Jellagen

From the Seabed to the Sickbed
Next Generation Collagen Biomaterials

Overview Presentation
ERA-MBT Research & Innovation Launch Map
13th October 2016

non-mammalian collagen

Vision & Mission

To become the global market leader and experts in manufacturing disease and bioburden free next generation collagen and developing innovative solutions for specific applications in academic, medtech, pharma and biotech markets.

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- Manufacturer of **next generation collagen** technology derived from jellyfish for cell culture (therapy) & med-device.
- Large addressable markets (multi US$Bn) looking for safer & technically superior alternatives
- De-risked business model: Collagen used in FDA/EU approved med-device & cell culture products
- Collagen products on market and generating early revenues – **offers *in vitro* to *in vivo* products**
- Establishing a GMP manufacturing site, Cardiff (Q1-2017)

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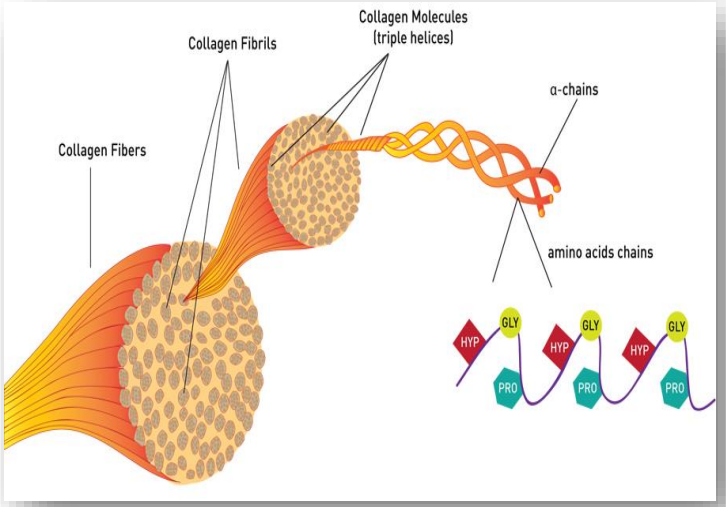
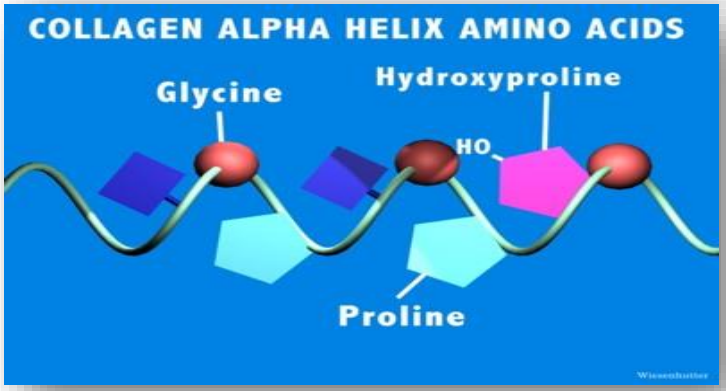
Collagen

A Natural Biomaterial Polymer

- A key protein component of the Extra Cellular Matrix (ECM)
- Highly conserved across a wide variety of species
- Triple helical scaffold
- The triple helix may confer stability (strength & elasticity)
- Predominant market sources from bovine & porcine
- Used in a wide range of med-device & tissue engineering applications
- Jellyfish serve as an ideal source of collagen





Market Need

A trend towards safer alternate sources & types

Key Benefits

- Next generation collagen
- Non mammalian & Disease free (BSE)
- Conserved structural protein with decades of precedence of medical use
- Material allows for efficient nutrient uptake and oxygen supply to cells
- Scaffolds allow for bespoke pore size control – better cell seeding for greater range of cell types
- Provides a good fibrillar structure – better than rat tail

