

"Enhancing Bioeconomy (Earth & Space) and under-demand manufacturing in Space through in-situ natural materials and Additive Manufacturing"

Prof. Nieves Cubo Mateo

Principal Investigator of ARIES, Nebrija University
Responsible of Space Exploration Club



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Previous studies: PLT – Space 2018-2019 (ESA funding)



3D Printing of Living Tissues for Space Exploration

Programme: Discovery

Start/End Date: 2018/2019

Programme Reference: 15/069

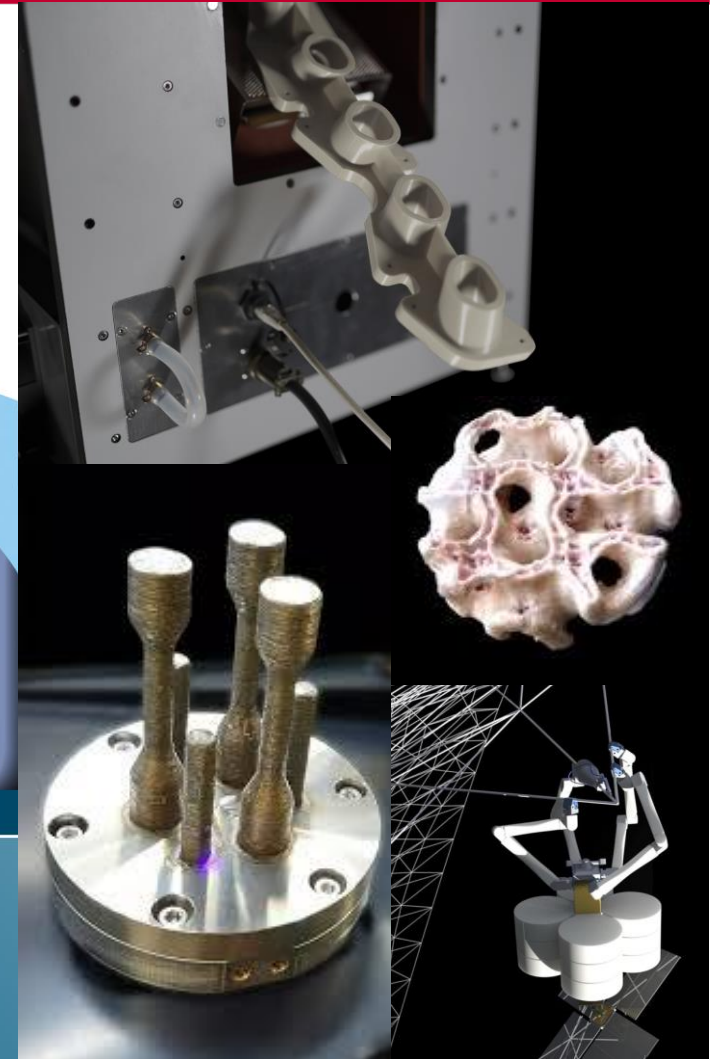
Contractor: OHB System AG

Country: Germany

SPACE SYSTEMS

Summary: PLT – Space
11.12.2019, ESTEC, Noordwijk

We. Create. Space.



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Long-term missions: enhance autonomy

