**Commercial Collagen Matrices for in vitro diagnostic bioartificial arteries**

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**Statement of Purpose:** In vitro bio-artificial arteries are also used for in vitro diagnostic analyses, for example, cardiovascular medical device prototypes (Floren et al., 2004). These devices, such as stents and specialty angioplasty catheters, undergo refinements in *in vitro* bioreactors until specific parameters are met for animal trials: i.e. drug delivery, catheter and stent deployment, smooth muscle cell affects etc (Punchard et al., 2009; Yazdani and Berry, 2009). Unfortunately, there are many obstacles in forming bio-artificial arteries from pure collagen, including laborious extraction techniques, various manufacturer compositions, and extended cell culture conditioning to form the necessary mechanical and surface properties. To increase the in vitro experimental throughput of cardiovascular prototypes, we propose to simplify the collagen tube/bio-artificial artery synthesis in a bioreactor by utilizing collagen films that are industrially manufactured, inexpensive, and available anywhere a butcher shop is located. These collagen films were prepared from edible, collagen based sausage casings. The collagen film was characterized with respect to mechanical properties, film structure and composition, and its potential to act as a matrix for cardiovascular relevant cell cultures.

**Methods:** The edible collagen film was characterized by FE-SEM, NMR, mass spectrometry, and Raman Microscopy to elucidate its physical structure, leachables, and collagen subtype composition. Mechanical properties of the film were tested in radial and axial collagen directions in both wet and dry environments, with anisotropic properties found. NMR and Raman Microscopy were used to elucidate the additives in the collagen film added in by the manufacturer, Nippi Inc (Tokyo, Japan). Stem cell lines MSC and HUVEC were seeded onto the collagen films and assessed for cell adhesion, growth, and orientation at 3, 6, and 10 days post- seeding.

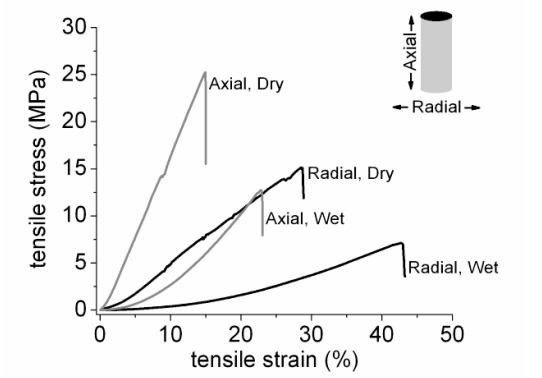


Figure 1. Mechanical properties of commercially available edible collagen films displaying anisotropic properties.

**Results:** The collagen films had a thickness ranging from 50 microns (dry) to 70 microns (wet). Figure 1 shows the mechanical properties of the collagen films in the axial and radial directions, in wet and dry states. The films displayed 2-3 times more tensile strength then saphanous veins, with ~ 2 times less elongation.

Cell cultures of MSC and HUVEC were found to adhere and proliferate on the collagen films, along with other types of cardiovascular cell types. Figure 2 presents HUVEC-GFP (upper left), DAPI stained cellulose fibers (upper right), collagen Bright field surface (lower left), and overlay (lower right). Using the DAPI stain as cellulose marker, the stem cell lines were found to orient themselves in a perpendicular direction to that of the cellulose fibers, and parallel to the machine grooves within the collagen film.

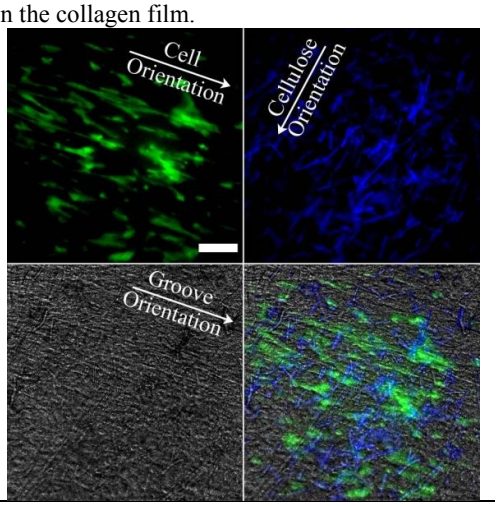


Figure 2. Mesynchymal stem cells grown on edible collagen films for 10 days in a specific orientation..

**Conclusions:** Edible sausage films composed of collagen and cellulose have been characterized towards their use as a biomaterial for in vitro arteries. Their physical and mechanical properties allow them to be stored at room temperature and while being able to be used after a few minutes of preparation ($dH_2O$ rinsing and 70% EtOH sterilization) for cell culture applications. Characterization by FE-SEM, mass spectroscopy, amino acid analysis, and Raman microscropy suggests that the collagen fibrils are aligned, stabilized, and biologically available to act as cell guides for cell orientation, without cumbersome mechanical treatment.

**References:**

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