Target jellyfish species rich in collagen – *Barrel Jellyfish*

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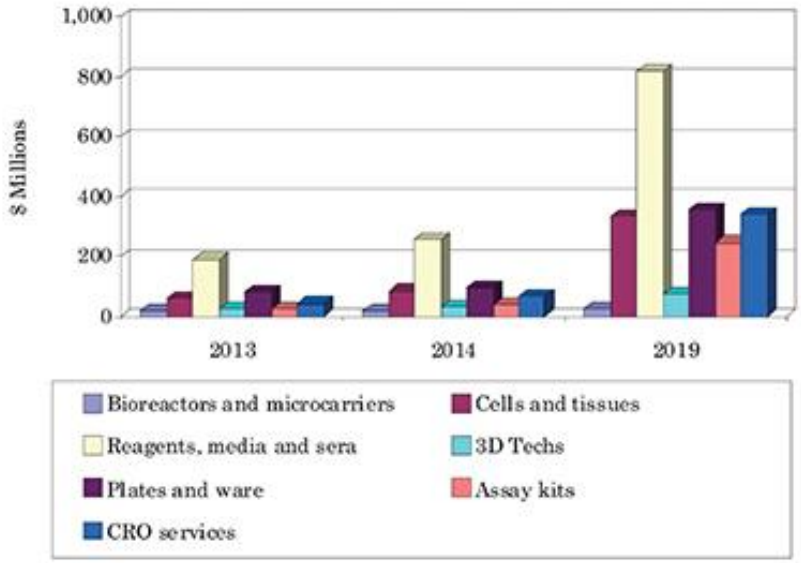
Market Trend

Towards 3D Cell Culture

FIGURE 1

THREE-DIMENSIONAL CELL CULTURE MARKET, 2013-2019
($ MILLIONS)



Source: BCC Research, "3D Cell Culture: Technologies and Global Markets" (BIO140A), January 2015

- 2D since 1950s "Old Tech"
- 3D offers *in vivo "*like" capabilities
- Global 3D cell culture market = $586M 2014.
- Forecast to grow > US$2.2Bn by 2019 (CAGR) of 30.1%.
- Biggest increase will come in the area of **assay kits**, which is forecast to jump to $588M by 2019.

Company Overview

Operational since August 2013 – 5 FTEs

Headquartered. Cardiff. Wales

>£2M investment secured since April 2014

- **Focus**: Sourcing and manufacture of a **functional** jellyfish collagen
- **Products**: Cell culture (2D & 3D), regen med/tissue engineering and medical devices
- **Markets**: Multi-billion dollar growth markets
- **Key USPs**: Next Generation, non-mammalian, non disease & technical advantages

Current Products

Cell culture reagents

Native collagen in solution or dried

Collagen sponges for 3D cell culture

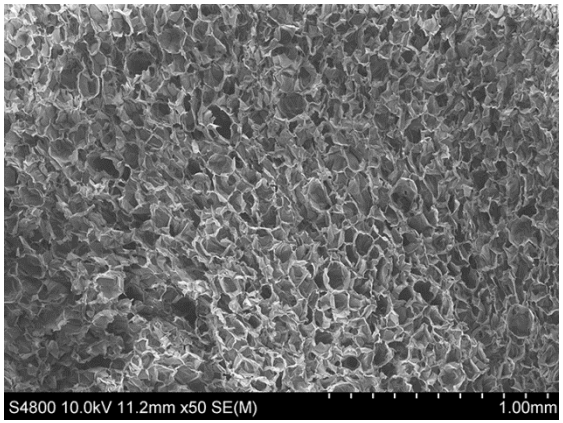
Collagen biomaterial coatings

Current Products

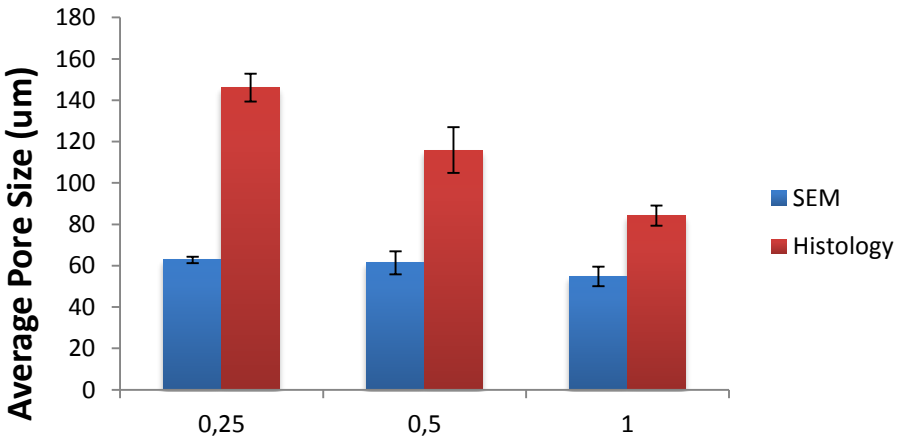
Research grade materials

Product Specification & Benefits

- Highly pure & native in structure (preserved triple helix)
- Next generation collagen
  - Offers greater versatility to type I and type II
- BSE (Prion) & disease vector free
- Better fibrillar structure than rat tail and bovine collagen type I
- Better control over pore size = optimal cell seeding and bespoke collagen product offering



