

Cultured Meat

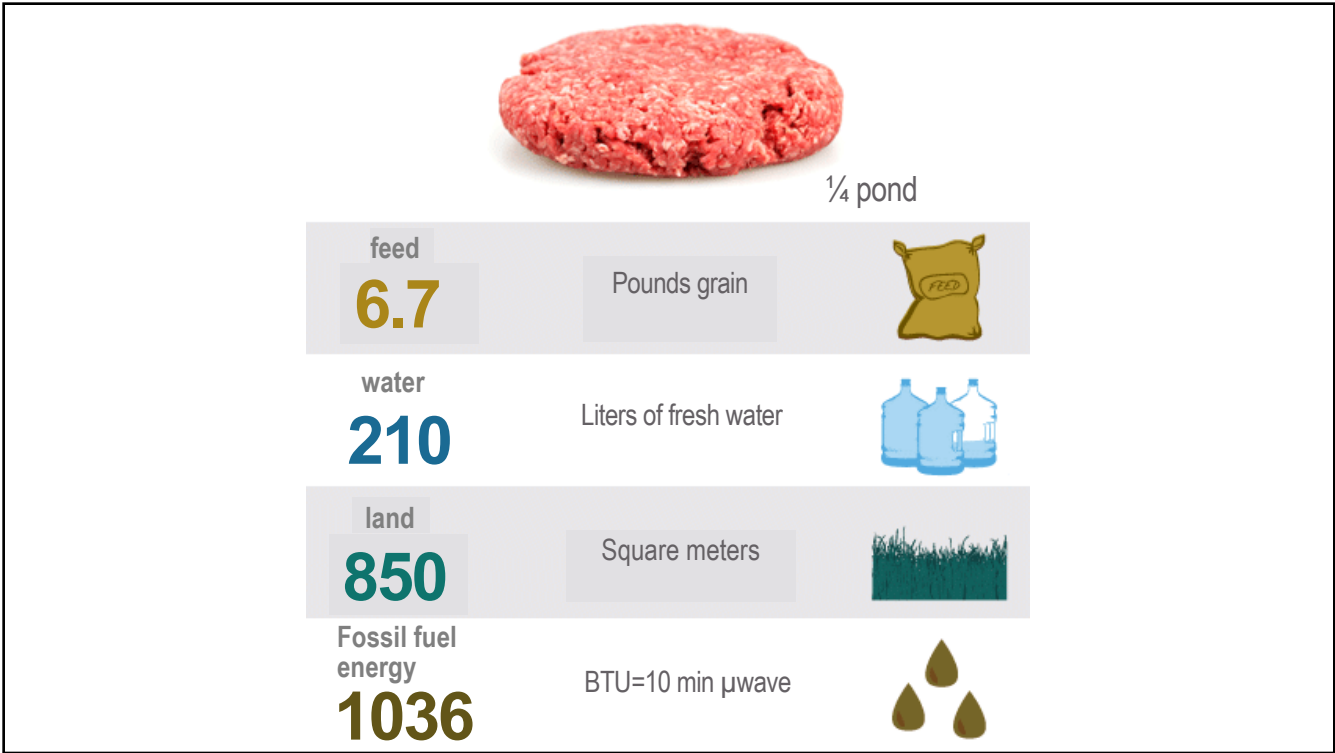
Mark Post, MD, PhD

CSO Mosa Meat
Prof of Physiology
Maastricht University

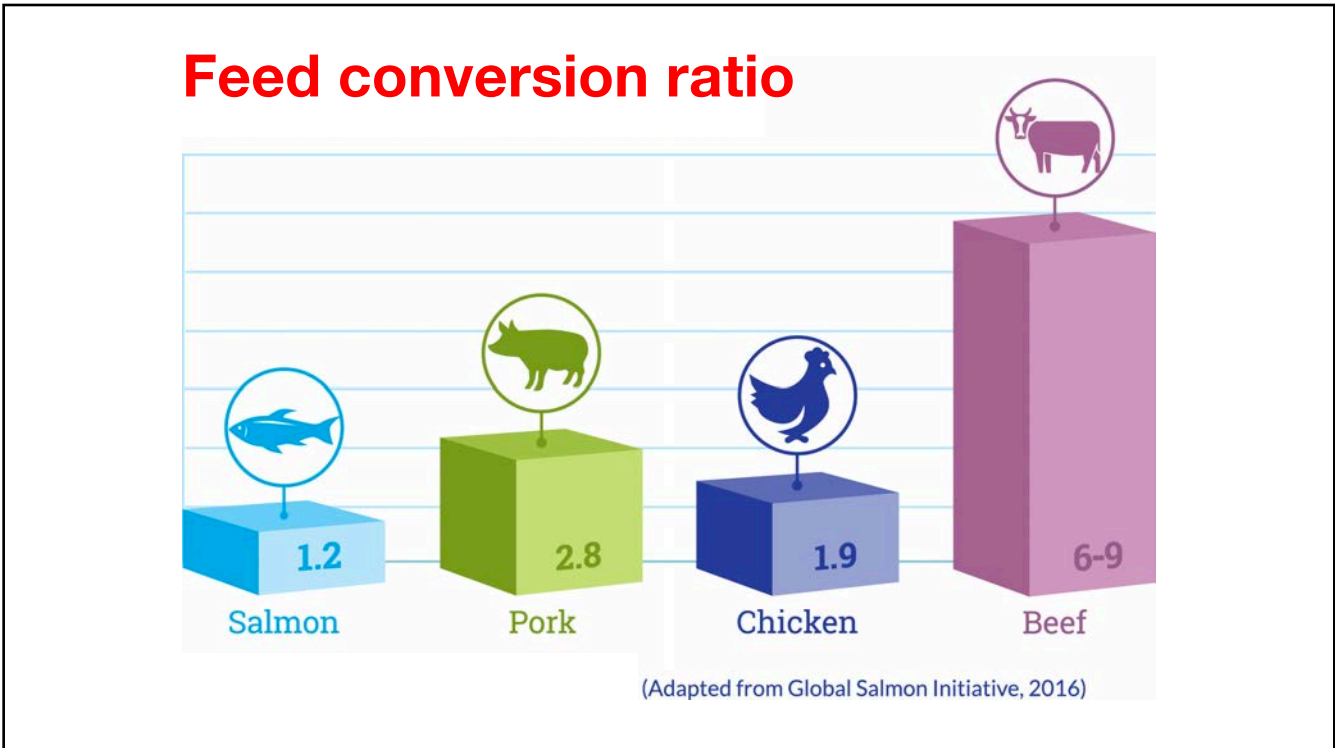
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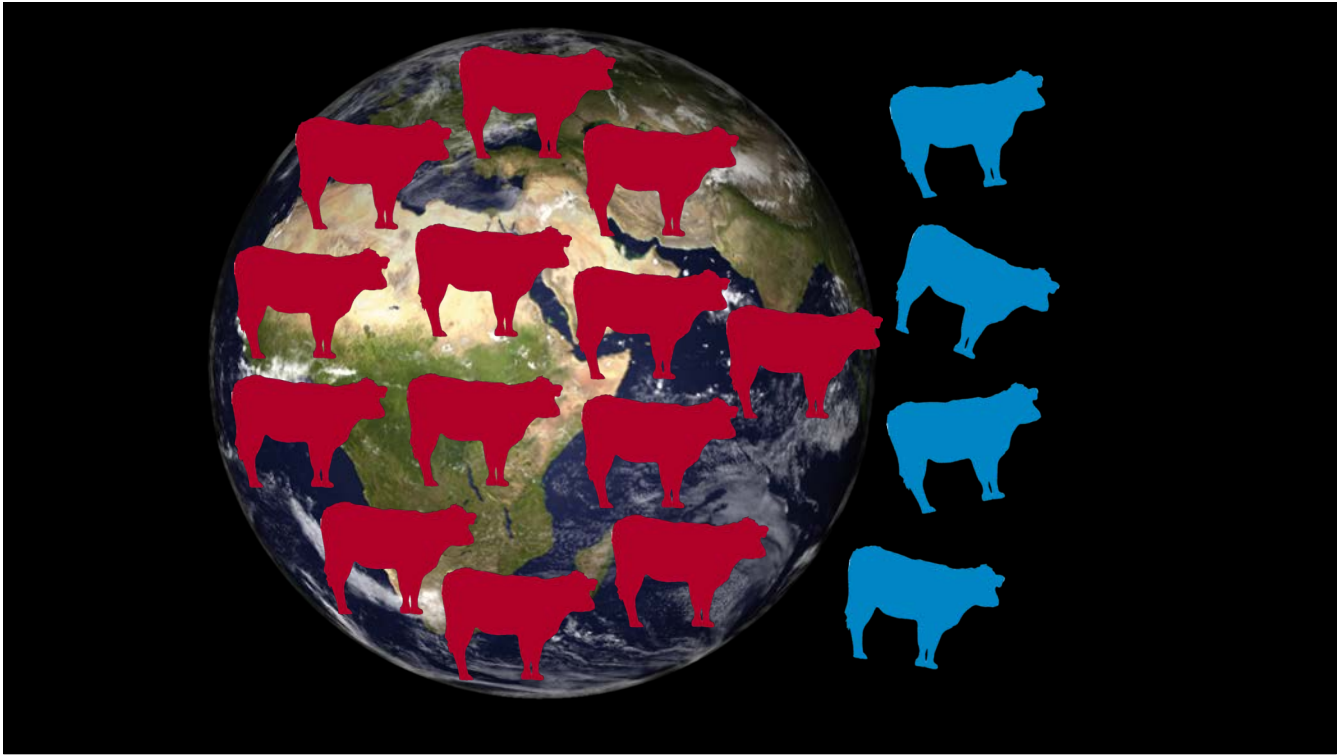
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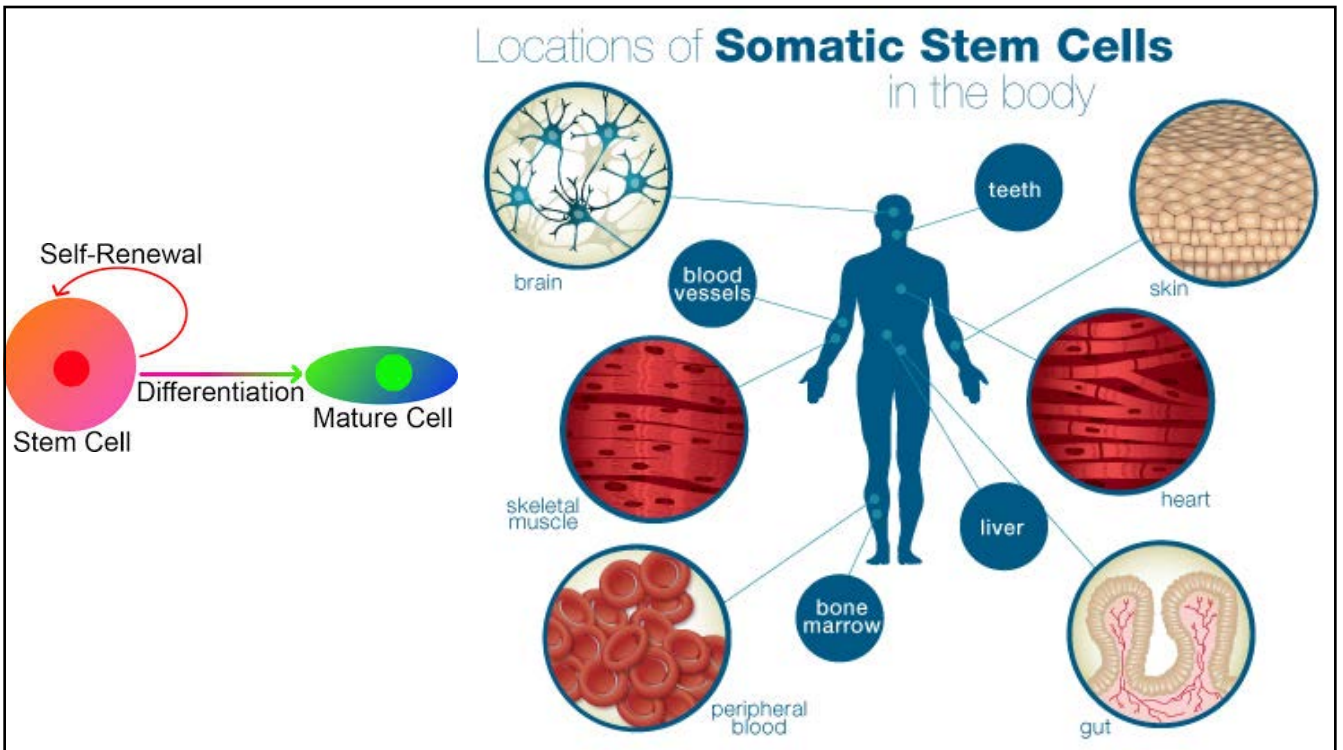
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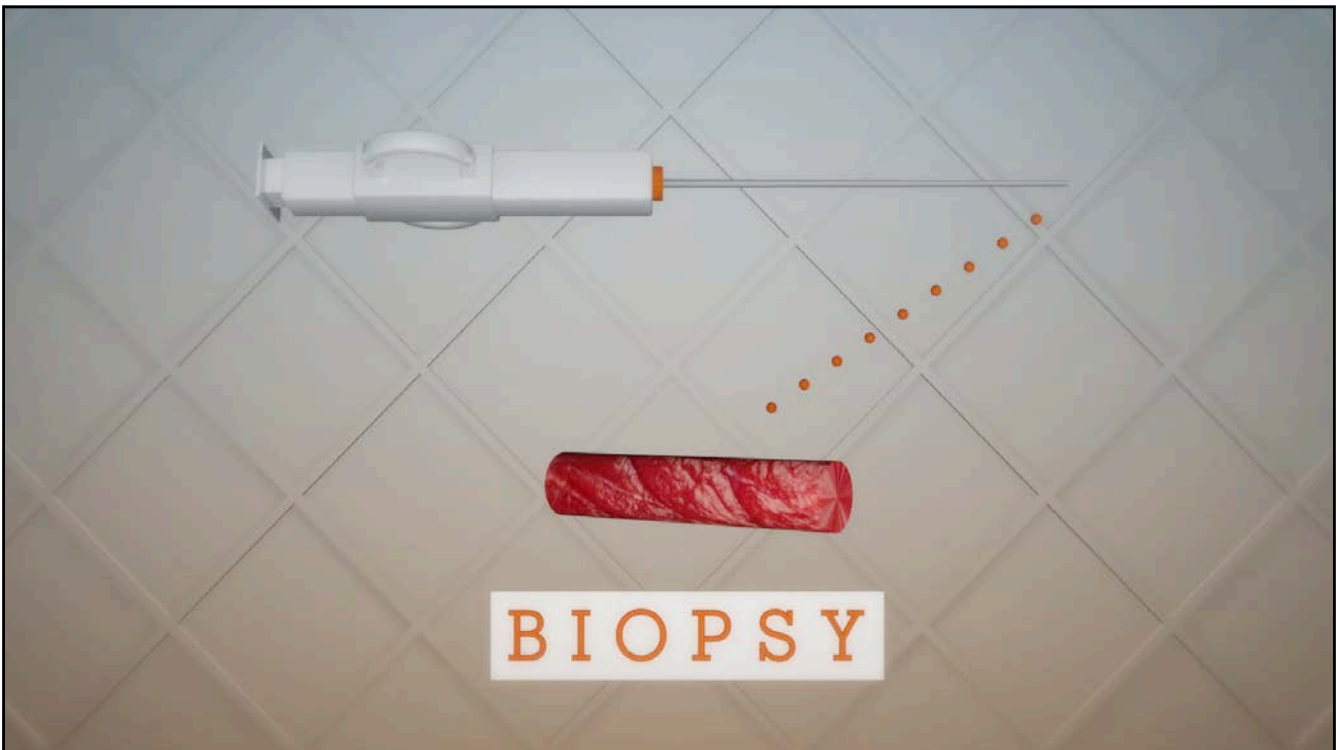
