










WP1

Processing and Validation of Natural Materials for TERM
















Objectives:

- To select and process natural biomaterials that could be used for tissue regeneration
- To use adequate methodologies for the processing of the biomaterials in different forms

Tasks:

- Task 1 - Natural materials selection and processing**
- Task 2 - Physical characterization of selected natural materials**
- Task 3 - Development of matrices**
- Task 4 - Degradability tests**
- Task 5 - Organic-inorganic composites, blends**
- Task 6 - In vitro biological evaluation**
















WP PROGRESS

1) Natural Materials selection

Selection was performed by analyzing possible sources, purification process, bioactivity, and processability

	Materials	Sources	Materials	Sources	Materials	Sources
Proteins	Silk	Bombyx mori (pure race and poly-hybrids) Thai silk Wild silk	Keratin	Cashmere Camel Horse	Collagen	Sponges Jellyfish Cuttlefish codfish Duck feet
Polysaccharides	Chitosan	Crustaceans (shrimps, crabs)	Hyaluronic acid	Streptococcus equi	Gellan gum	Sphingomonas (Pseudomonas) elodea
Inorganic	Calcium Phosphate	Cuttlefish bone Horse bone Black chicken bone	Alginate Silicates	Brown algae Diatoms		















2) Characterization of natural materials:

- Each material has been extracted from different sources and its physical characterization is being conducted
- A deep analysis of the isolation process and possible sources was performed

Specific work performed:

- Silk extraction steps were analysed from silk obtained from different sources: degumming, dissolution, dialysis and sericin isolation methods
- The amino acid composition, molecular weight, secondary structure and mechanical properties of Collagen and Keratin obtained from different sources was analysed.














-The processes of deacetylation and purification of Chitosan obtained from crustaceans were analysed, namely their effect on the properties - e.g. different solubility and processability.

-Hyaluronic acid was modified with catechol groups to enhance its adhesive properties.

- Both low acyl Gellan gum and high acyl Gellan gum mechanical properties, swelling and degradation kinetics were investigated.

- Different crosslinking processes were tested for Gellan gum, e.g. CaCl₂, photocrosslinking with UV light , ionic crosslinking.



















3) Development of matrices:

Specific fabrication methods were used to obtain constructs by starting from the selected polymers, such as membranes, hydrogels, porous structures, fibrous substrates, with tuned physical- chemical and biological properties.

Method	Solvent casting	LbL technique	Electro spinning	Freeze-drying	Gelation	3D Printing
Materials	Chitosan Hyaluronic acid Collagen	Chitosan Hyaluronic acid Calcium phosphate	Silk fibroin	Chitosan Collagen Calcium phosphate	Gellan gum Silk fibroin Alginate	Silk fibroin














4) Raw materials were tested in terms of safety, by following ISO 10993 directive (cytotoxicity by contact and on extracts).

5) Selection of the experimental protocols for the in vitro evaluation of possible cytotoxic effect of natural materials (in particular silk fibroin) and scaffolds based on natural materials was made.

6) For all processing methods, standard protocols were written and used by the consortium.

7) A quality control on the sources was defined to improve the safety of raw materials and reproducibility of the process





Deliverables/Milestones





Deliverables achieved:
D1.1. - Natural origin materials with different properties and of different origin





Deliverables not achieved
None





Milestones achieved:
MS1 - Selection of candidate natural materials for TERM applications





Milestones not achieved
none

   							
WP1 Secondments							
N.	Start date	Duration months	Type	Name	Destination	Activity /Major achievements	Task
1	Jan 2018	1	ER	Antonella Motta	CHU	Definition of criteria for polymer selection. Definition of optimal degumming conditions for Thai silk	T1, T2
15	Jan 2018	1	ER	Gilson Khang	UMINHO	-Extraction and characterization of CaP from chicken bone -Processing and characterization of materials based on Gellan Gum and CaP	T1, T2, T3, T4, T5
32	June 2018	1	ER	Danaa Ganbat	UMINHO	-Selection of natural materials from MUST -Training on equipment for Processing and Fabrication of natural materials for Biomedical Applications available at UMINHO	T1, T3
24	July 2018	1	ER	Enktuul Tsendeekhuu	UMINHO	-Selection of natural materials from MUST -Training on biological screening of keratin from cashmere and horse hair	T1, T6
16	Oct 2018	1	ER	Dulguun Dorjgotov	UNITN	Analysis of natural extracts from seabuckthorn oil to improve the bioactivity of scaffolds	T1

   							
N.	Start date	Duration months	Type	Name	Destination	Activity /Major achievements	Task
17	Nov 2018	1	ER	Dulguun Dorjgotov	UMINHO	-Selection of natural materials from MUST - Processing and characterization of membranes based on chitosan, hyaluronic acid ad Calcium phosphate -Characterization of processing and characterization methods of polysaccharides and CaP available at UMINHO	T1, T2, T3, T4, T5, T6
34	Aug 2018	6	ESR	Chavee Laomeeaphol	UMINHO	-Processing and characterization of Thai silk fibroin hydrogels -Investigation of their gelation mechanisms - Training of processing and characterization methods of silk materials available at UMINHO	T1, T2, T3, T4, T6

   							
N.	Start date	Duration months	Type	Name	Destination	Activity /Major achievements	Task
26	Sept 2018	3	ESR	Isabel Oliveira	CBNU	-Processing and characterization of gellan gum and gellan gum / silk hydrogels -Training of characterization methods available at CBNU	T1, T2, T3, T4, T5 T6
27	Dec 2018	1	ER	Peerapat Thongnuek	UMINHO	- Selection and training of the methods available at UMINHO for the processing of Thai silk alone or in combination with other natural materials	T1,T2,T3
15	Jan 2019	0.5	ER	Gilson Khang	UMINHO	-Processing and characterization of gellan gum and gellan gum / silk hydrogels	T1, T2, T3, T4, T5 T6
4	Jan 2019	0.5	ER	Nuno Neves	CHU	-Processing and characterization of Thai silk fibroin materials	T1, T2, T3, T4, T6

   							
Deviations occurred from the initial plan:							
Rescheduling of UMINHO ER Secondments – did not affect WP1 scientific work plan							
UMINHO ER secondments are already planned for the next months							
Rescheduling of CBNU ESR Secondments – did not affect WP1 scientific work plan							
Future implementation							
Continue the work in progress related with the extraction, processing and characterization of the materials from the selected sources to achieve D1.2: Micro/nanospheres, nanostructured materials, membranes and hydrogels with tailored physicochemical properties DUE: Month 36							