kiran RR, Kopperi H, Mohan SV (2022) Micro/nano-plastics occurrence, identification, risk, analisys and mitigation: challenges and perspectives. Rev Environ Sci Biotechnol 21(1): 169-203.
17. Cosmoprof (2025) The global Beauty industry: The markets to monitor in the next future. Cosmoprof Worldwide Bologna, Italy.
18. PR. Cosmetic market global forecast to 2026 Precedence Research 2024. www.presedenceresearch.com.
19. Morris T Green consumerism: Who Cares about the Environment GWI Report 2020.
20. McKinsey. The growing consumer demand for Sustainable products 2023 MacKinsey & Company Report.
21. Almack A. Consumers care about sustainability 2024. Plastic for change.
22. Zora M, Mudhafar M, Majhool AA, Abood SF, AlsallawiHA, et al. (2023) Review of green composite: Importance of biopolymer uses, and challenges. J Adv Res Flu MEC &Term Sci 111(1): 194-216.
23. Danti S, Trombi L, Fusco A, Azimi B, Lazzeri A, et al. (2019) Chitin nanofibrils and Nanolignin as functional agente in skin regeneration. Int J Mol Sci 20(11): 2669.
24. Morganti P, Morganti G, Colao C (2019) Biofunvtional textiles for aging skin. Biomedicine 7(3): 51.
25. Morganti P, Morganti G, Coltelli MB (2019) Chitin nanomaterials and nanocomposites for tissue repair. In: Choi AH and Ben-Nissan B (Eds.), Marine-derived biomaterials for tissue Engineering applications, Springer, Singapore, pp. 523-544.
26. Morganti P (2016) Use of Chitin nanofibrils from biomass for an innovative bioeconomy. In: Ebothe J and Ahmed W (Eds.), Nanofabrication using nanomaterials, One Central Press Manchester, UK, pp. 1-22.
27. Morganti P, Morganti G, Gagliardini A, Lohani A (2021) From cosmetics to innovative cosmeceuticals- non-woven tissues as biodegradable carriers. Cosmetics 8(3): 65.
28. Morganti P, Fabrizi G, Coltelli MB, Danti S, Azimi B, etc. al. (2024) Skin delivery and innovative carrier's effectiveness. Auctores Publishing LLC 10(5): 1-7.
29. Morganti P, Coltelli MB (2019) A new carrier for advanced Cosmeceuticals. Cosmetics 6(1): 10.
30. Morganti P, Chen HD, Morganti G (2020) Nanocosmetics: future perspective. In: Nanda A, Nanda S, Nguyen TA, Rajendran S, Slimani Y (Eds.), Nano-cosmetics: Fundamentals, applications and toxicity2020, Elsevier, Amsterdam, Netherland, pp 455-481.
31. Coltelli MB, Morganti P, Castelvetro V, Lazzeri A, Danti S, et al. (2022) Chitin Nanofibrils-nanolignin complexes as carriers of functional molecules for skin contact applications. Nanomaterials 12(8): 1295.