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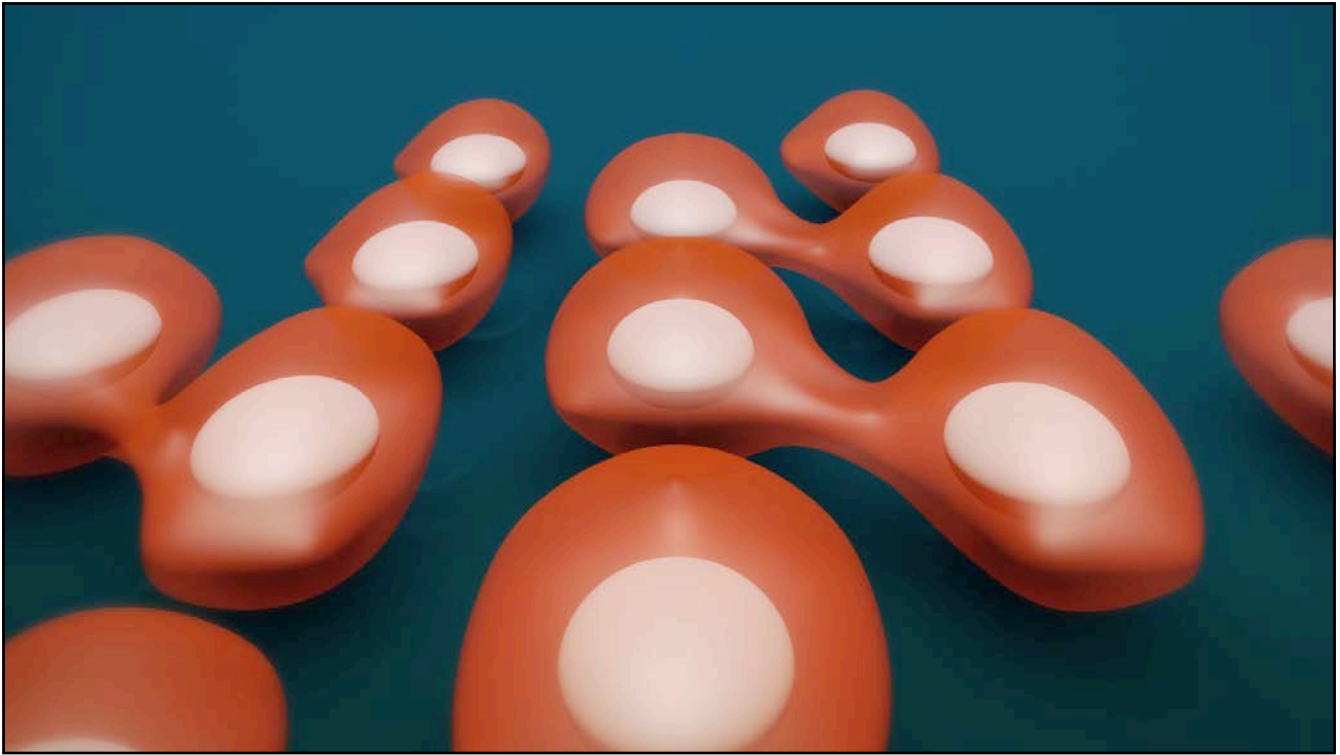
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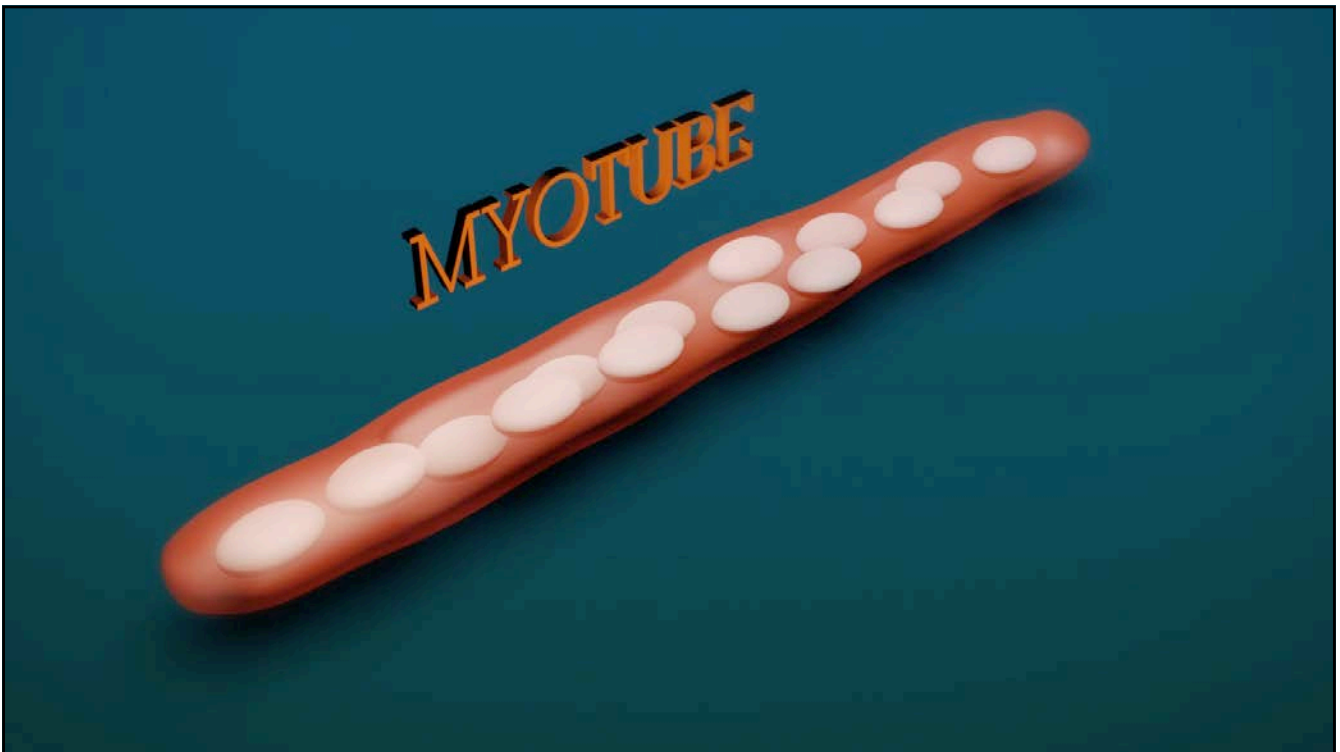
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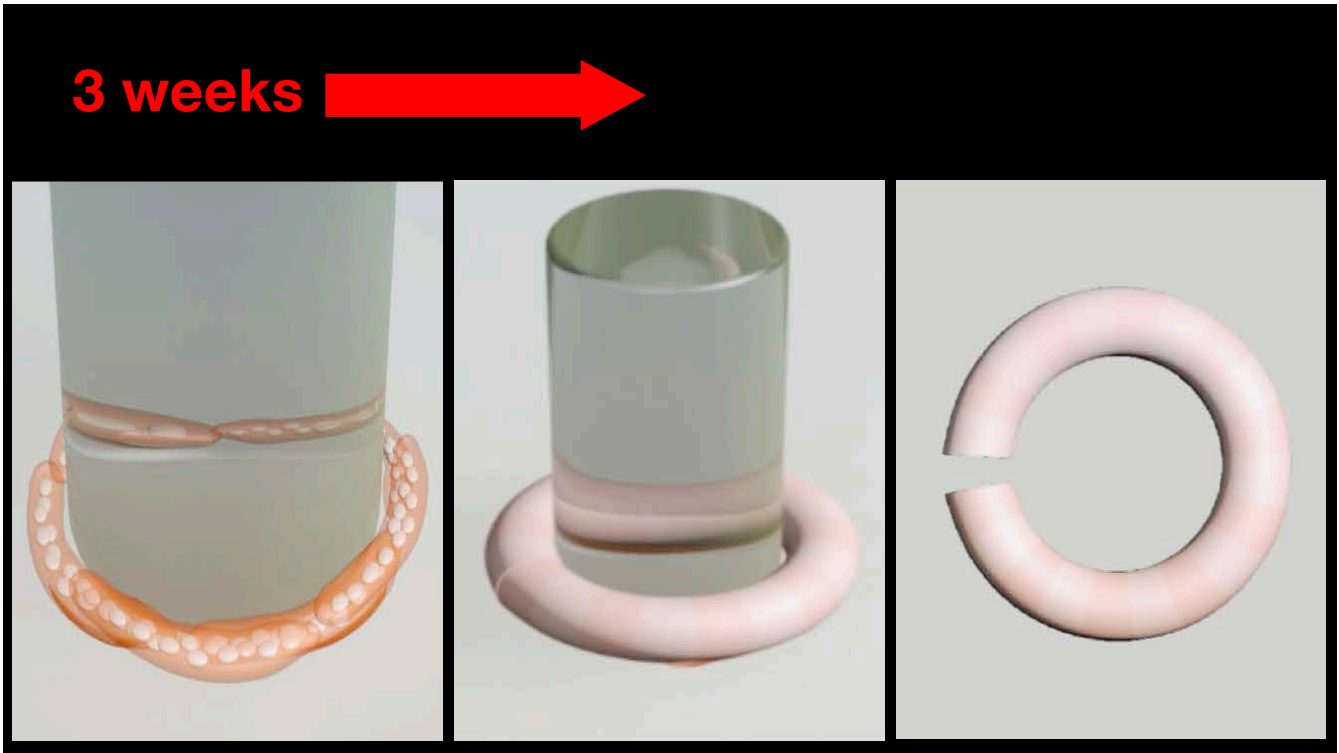
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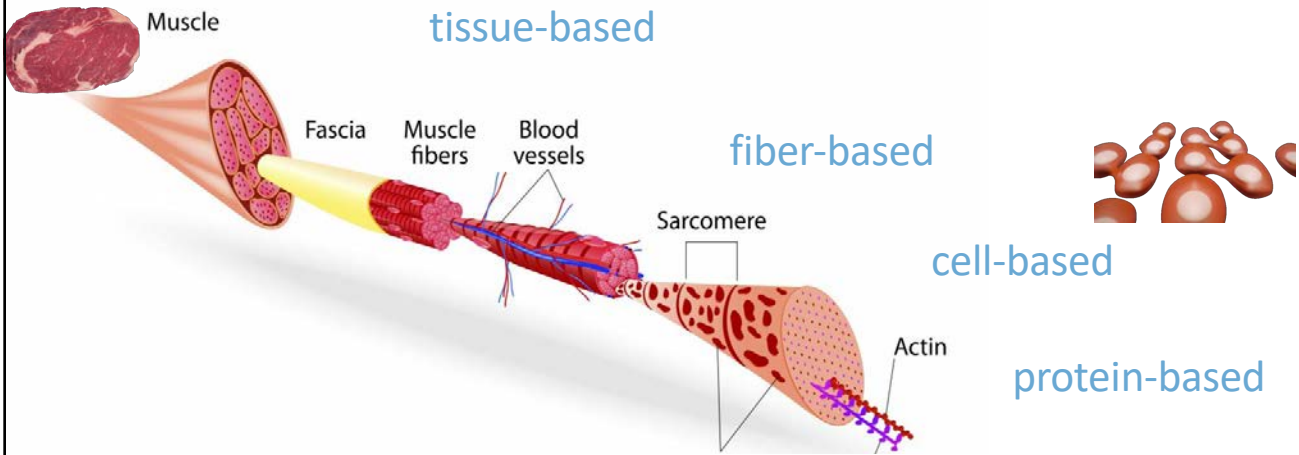