SEM Image jellyfish collagen



Comparative Analysis

Performance Data

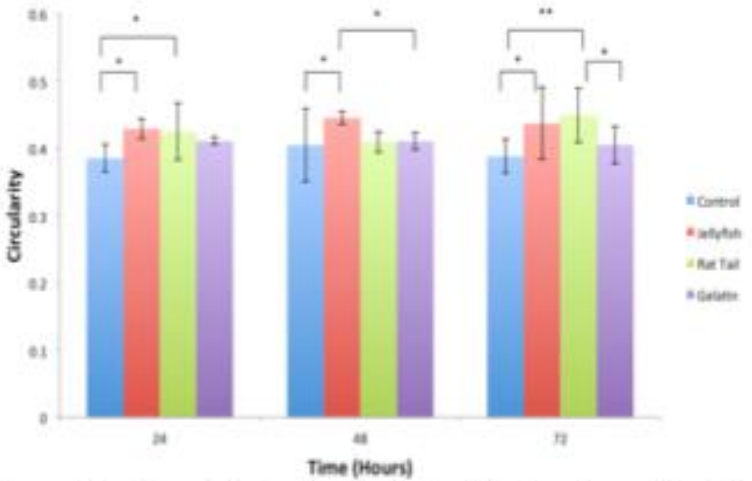


Figure 18 – Morphological analysis of cells using ImageJ circularity values. On average over a 72-hour period cells cultured on control and gelatin coated plates showed lower circularity values to those cultured on jellyfish and rat-tail collagen coated plates. Values displayed are average circularity ± STDEV of triplicate data. Statistical analysis was preformed using two-tailed student's t-test *p<0.05, **p<0.01

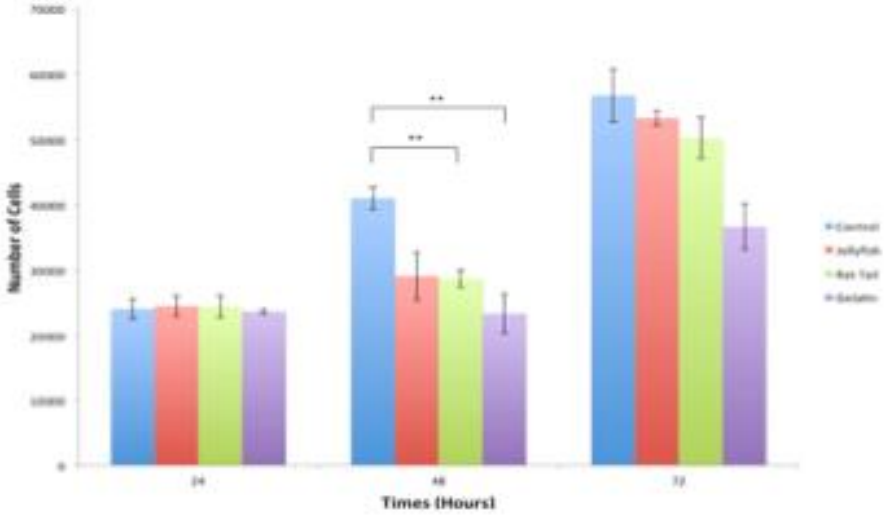
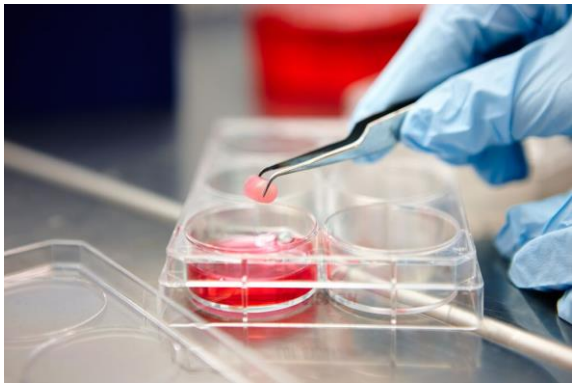


Figure 16 –Proliferation analysis of cells seeded on control, jellyfish collagen, rat-tail collagen and gelatin coated plates over 72 hours. At 24 hours cell number is equivalent to that of seeding density. A lag phase occurs at 48 hours for coated plates before collagen coated and control plates double in cell number. All values are average ± STDEV from three biological repeats. Statistical analysis was performed using two-tailed student's t-test *p<0.05, **p<0.01.

