Microneedle from fish scale biopolymer

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**Citation:** OLATUNJI, O., IGWE, C.C. and DAS, D.B., 2014. Microneedle from fish scale biopolymer. The Third International Conference on Microneedles 2014, University of Maryland School of Pharmacy in Baltimore, Maryland, 19th - 21st May 2014, p.66.

**Additional Information:**
- This is a conference abstract.

**Metadata Record:** [https://dspace.lboro.ac.uk/2134/14992](https://dspace.lboro.ac.uk/2134/14992)

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Microneedles from Fish Scale Biopolymer

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Abstract

We report on the fabrication of microneedles from polypeptides produced through hydrolysis of the fish
scales using micromoulding technique. Insertion studies on artificial and porcine skin samples confirming
strength of microneedles produced to pierce skin are also presented. Evaluation of the properties of
polypeptide films prepared from the fish scales gave refractive index (1.34), protein concentration (78%),
ash content (1.6%) at a moisture content of 22%. The fabricated microneedles were successfully inserted
into artificial skin models and imaging using digital camera showed microneedles remained intact when
inserted and when removed from the skin models. The microneedles were also successfully inserted into
porcine skin and were shown to dissolve gradually at 0s, 60s, 120s and 180s after insertion. Microneedles
containing methylene blue as model drug were produced and successfully pierced porcine skin. 3D finite
element (FEM) simulations were carried out using the measured mechanical properties of the biopolymer
films (Young’s modulus: 0.23N/mm²; tensile strength: 1.8105N/mm²) to evaluate the stress distribution on
various dimensions of the fish scale derived microneedles and hence, their ability to withstand force
necessary to pierce the skin without fracture. Results from the showed that microneedles with tip radius
between 10 and 100µm could withstand up to 0.12N of force per microneedle without fracture, which is
indicated when the stress at the tip of the microneedle exceeds the ultimate stress of the material of
fabrication. Using skin insertion tests and finite element simulations this study provides evidence that
microneedles fabricated from fish scale biopolymer can effectively pierce and degrade into skin and
therefore are good candidate for transdermal applications.

Figure 1 Arrays of Microneedles produced from fish scale biopolymer.

Reference

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