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diverging approaches

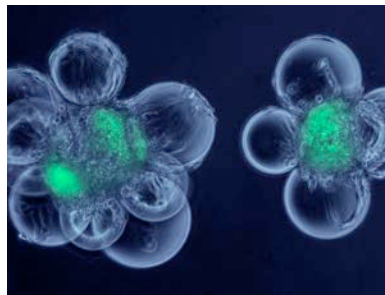


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EFFICIENCY



culture conditions



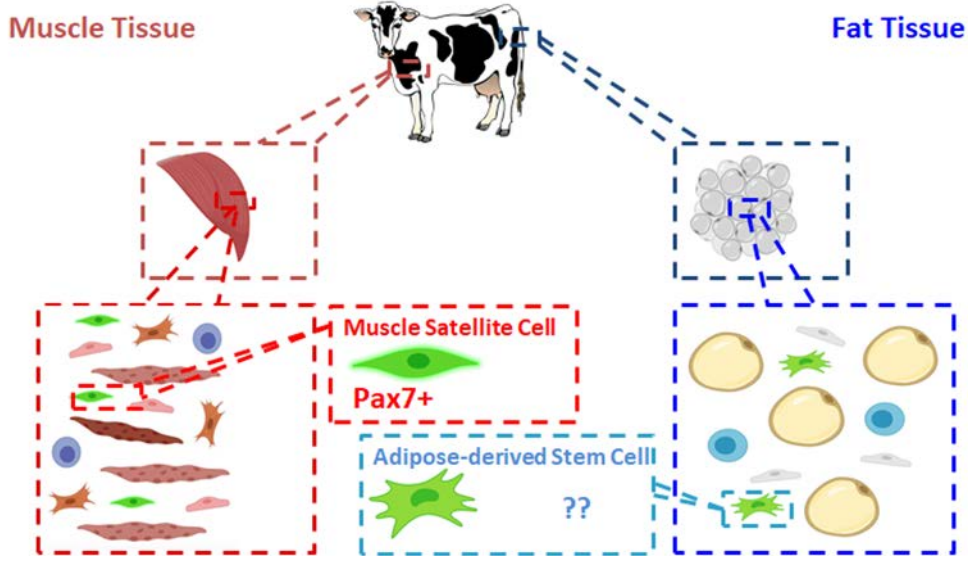
cell selection



scale up

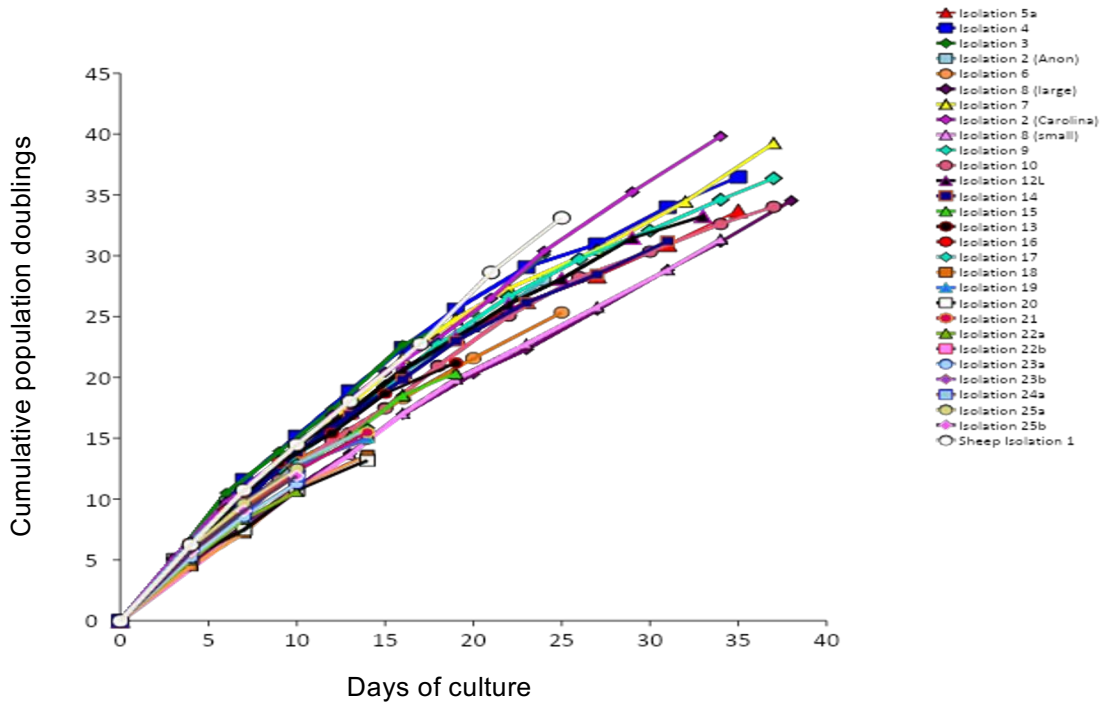
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Stemness and Isolation - Selecting cells

