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Evaluation of skin collagen under infrared exposure: a study based on Small Angle X-Ray Scattering using synchrotron radiation

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Infrared radiation (IR) penetrates the epidermal and dermal layers of skin increasing temperature significantly [1], and consequently it can damage both skin compartments. Collagen is located in the dermis and accounts approximately 75% of total dry weight of skin providing integrity of this tissue [2, 3]. This protein could be damaged at high temperatures coming from IR exposure, which can cause skin disorders.
The regular staggered structure of collagen induces periodic variations of electron density visible by X-ray scattering as sharp Bragg peaks. Position, intensity and number of reflections of the typical axial periodicity of skin collagen change by effect of tissue physiology or physical conditions [2, 3]. The use of synchrotron radiation with Small angle X-ray scattering (SAXS) is required to detect skin collagen reflections, due to these changes are not detected with a conventional radiation source.
In this work the evaluation of collagen structure in native skin and in skin exposed to IR was performed by SAXS using synchrotron radiation. Different skin treatments were carried out with phospholipid nanostructures (bicosomes [4]) incorporating beta-carotene to evaluate their protection effect on skin collagen against IR exposure.

The characteristic collagen peaks in the X-ray profiles showed a decrease in intensity in the skin samples exposed to IR in comparison with native skin. This fact could indicate the disorganization in the structure of the collagen, which was consequence of the degradation of the protein (Fig. 1).

The skin samples previously treated with bicosomes incorporating beta-carotene and subjected to IR kept the X-ray profile with the characteristic features of collagen. This fact would evidence the preservation of collagen fibres of the skin treated with this system under IR exposure, indicating the potent efficacy on collagen preservation of bicosomes with beta-carotene.
In conclusion, the heat produced by IR exposure damages skin causing degradation of skin collagen, and bicosomes protect collagen fibers of the skin under IR exposure. Further, the use of synchrotron radiation in SAXS is a good technique to evaluate microstructural changes of skin collagen.

References

[1] Skin Pharmacology and Physiology, 23, (2010), 15-17.
[2] Soft Matter, 7, (2011), 8605-8611.
[3] Material Science and Engineering C: Materials for Biological Applications, 28, (2008), 140-1429.
[4] Biophysical Journal, 99, (2010), 480-488.

Caption (s) - Add figures as attached files (2 fig. max)

Fig. 1: SAXS profiles of different skin samples with the correspondents reflections of collagen. Native skin (black), skin exposed to IR (red), skin exposed to IR previously treated with bicosomes incorporating beta-carotene (blue).

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