Medaka Fish As A Good Model To Study Skin Aging By Atomic Force Microscopy

Gaël Runel, Noémie Lopez, Muriel Cario-André, Julien Chlasta and Ingrid Masse,
CRCL EMT and cellular pliancy and the multistep process of tumorigenesis, Alain Puisieux
BioMeca® SAS, Lyon, France

INTRODUCTION

Studying skin aging in animal models, either to better understand age-related physiological changes or to find novel molecules that could act on aging, remains relatively long and costly. Fish could be appropriated models for this aim since skin structure is sufficiently similar to mammals one. Indeed, fish has been shown remarkably useful to investigate pigment biology (Schartl and Larue 2016). In particular, the Japanese Medaka, a small fish model with attractive experimental characteristics, could be of interest for studying aging since it accumulates over lifespan some biomarkers currently associated with aging features in others vertebrates. However, little is know about aging of the Medaka fish skin especially in its biomechanical properties and skin architecture. Our work aimed at studying Medaka skin aging at molecular, cellular and biomechanical levels.

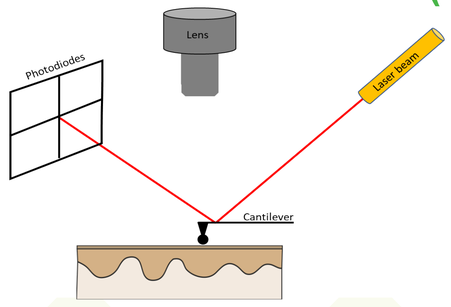
Study of skin Medaka fish aging by Atomic Force Microscopy (AFM)