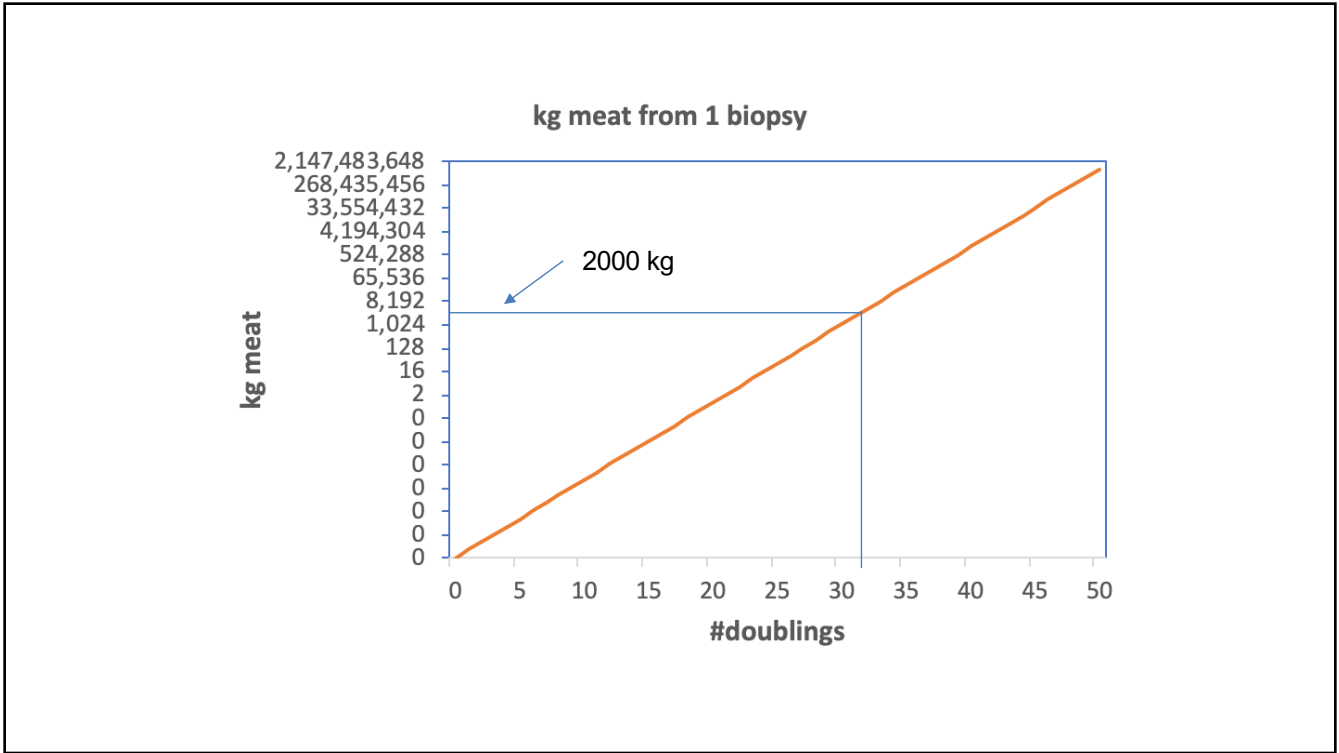


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The many ways to make an iPS Cell

Retroviral or lentiviral transduction

Genomic integration
Tumors in chimeric animals due to ectopic expression of proviral transgenes
Perinatal death of hepatocyte-derived iPS chimera

C **Plasmid transfection**

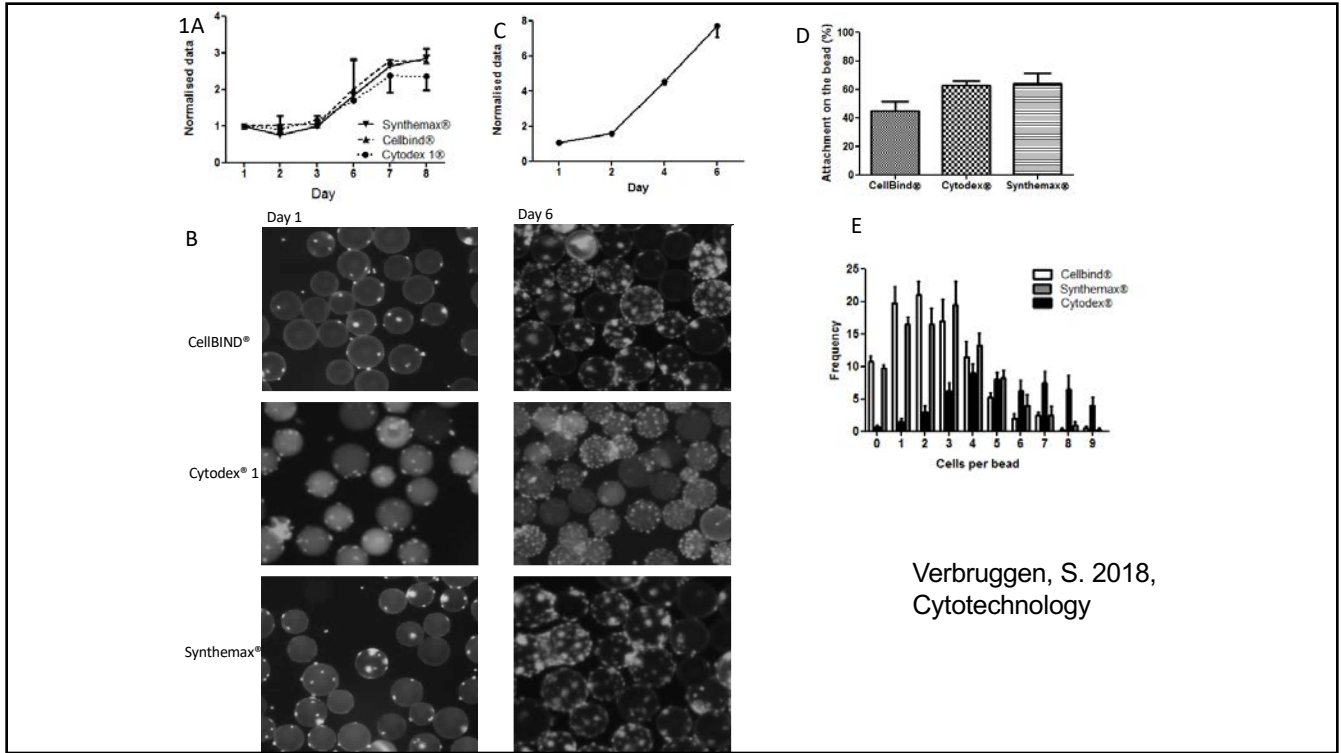
No genomic integration

Future goal is eliminate as many of the K,O,S,M factors as possible and replace them with small molecules

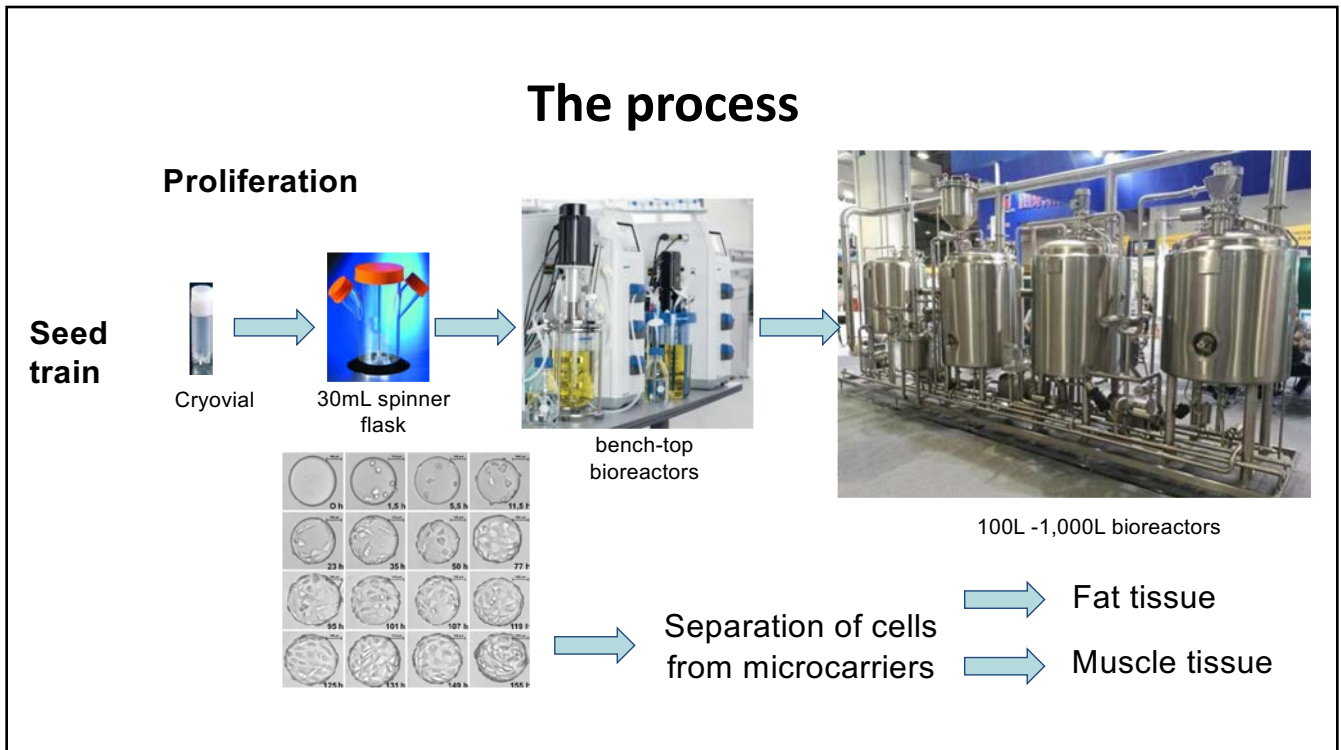
Optimized inducible Overexpression (OPTi-OX)

Kotter, Stem Cell Rep. 2017;8:803

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Farm level



1 farm = 3,5 m³

4 X 1.000 L

The Netherlands: 5000 farms with cattle for meat
1 x 10⁶ cows
250 cows / farm

1 cow → 400 g / day = 150 kg / yr

1 average (Dutch) farm produces 35 tn / year



Pictures and data:
Mosa Meat; CBS-Statline; Valkversmarkt.nl; GE Life Sciences

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Required production volume

For 10% world
consumption
(30 x 10⁶ t/y):

- 2 x 10⁶ m³ bioreactor volume
- 20.000 x 100 m³ bioreactors

How ?

For TOTAL world
consumption
(300 x 10⁶ t/y):

- 20 x 10⁶ m³ bioreactor volume
- 1,5 x total world fermentation capacity

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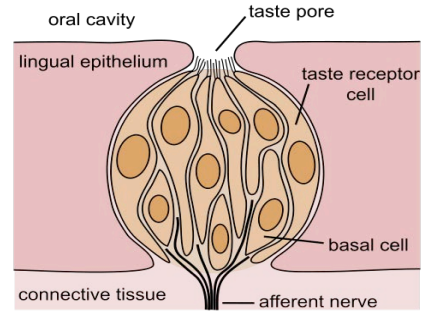
MIMICRY



