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Eco-design technology to develop a natural interpenetrating biopolymer network (IBPN) with outstanding properties

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PURPOSE OF THE ABSTRACT
Interpenetrating polymer networks (IPN) (1) have gained great attention in the last decades, mainly due to their biomedical applications. IPN display properties that can be very different according to the macromolecular constituents. The process can also tailored the functionalities of the resulting material. Currently, IPN are composed of chemical polymers mainly cross-linked by using chemicals. Our study aimed to develop an IPN based on natural polymers and chemical free to obtain a biopolymer-based film, biosourced and biodegradable with ?second skin? properties (2). Moreover, the resulting product needs to be in accordance with the requirements of the cosmetic industry in terms of efficacy and safety.

For this purpose, we studied the influence in the process of different natural polysaccharides molecular masses and their ratio but also the nature and concentration of the cross-linker on the final properties of the product. This approach led to the development of the patented IBPN technology® (Interpenetrating BioPolymer Network). This eco-designed technology relies on a mastered extraction in water and a natural ionic cross-linking. The resulting material is composed of a galactomannans network from Caesalpinia spinosa (3, 4) and of a sulfated galactans network from Kappaphycus alvarezii (5, 6). Thermodynamic analyses by DSC (Differential Scanning Calorimetry) and DMA (Dynamic Mechanical Analyses) associated with visualization by AFM (Atomic Force Microscopy) and SEM (Scanning Electronic Microscopy) revealed the physical-IPN organization of the obtained material. Applied to the skin, this natural physical-IPN, or IBPN, forms a resistant, flexible and non-occlusive ?second-skin? film. It protects against mechanical aggressions (-14%, $P<0.05$), pollutants (-47%, $P<0.001$) and irritants (-22%). Moreover, this film displays a selective protection against bacterial adhesion because it did not influence the adhesion and colonization of Staphylococcus epidermidis at the surface of a reconstructed epidermis, whereas it reduced the formation of biofilm formed by Staphylococcus aureus.

In conclusion, the biopolymer-based film displays outstanding ?second skin? properties regarding to its physical-IPN organization. The sourcing of the two plants used for its production as well as the biopolymerization technology are sustainable. The resulting IBPN has no impact on human and environment and is perfectly suitable to the cosmetic industry requirements (safety risk assessment dossier, regulatory compliant ?) for new promising applications.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

IBPN technology | IPN | second-skin film

BIBLIOGRAPHY

(1) Advanced Drug Delivery Rewiews (2013) 65 1172-1187
(2) Nature Materials (2016) 15, 911–918
(3) Food Hydrocolloids (2001) 15 433-440
(4) Biotechnol. Agron. Soc. Environ. (2010) 14 (1) 213-223
(5) Food Hydrocolloids (2011) 25 32-41