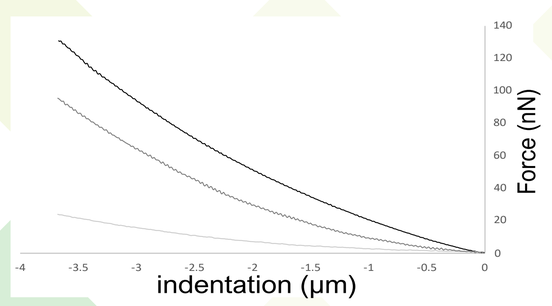
Japanese Medaka fish



Skin Medaka fish

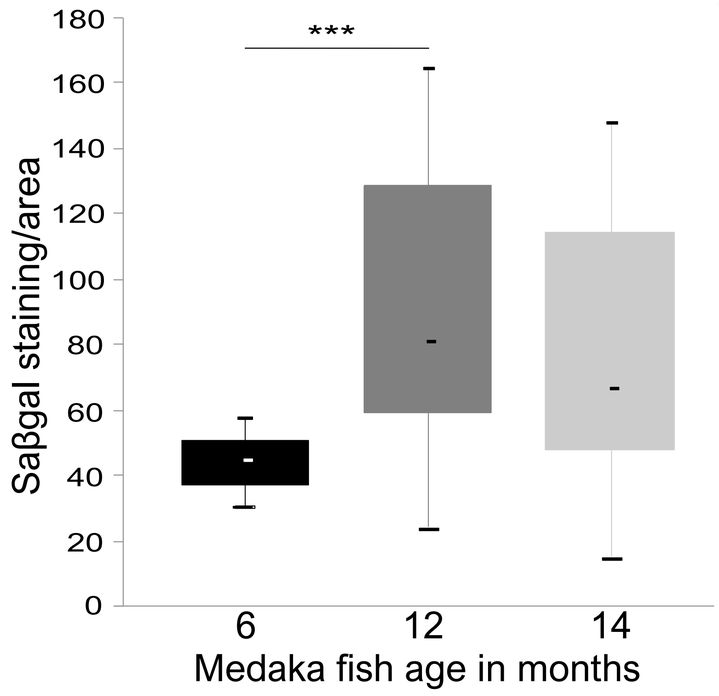


AFM flow diagram

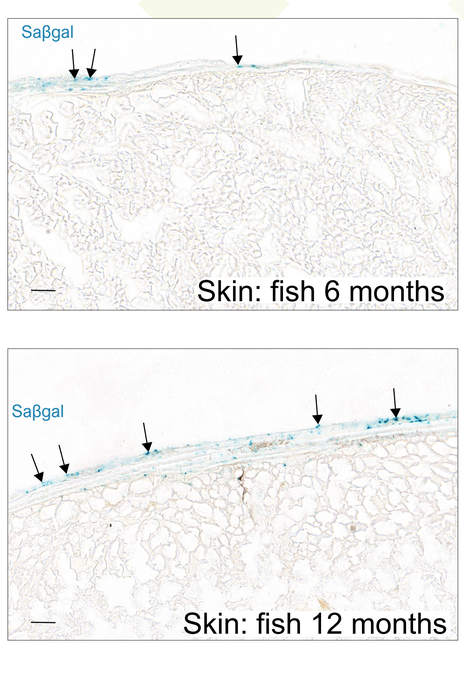


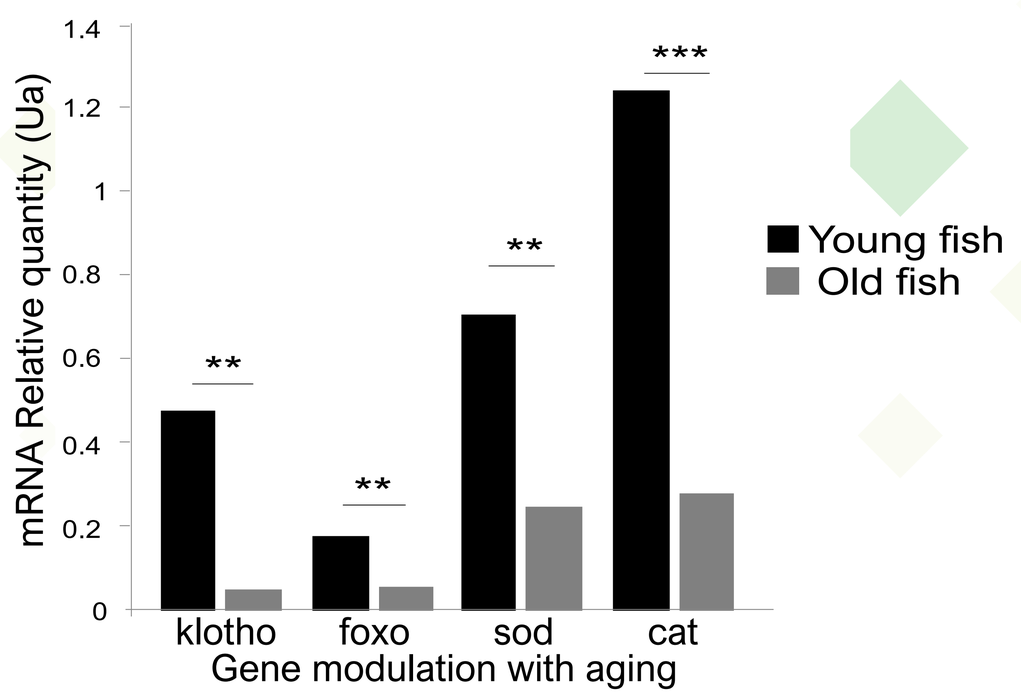
Force indentation curves

Medaka fish skin undergoes molecular aging in a similar way as in mammals: Accumulation of senescent cells and decrease of detoxification gene expression



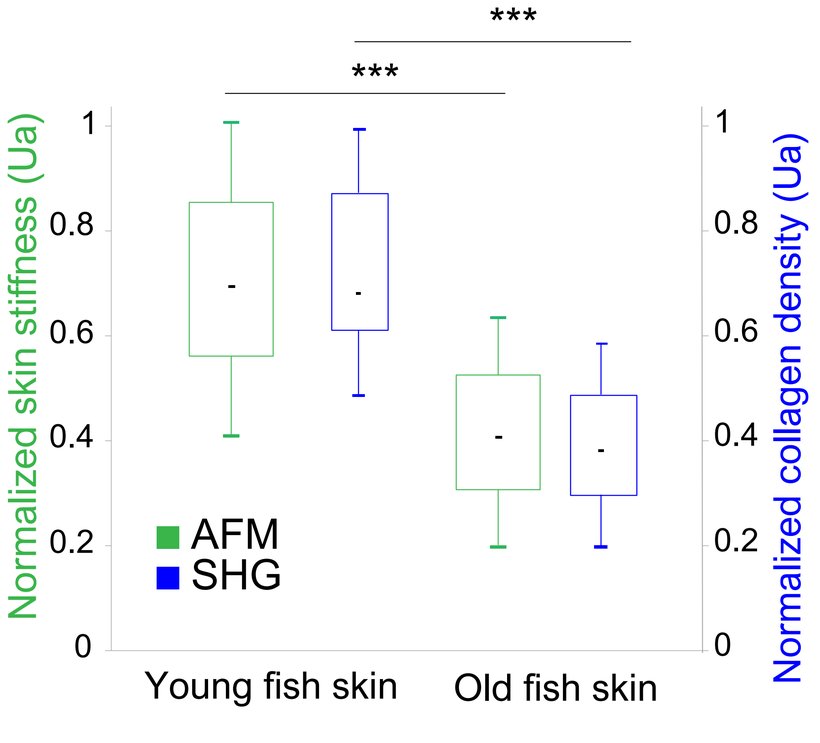
Medaka fish age in months

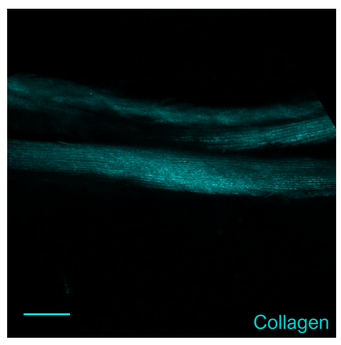




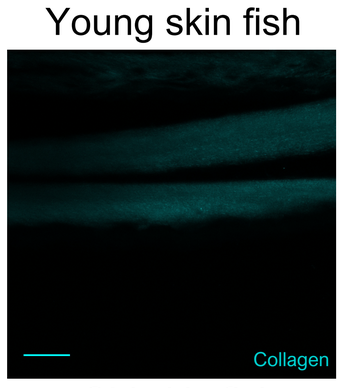
Gene modulation with aging

During aging, stiffness decreases concomitantly to dermal collagen density in Medaka skin, as in human reconstructed skin