color

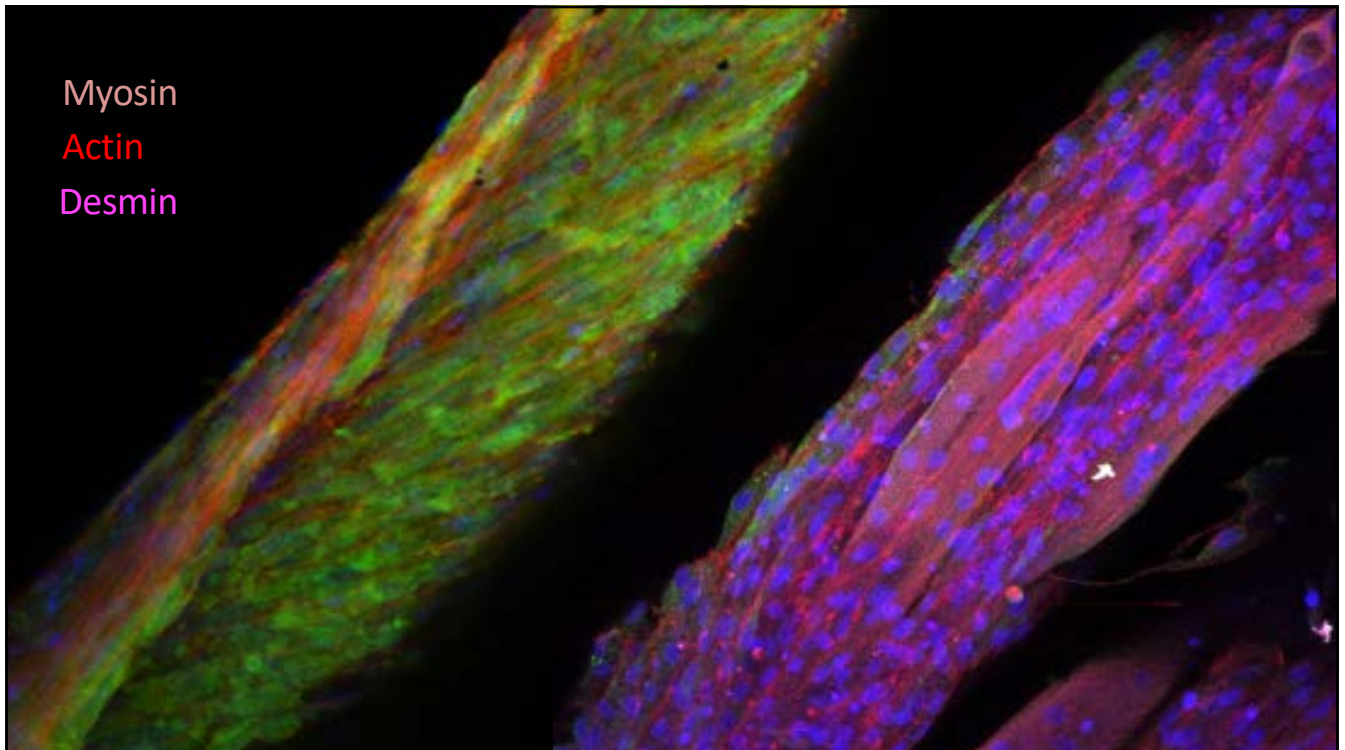


texture



taste

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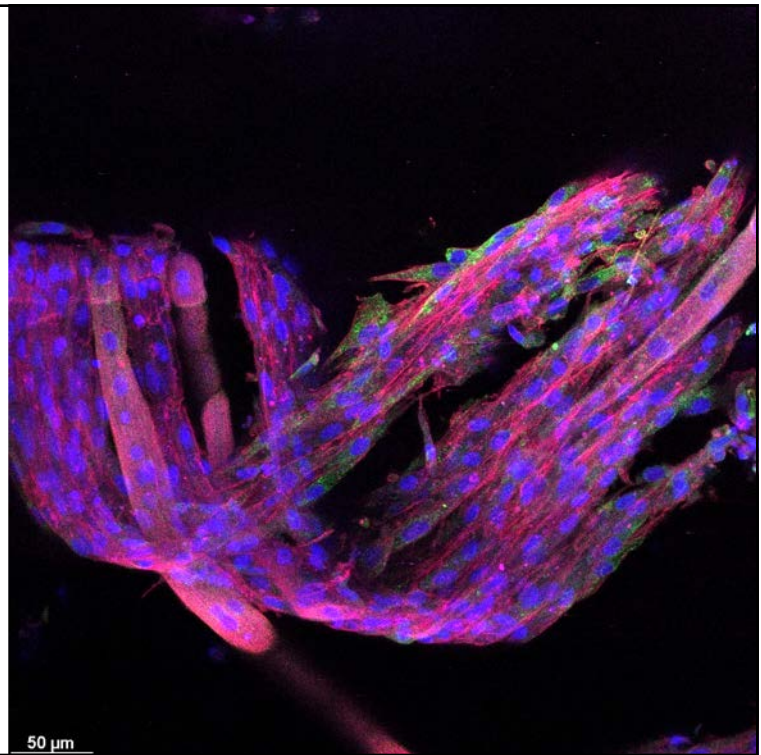
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Laminin-based BAMs

Robust differentiation in 3D shown by myotubes throughout the construct.

Animal-free gel system.

High expression of desmin (pink).

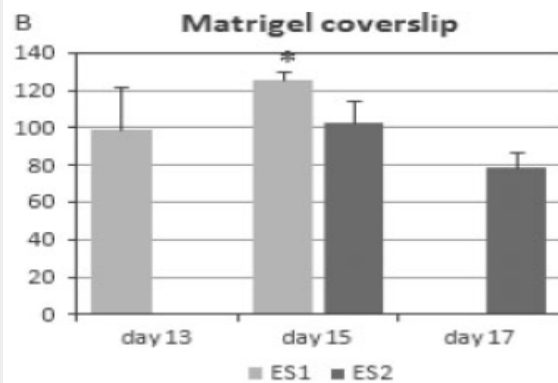


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Electrically stimulated muscle



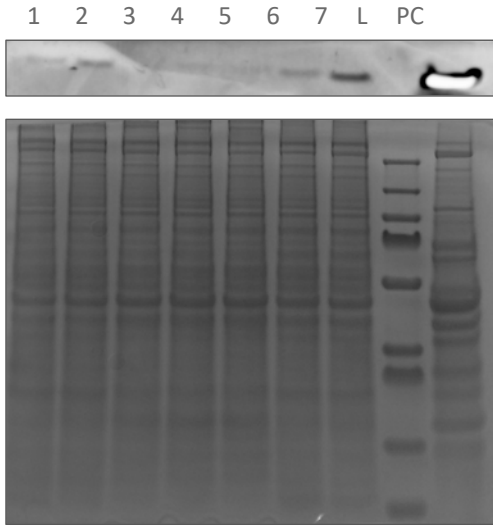
% increase α -actinin + cross striations



Boonen et al., J Tissue Eng Regen Med 2011; 5: 60–68.

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Myoglobin expression is induced during muscle differentiation in 2D tissue

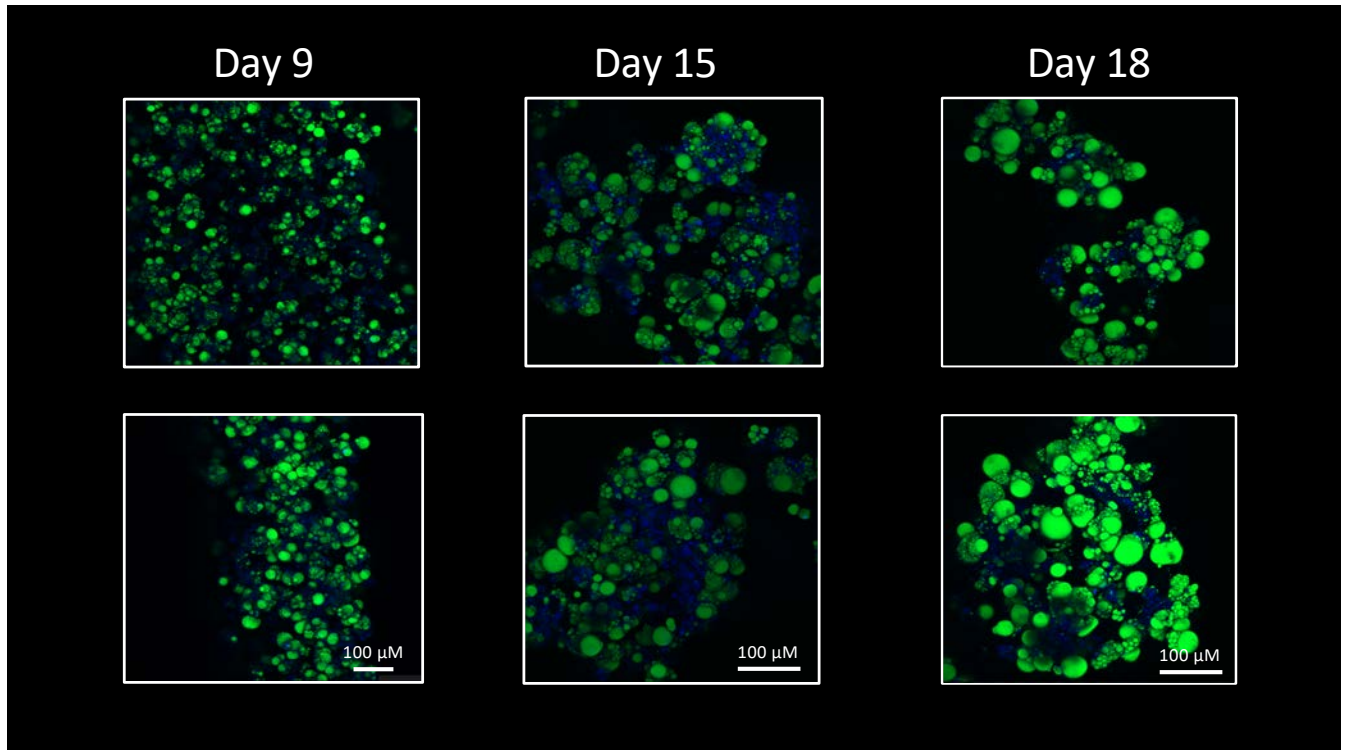


- 1 Iso 16-LG-D7
- 2 Iso 9-LG-D7
- 3 Iso 19-LG-D4
- 4 Iso 19-LG+AA+Ferritin-D4
- 5 Iso 19-LG+AA+FeGluc-D4
- 6 Iso 12-HG-D4-normoxia
- 7 Iso 12-HG-D4-hypoxia

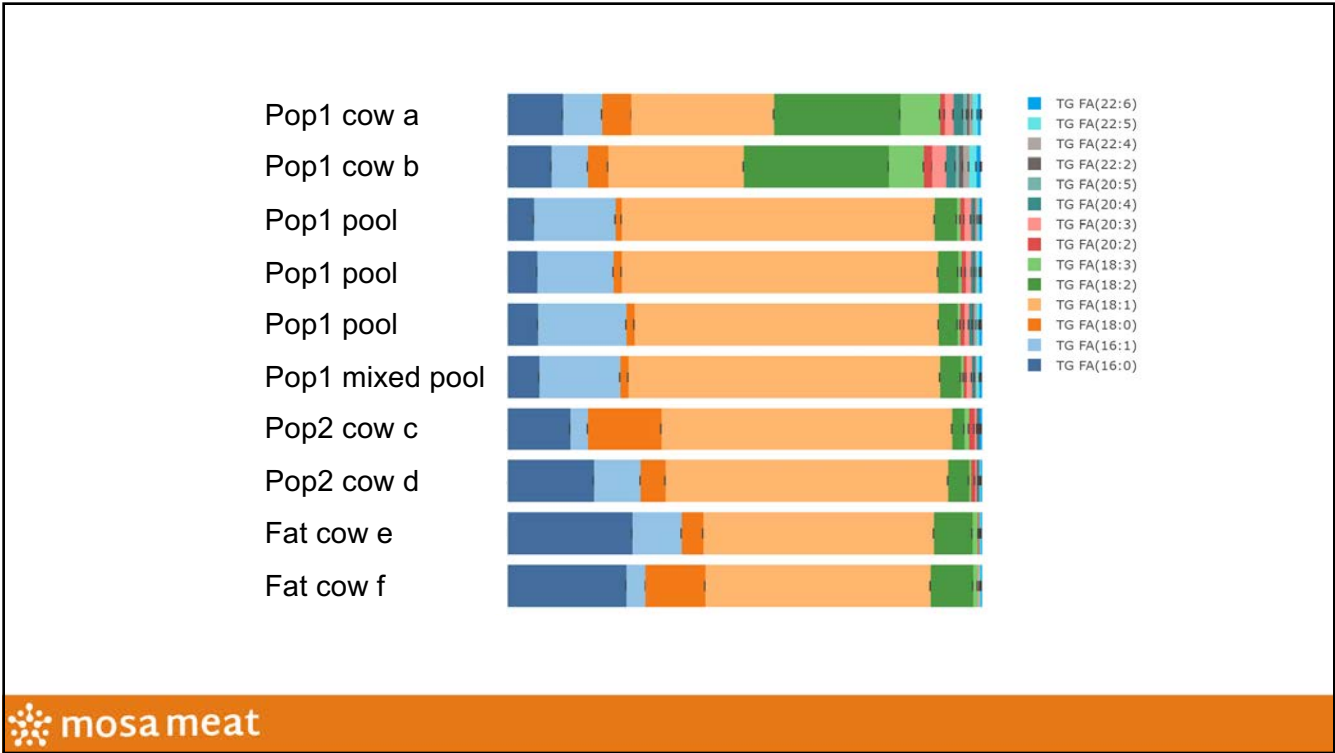
- L Protein ladder
- PC Meat positive control

A) Western blot showing the protein expression of myoglobin.
 B) Coomassie stained gel corresponding to the samples shown in A).

