CALCIUM PHOSPHATES & COLLAGEN, SIMULTANEOUS EXTRACTION FROM FISH BONES AND THEIR COSMETIC APPLICATIONS

S. Gandolfi[1, 2], C. Fusacchia[1,2], L. Degli Esposti[1], S. Panseri[1], C. Piccirillo[3], S. Manfredini[4], A. Vitali[5], T. Sibillano[6], C. Giannini[6], M. Iafisco[1], A. Adamiano[1]

[1]Consiglio Nazionale delle Ricerche (CNR), Institute of Science, Technology and Sustainability for Ceramics (ISSMC), Via Granarolo 64, Faenza,48018, Italy, sara.gandolfi@issmc.cnr.it; [2]Università Degli Studi di Parma, Dipartimento di Scienze Chimiche, della Vita e della Sostenibilità Ambientale, Parco Area delle Scienze 17/A, 43124, Parma, Italy; [3]Consiglio Nazionale delle Ricerche (CNR), Institute of Nanotechnology (NANOTEC), Campus Ecotekne, Via Monteroni, 73100, Lecce, Italy; [4]Università Degli Studi di Ferrara, Dipartimento di Scienze Della Vita e Biotecnologie, Via L.Borsari, 46, 44121 Ferrara, Italy; [5]Consiglio Nazionale delle Ricerche (CNR), Institute of Chemical Sciences and Technologies "G. Natta" (SCITEC), Piazzale Aldo Moro 7, 00185 Roma, Italia Roma, Italy; [6]Consiglio Nazionale delle Ricerche (CNR), Institute of Crystallography (IC), Via Giovanni Amendola 122/O, 70126, Bari, Italy

Fish bones represent a valuable by-product with significant potential for the extraction of high-value compounds. Bones are primarily composed of a mineral fraction (calcium phosphates), water and organic material, which consists of 90% collagen. In this work, we applied a novel protocol to simultaneously extract the protein component (Col) and the mineral component (CaPs) from salmon bones. Within the large CaPs family, hydroxyapatite (HA) is perhaps the most interesting mineral with a wide range of applications. Among these, this study focused on its use in oral hygiene as a remineralising agent[1] and in sun care as a sun protection factor (SPF) enhancer. [2].

Extraction was performed by alkaline hydrolysis, using ammonium bicarbonate (NH_4HCO_3) as the extraction solution.

The booster activity of the mineral phase was evaluated in sunscreen formulations containing different percentages of CaPs in combination with different percentages and types of UV filters. XRD spectra show that the extracted mineral consists of a biphasic mixture of β-tricalcium phosphate (β-TCP) and hydroxyapatite (HA). β-TCP shows higher solubility than HA in both neutral and acidic conditions, suggesting that it could be an interesting material for dental desensitisation: by releasing ions, it stimulates enamel remineralisation and prevents tooth sensitivity. In sunscreen applications, CaPs significantly increased the SPF in all formulations, in proportion to their concentration and that of UV filters. This can be attributed to their capacity of scattering, which facilitates optimal interaction between incident radiation and the UV filters in the cream, resulting in a substantial increase of UV protection.

This results in creams with the same level of sun protection but with a reduction in the quantity of UV filters, which are often harmful to health and the environment.

The protocol developed offers the possibility of obtaining products with high added value within the framework of a circular economy. The preliminary results indicate that calcium phosphates extracted from fish bones can act as effective SPF boosters in sunscreen formulations, as well as being useful in dentistry, where they can repair micro-lesions in teeth by depositing on dentin and enamel, stimulating remineralisation.

Key words: *Circular economy, fishbones, Hydroxyapatite, Collagen*

REFERENCES

[1] L. Degli Esposti et al., "Natural, biphasic calcium phosphate from fish bones for enamel remineralization and dentin tubules occlusion," Dental Materials, vol. 40, no. 4, pp. 593-607, 2024.

[2] A. Adamiano et al., "Calcium Phosphates from Fishery Byproducts as a Booster of the Sun Protection Factor in Sunscreens," ACS Biomaterials Science & Engineering, vol. 8, no. 11, pp. 4987-4995, 2022.

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