Overall data is showing jellyfish collagen (**red**) is able to provide architecture allowing for good cell morphology and cell proliferation vs rat tail **(green**)

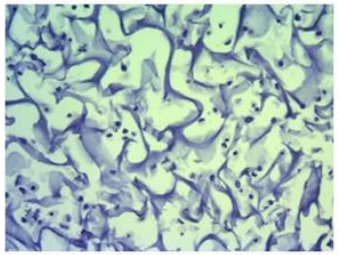
Cartilage Tissue Engineering

3D Cell culture – Medical Device Prototype

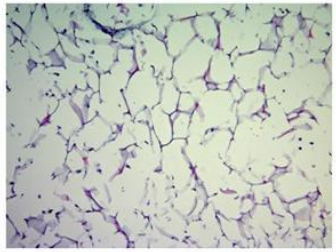


Jellyfish collagen scaffold

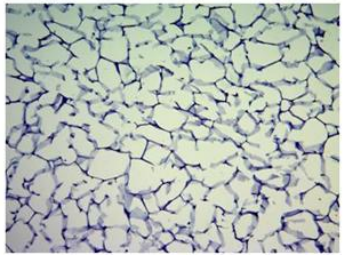
Jellyfish collagen cross-linked 3D scaffold



Bovine gelatin cross-linked 3D scaffold



Jellyfish collagen cross-linked 3D scaffold



Jellyfish collagen efficiently binds chondroctye cells

Cells preferentially attach to jellyfish collagen.

Jellyfish scaffold allows for a more structured chondrocyte phentotype than the bovine gelatin scaffold.

Allowed cells to migrate & differentiate into good quality rounded chondrocytes (**non fibrous**)

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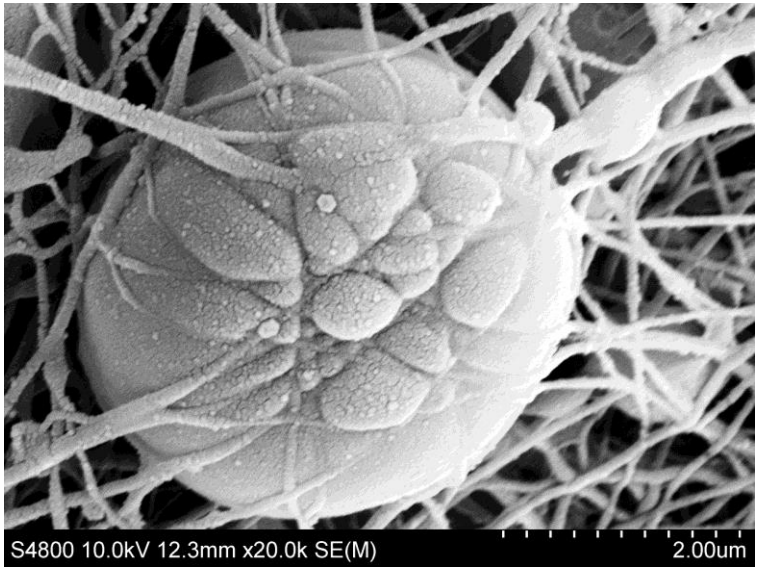
Medical Device Product Development

Nano-Engineered **biomimetic** medical devices

Use of electrospinning to produce nano-fibre mats using jellyfish collagen

Jellyfish collagen



Jellyfish collagen electrospun biomimetic mat - Chrondocyte shown embedded 100nm – 200nm fibres

Applications
Cell culture
Collagen mats
Tissue engineering
Biomaterial coatings
Wound device
Bone/dental device

The scale of the fibres is commensurate with natural ECM so ideal for cell growth.

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Thank You

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