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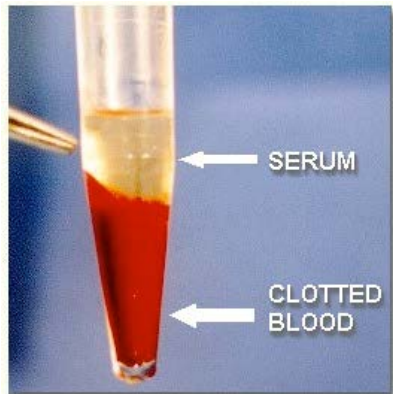
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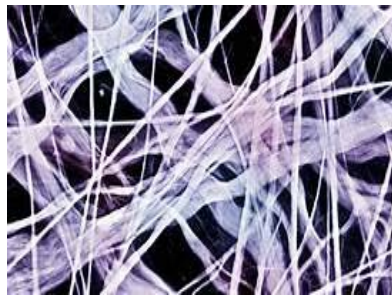
mosa meat

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SUSTAINABILITY



serum



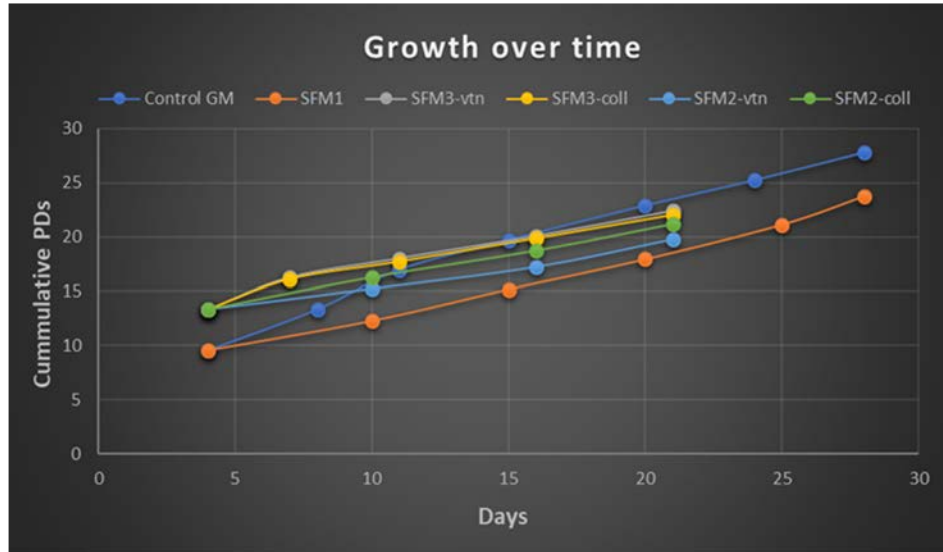
collagen



recycle

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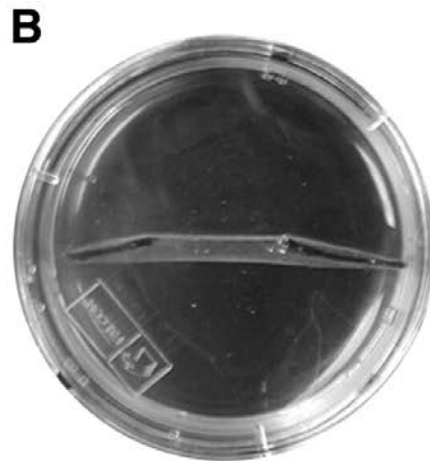
Comparable growth performances achieved in SFM



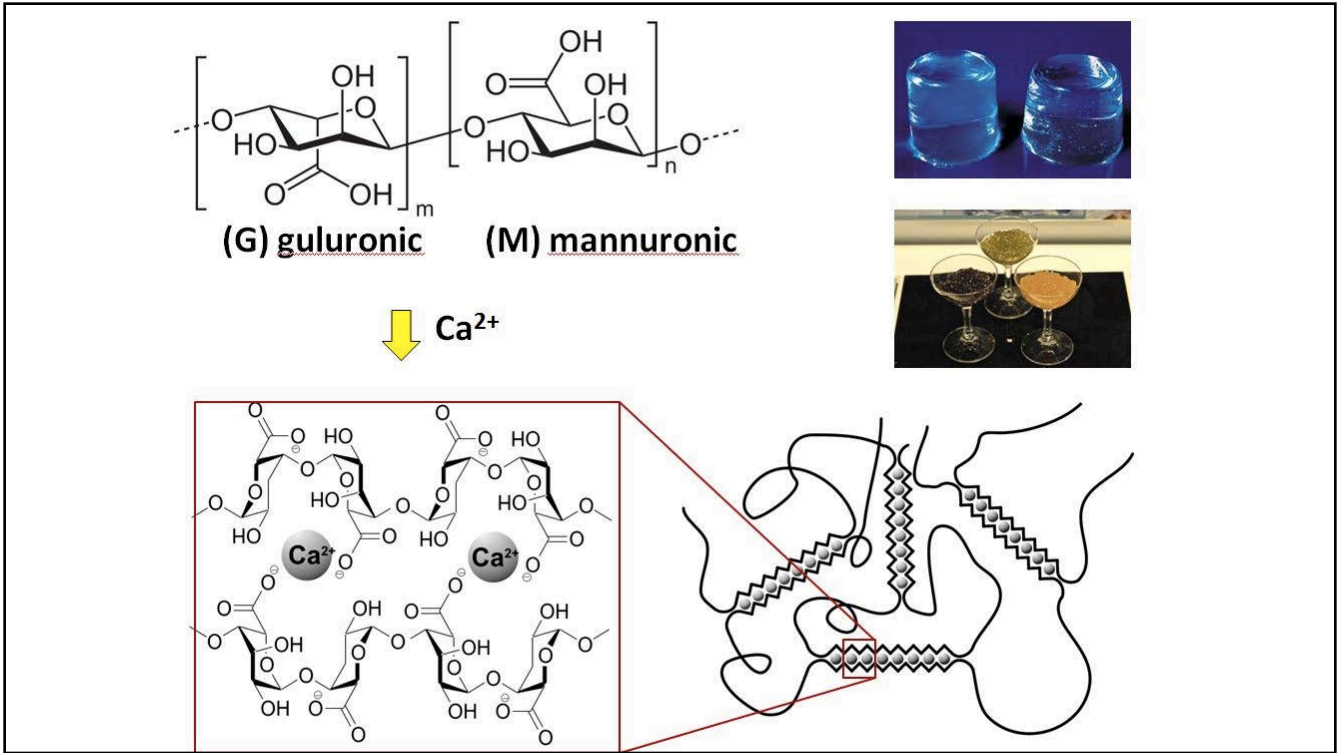
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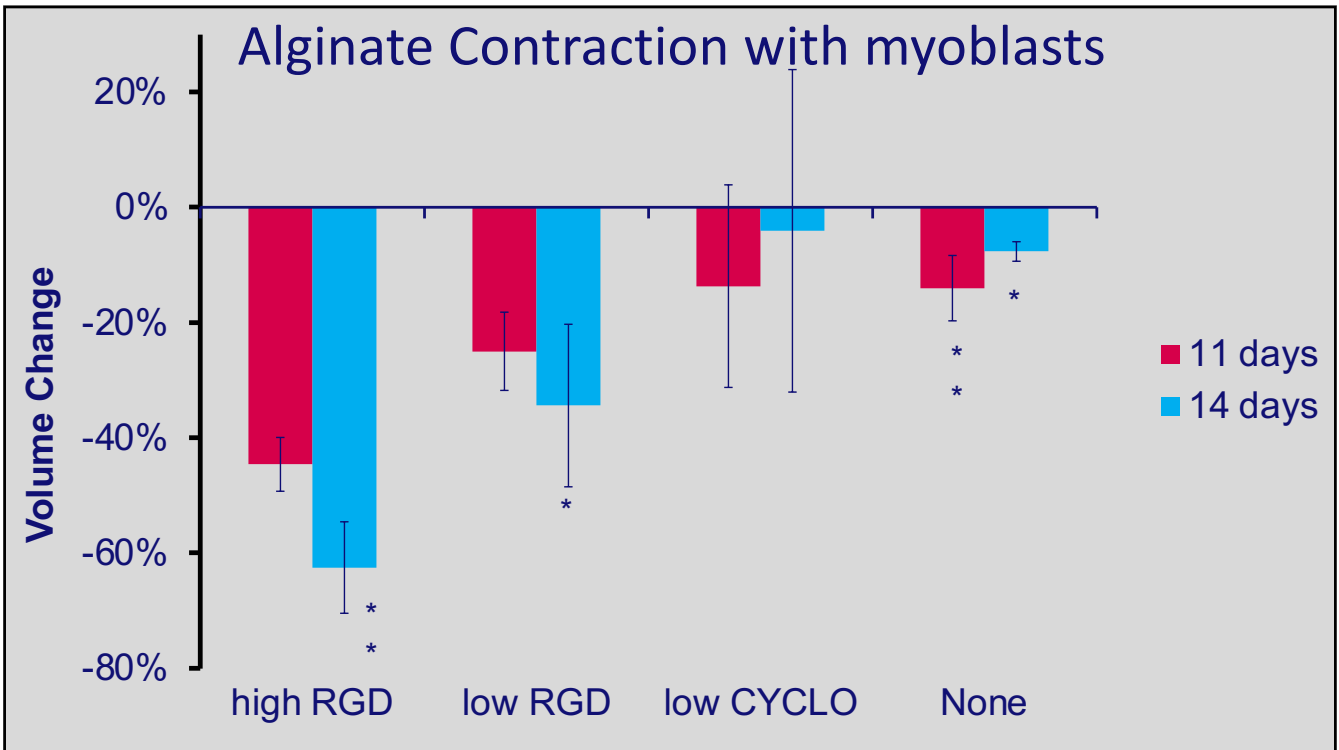
sustainability: gel contraction