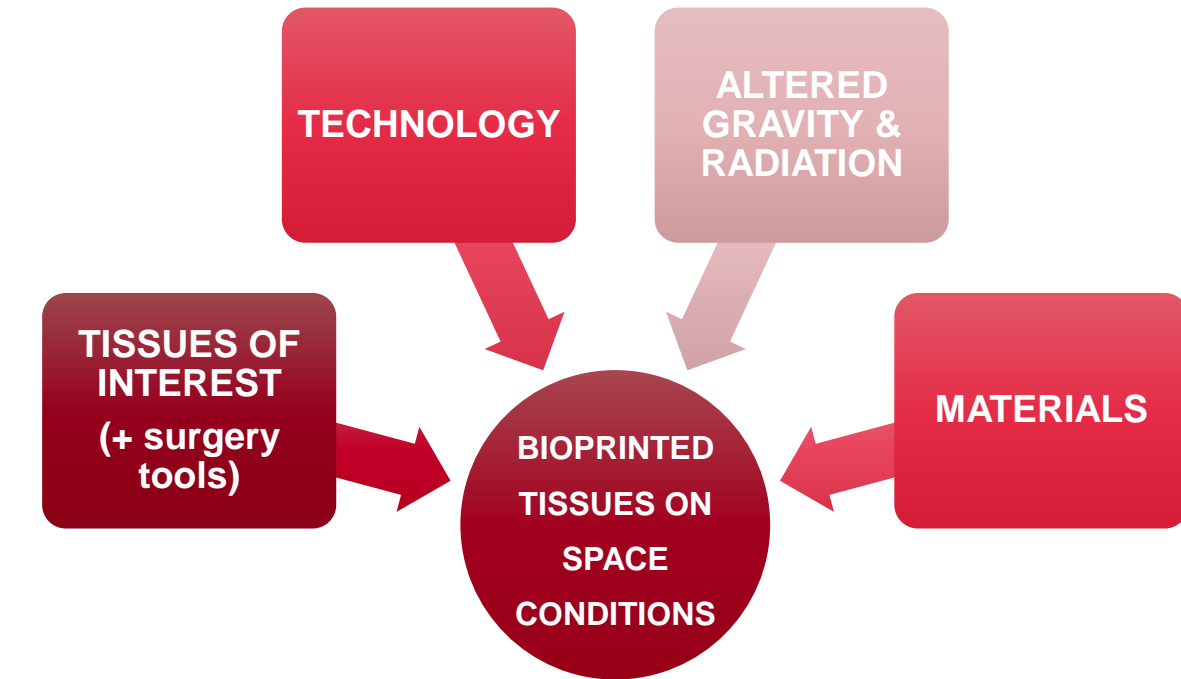
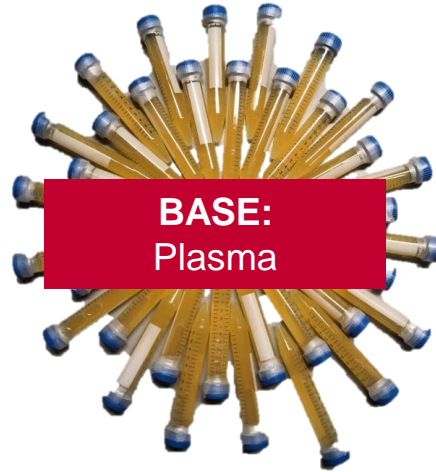


Image: original composition with images from NASA and ESA

Raw materials: growable, reusable, edible



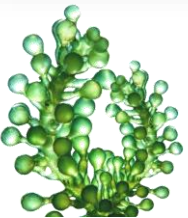
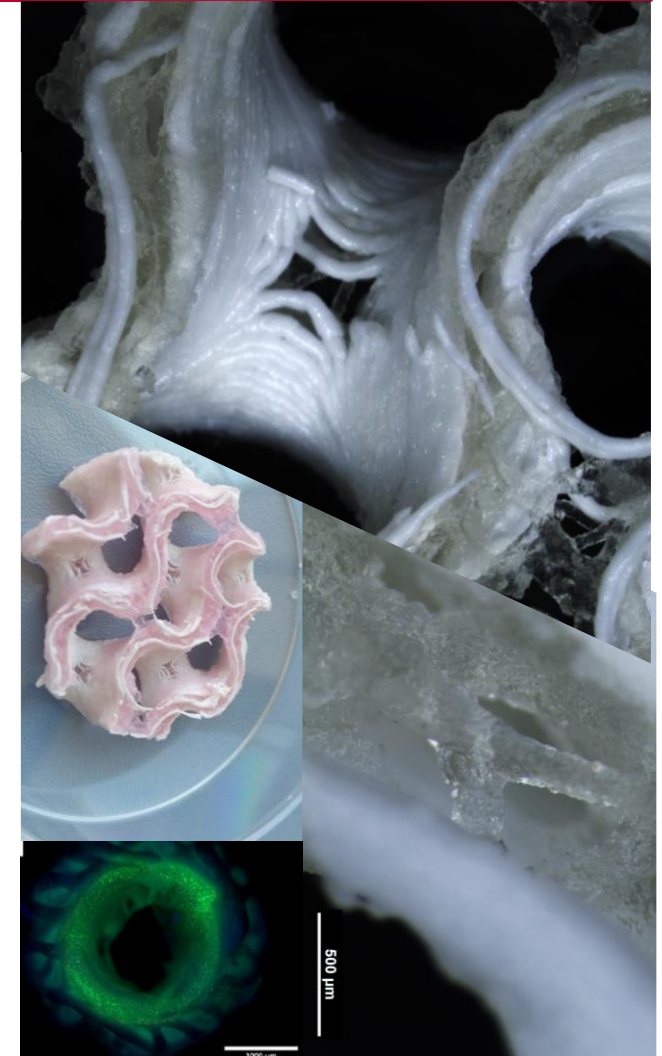
BASE:
Plasma