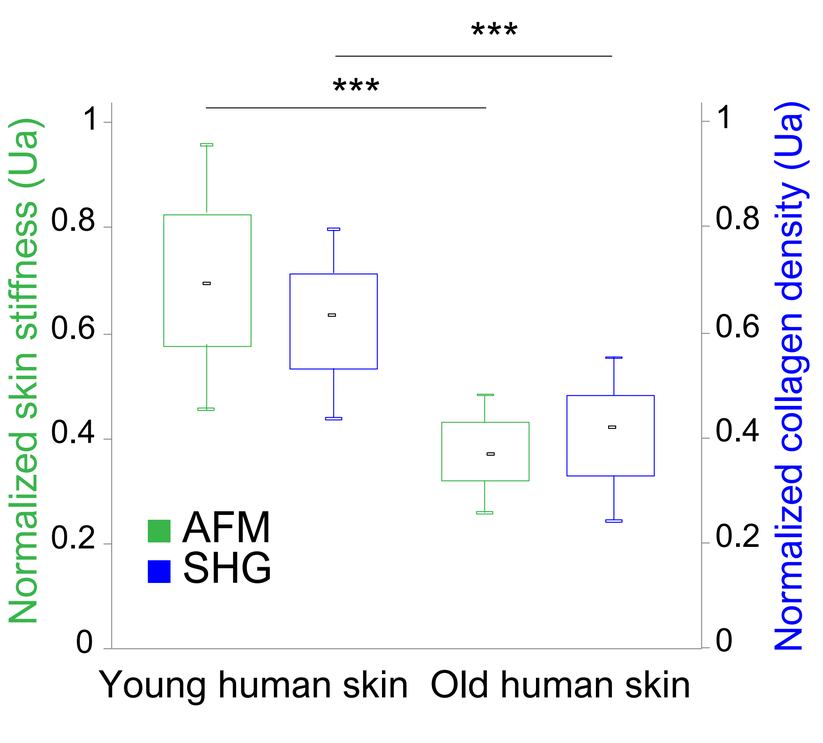


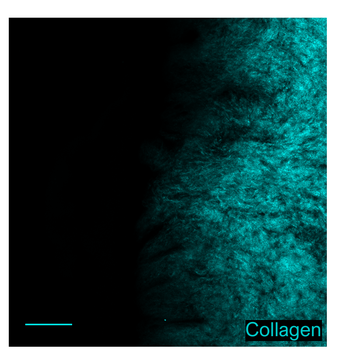


Young skin fish

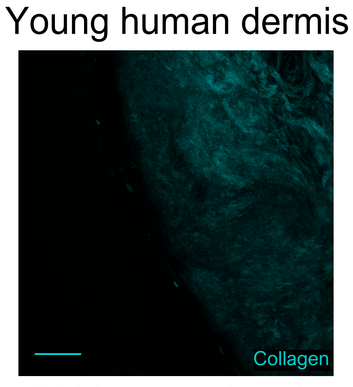


Old skin fish





Young human dermis

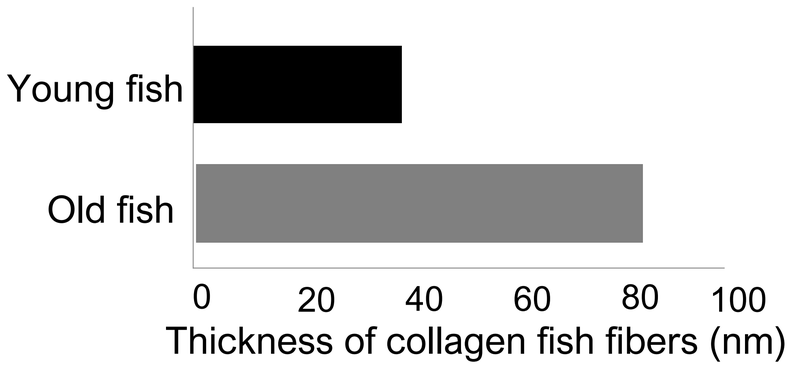


Old human dermis

The organization of dermis collagen fibers is modified through aging, with homogenization of collagen fibers and thickening



Fish collagen orientation measured by AFM



Conclusion

Overall, we showed for the first time that Medaka fish could be a highly pertinent model to study skin aging. We revealed that well-defined biomarkers of human skin aging are conserved in Medaka fish. We also identified stiffness modulation by AFM as a new parameter that signs skin aging and could reflect a dermis reorganization during aging. Thus, Medaka fish will be useful to further study skin aging and identify new molecular actors of this phenomenon, but also to potentially screen novel molecules that could act on.

Acknowledgements