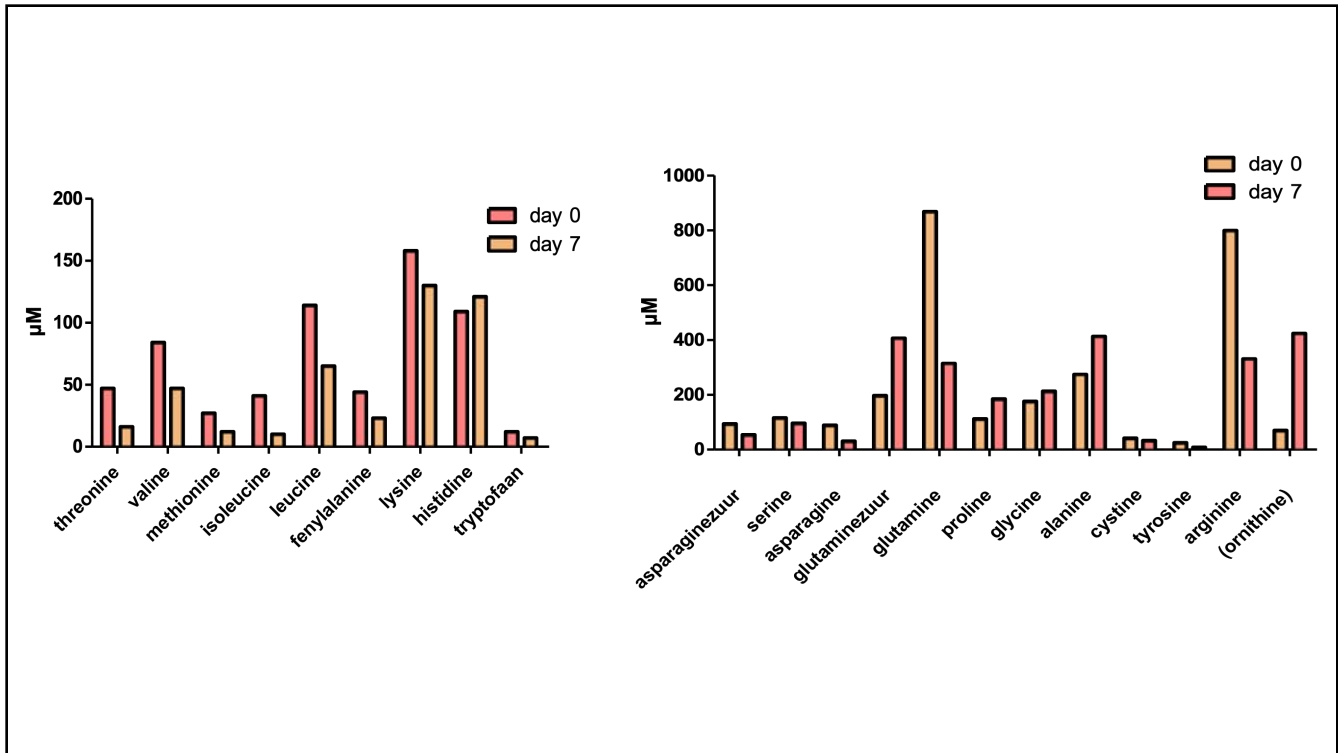
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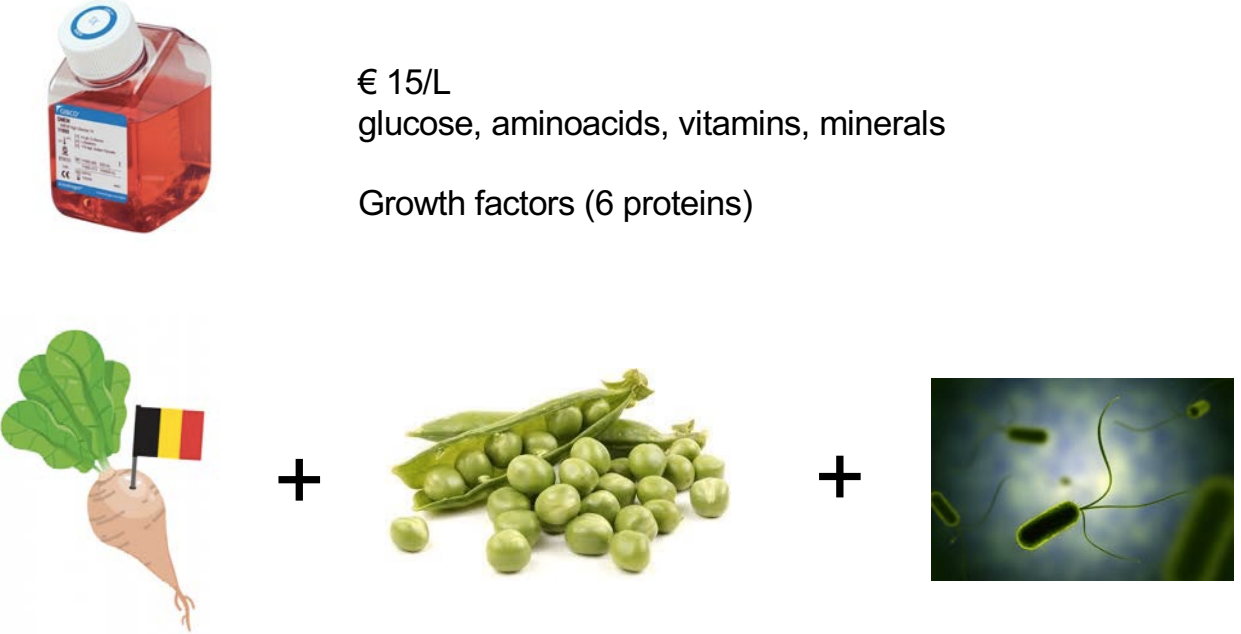
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	90%	recovery plates						
	85%	recovery µcarriers						
overall yield	59%	stop @ 25,000L						
	1.00E+10	cells/kg meat						
							w/o recycling	w recycling
	sample prep	growth	harvest	cleaning	tissue formation	medium recycling	total cost/kg	total cost/kg
consumables (FBS)	€26.80	€707,318	€1,461		€14,146	-€360,732.25	€722,953	€362,220
consumables (if GFs)	€26.80	€142,283	€1,461		€2,846	-€72,564.11	€146,616	€74,052
consumables (if GFI)	€26.80	€4,526	€1,461		€91	-€2,308.38	€6,105	€3,797
scaffolding material					€300		€300	€300
energy		€96		€9			€105	€105
labour	€48.00	€751				€751	€799	€1,551
equipment €	€10.00	€1.25			€5.75		€17	€17
total cost (if GFI)							€7,326	€5,769
total cost/kg							€175.57	€138.25

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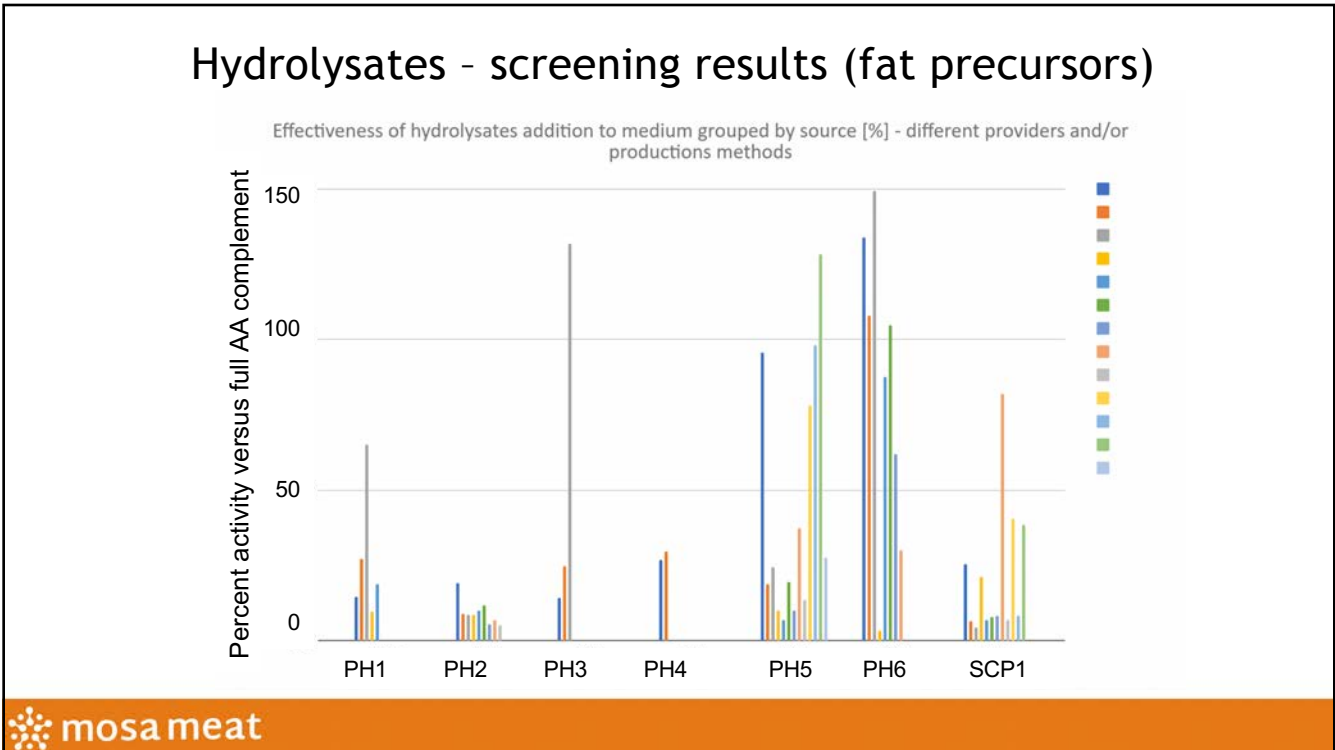


€ 15/L
glucose, aminoacids, vitamins, minerals
Growth factors (6 proteins)