**FAST
GELATION:**
+ Alginate

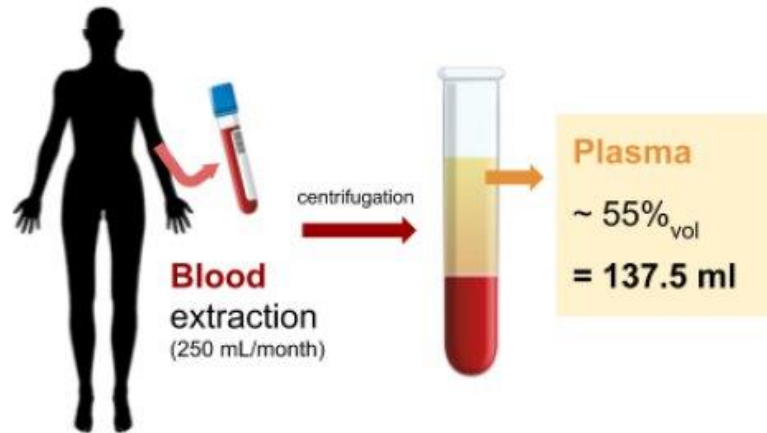


PRINTABILITY:
+ Methylcellulose



A novel plasma-based bioink stimulates cell proliferation and differentiation in bioprinted, mineralized constructs. *Tilman Ahlfeld, Nieves Cubo-Mateo, Silvia Cometta, Vera Guduric, Corina Vater, Anne Bernhardt, A Rahul Akkineni, Anja Lode, Michael Gelinsky*

Raw materials: growable, reusable, edible



Skin equivalents



For 75cm² of skin, 12 mL of plasma are required.

With 137.5 ml, 860 cm² of skin equivalents can be prepared



The area of 17 adhesive notes

Bone constructs



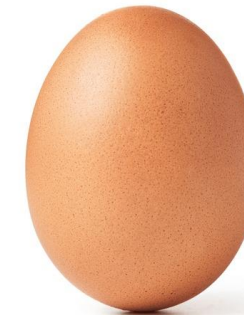
Plasma-based bioink: 2,56 mL of plasma / cm³



CPC ready to use paste: 3,50 g of CPC / cm³

With 137.5 ml, 54 cm³ of bone constructs can be printed

Also, 189 g of CPC are required



The volume of a chicken egg

All the values were experimentally calculated by the author (NC)



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Tech. study: altered gravity bioprinting (materials)



