



HAL
open science

Innovative instrumentation for assessing the mechanical properties of skin

Bastien Blanchard, Francis Ehrenfeld, Anthony Laffore, Corinne Nardin,
Giuseppe Percoco, Laurent Peno-Mazzarino, Christophe Derail

► **To cite this version:**

Bastien Blanchard, Francis Ehrenfeld, Anthony Laffore, Corinne Nardin, Giuseppe Percoco, et al.. Innovative instrumentation for assessing the mechanical properties of skin. COSM'INNOV - 5th edition: The International Congress for Cosmetics Research, May 2023, Orléans, France. . hal-04112912

HAL Id: hal-04112912

<https://univ-pau.hal.science/hal-04112912>

Submitted on 1 Jun 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Innovative instrumentation for assessing the mechanical properties of skin

Bastien Blanchard^{1*}, Francis Ehrenfeld¹, Anthony Laffore¹, Corinne Nardin¹, Giuseppe Percoco², Laurent Peno-Mazzarino², Christophe Derail¹

¹ Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, IPREM, Pau, France

² Eurofins BIO-EC laboratory, Longjumeau, France

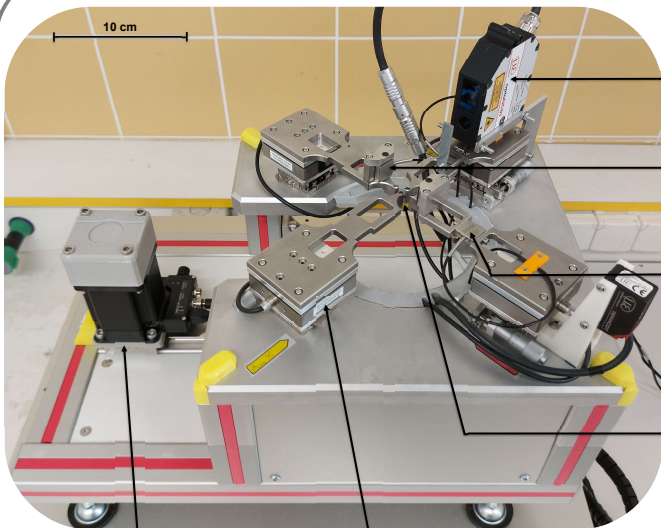
*bastien.blanchard@univ-pau.fr

I. Abstract

A specific instrument to assess the **viscoelastic properties** of human skin has been developed in this project. This innovative **technology** combined with the use of **ex vivo human skin explants** under physiological conditions for several days, should enable to help for the development of products intended for treatments. Indeed, we propose to analyse and evaluate in an objective way:

- the effects of different **external stresses** (stretch marks, UV rays exposure, chemical exposure, air pollution, injuries, freezing, etc.)
- the effects of **medical or dermo-cosmetic products** (moisturising creams, anti-stretch mark creams, healing dressings, etc.) on the viscoelastic properties of human skin.

II. Instrumentation



Motorised **sample holder** for preparing and moving the *ex vivo* skin explant

Piezoelectric actuator for moving the arms

Laser position sensor for measuring arm movement

Vertical force sensor for measuring the compression force applied to the skin explant

Horizontal force sensor for measuring the tensile force exerted on the skin explant

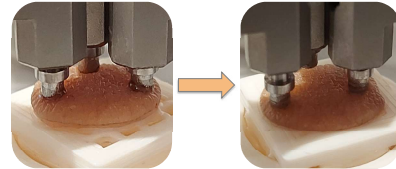
Stainless steel stud for gluing the skin explant to the technology arms

III. Studies conducted

A) Effect of enzymatic stress

- ➔ Explants are exposed to enzymes that degrade dermal fibres: collagenases and elastases
- ➔ Stress that allows to mimic an accelerated ageing of the skin

Protocol: 1. Mechanical tests at D0 before stress
2. Introduction of enzymes into the culture medium of the skin
3. Mechanical tests at D+2