+

+

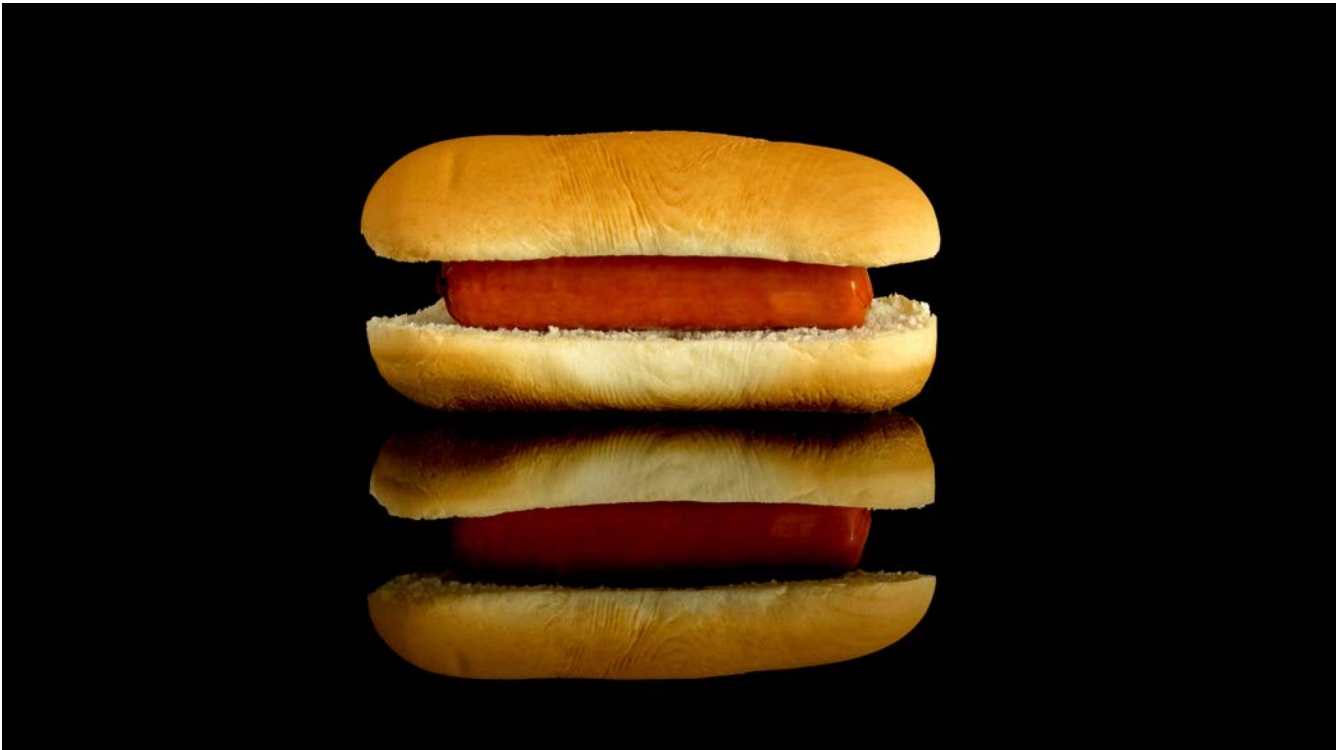
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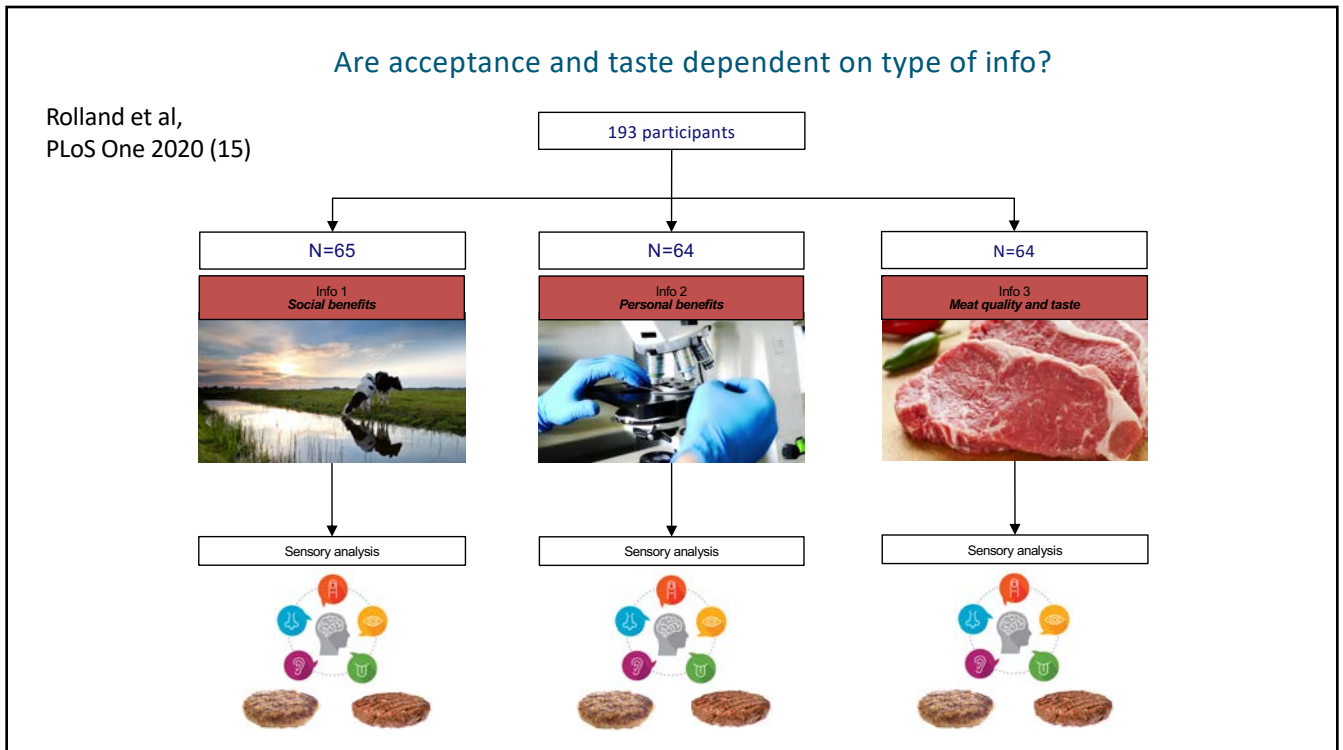
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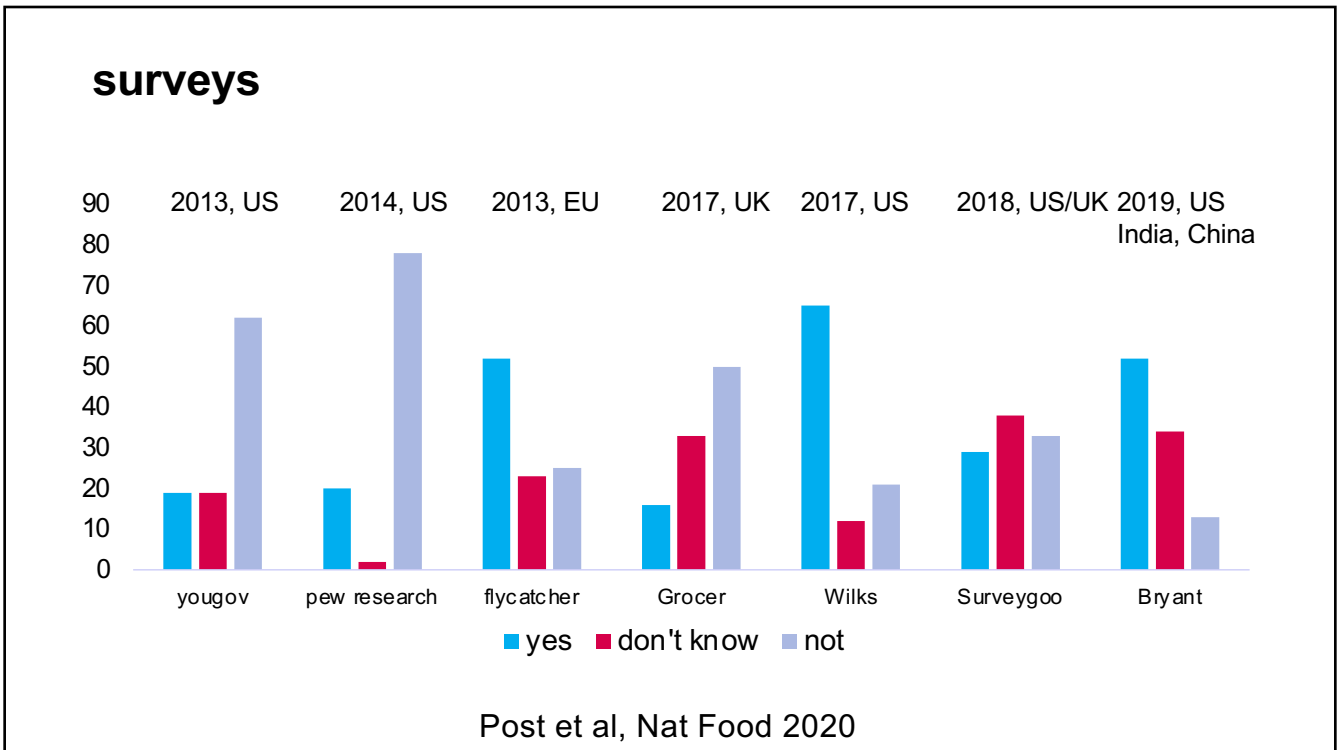
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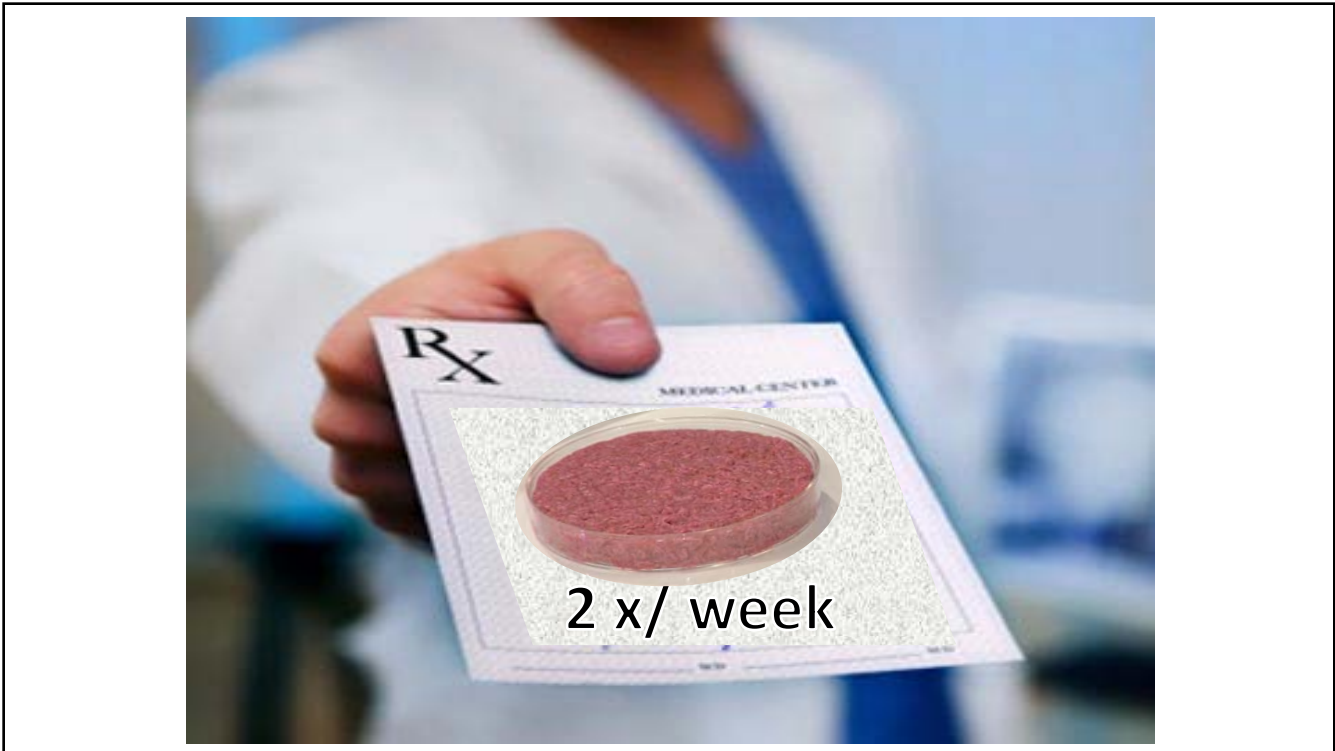
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Take home

- Worth pursuing, high likelihood of success
- Fat production is necessary for taste and texture and is possible with food compatible methods
- Scale up or scale out is a formidable task
- Cost effectiveness is function of technology, recycling, feedstock selection
- Regulatory approval is required

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