ENABLING & SUPPORT

Upside-down 3D-printed skin and bone, for humans to Mars



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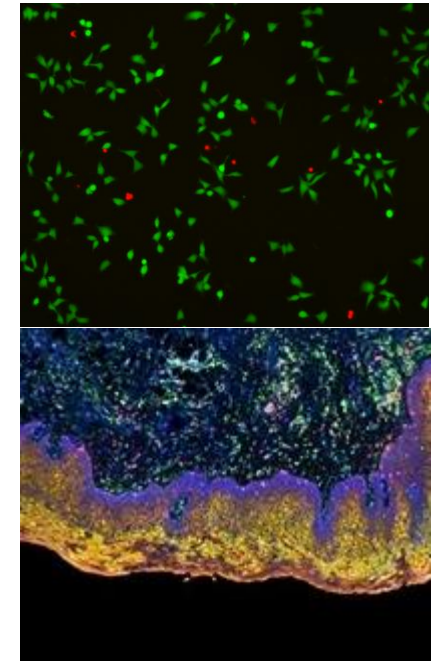
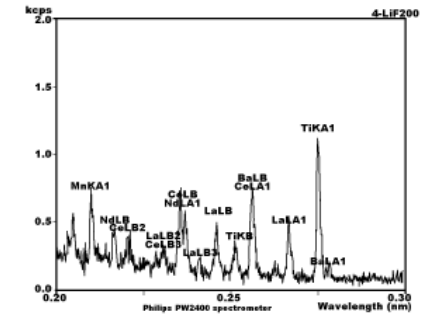
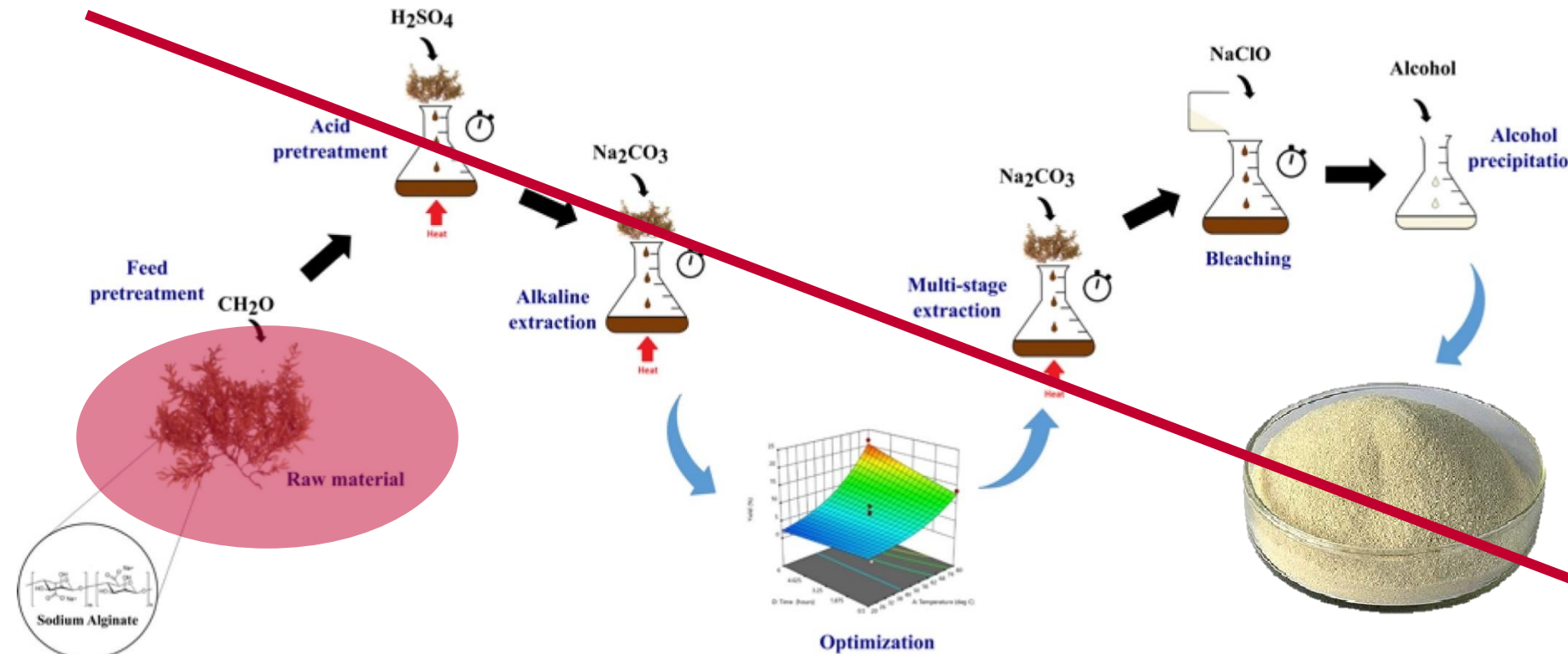
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No purified/refined materials to avoid Earth over-dependency



Mohammed, A., Rivers, A., Stuckey, D. C., & Ward, K. (2020). Alginate extraction from Sargassum seaweed in the Caribbean region: Optimization using response surface methodology. *Carbohydrate Polymers*, 245, 116419.



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