Ex vivo skin explant before (left) and after (right) stress

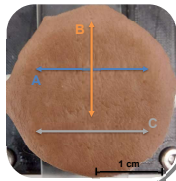
B) Mechanical properties of stretch marks

- ➔ Study of the differences in mechanical properties in a skin explant with stretch marks

Protocol:

Mechanical tests on 3 areas of the explants :

- A = in the stretch mark
- B = // streaks of the stretch mark
- C = healthy area

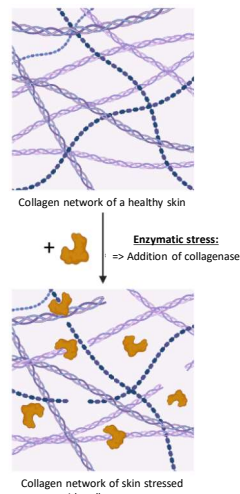
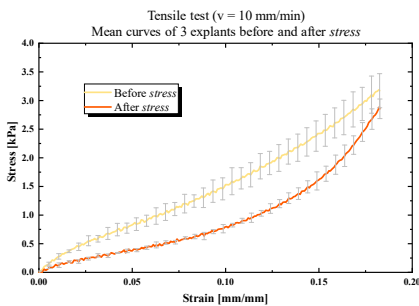


IV. Results

A) Effect of enzymatic stress

➔ Mechanical test

➔ Schematic illustration

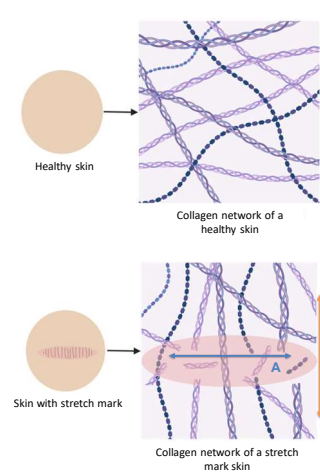
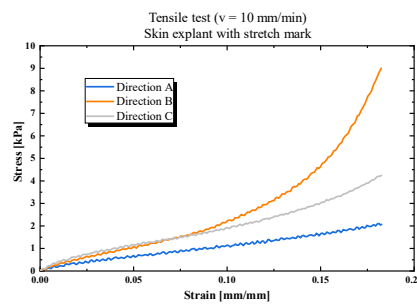


- ➔ Significant change in the mechanical behaviour of skin explants when exposed to enzymatic stress.
- ➔ Mechanical tests show that the skin loses its mechanical properties when exposed to enzymatic stress.
- ➔ At low deformations, the stiffness and viscoelastic properties of the skin are reduced.

B) Mechanical properties of stretch marks

➔ Mechanical test

➔ Schematic illustration



- ➔ Differences in mechanical properties induced by stretch marks on the skin :
 - Higher mechanical properties in the direction parallel to the streaks of the stretch mark (direction where the fibres are pre-oriented = dir. B)
 - Lower mechanical properties in the stretch mark (fibre breakage area = dir. A)

V. Conclusion

Progress of the project

- ✓ A **new instrumentation** to evaluate and characterise the mechanical properties of **ex vivo human skin explants** has been developed.
- ✓ Previous results have demonstrated the **robustness** and **ability** of the technology to accurately explore the mechanical properties of human skin explants without stress.
- ✓ These new studies demonstrate that the technology can measure differences in mechanical properties within **injured skin** and can also assess the **effect of stress** on the skin over time.

Reference

[1] Patent WO 2022/129813 A1

Perspectives & Applications

- ➔ To **confirm the results of enzymatic stress** in a more complete study: control skin + stressed skin + stressed skin with stress inhibitor.
- ➔ To validate and support the mechanical results by performing **histological sections** of skin explants.
- ➔ To carry out new studies to evaluate the **effects of different stresses** and wound healing on the mechanical properties of human skin.



Medical & Cosmetics

