Effect of cultured rat primary hepatocytes on the mechanical properties of collagen gel matrices

Peter E. Agbekoh, Catherine Henderson, Philip E. Riches and M. Helen Grant
Department of Biomedical Engineering, University of Strathclyde, Glasgow, UK
peter.agbekoh@strath.ac.uk

INTRODUCTION:

Collagen gels are widely used as matrices for in vitro cell culture and also for a variety of tissue engineering applications. The mechanical properties of matrices have been shown to be important parameters which greatly influence cell behaviour[1]. For successful support of long term cell growth and function, it is important for matrices to retain their mechanical integrity during the period of use. The presence of cells has been shown to alter matrix properties[2]. The aim of this study was to investigate the effect of seeding primary hepatocytes on the mechanical properties of collagen hydrogel matrices.

METHODS:

Adult rat primary hepatocytes were seeded at different densities on reconstituted type I collagen hydrogels (0.3% w/v) and maintained in culture for up to 7 days. Stiffness (aggregate modulus) and hydraulic permeability of the gels were evaluated at 48 h and 7 d using biphasic theory following confined compression testing[3].

RESULTS:

Stiffness and hydraulic permeability of the gels were altered when primary hepatocytes were maintained on them (Fig. 1). Presence of cells generally led to lowering of stiffness and an increase in hydraulic permeability.

DISCUSSION:

Primary hepatocytes influence the mechanical properties of collagen gels. The decrease in stiffness of collagen gels with presence of hepatocytes is most likely due to the cells degrading the matrix through the chemical action of degradation enzymes, and the physical exertion of mechanical forces on the gels by the cells. The increase in hydraulic permeability may also be due to the degradation of matrix which occurred with cell seeding.

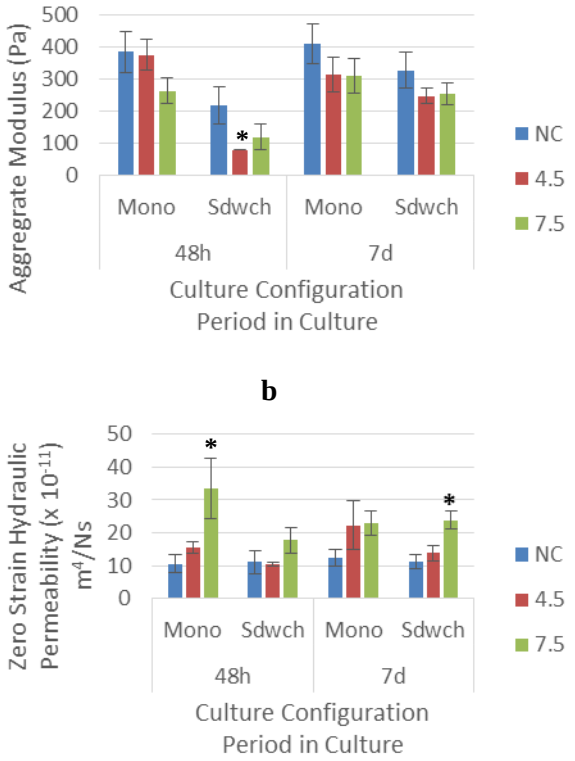

*Fig. 1: Effect of hepatocytes on stiffness (a) and hydraulic permeability (b) of collagen gels in monolayer (Mn) and sandwich (Sdwch) culture configurations. NC, no cells; 4.5, 4.5 x 10^5 cells/well; 7.5, 7.5 x 10^5 cells/well. Data are means ± SEM, n=3 independent experiments in triplicate, * represents significant difference from NC ($p < 0.05$) by ANOVA followed by Dunnett's multiple comparison test.*

CONCLUSION:

The change in mechanical properties observed in this study has implications for use of collagen gels as matrices for long term use.

REFERENCES:

[1]Engler et al. (2006) Cell 126(4): 677-689
[2]Saddiq et al. (2009) J Biomed Mater Res A. 89A(3): 697-706
[3]Mow et al. (1980) J Biomech Eng. 102:73–84