

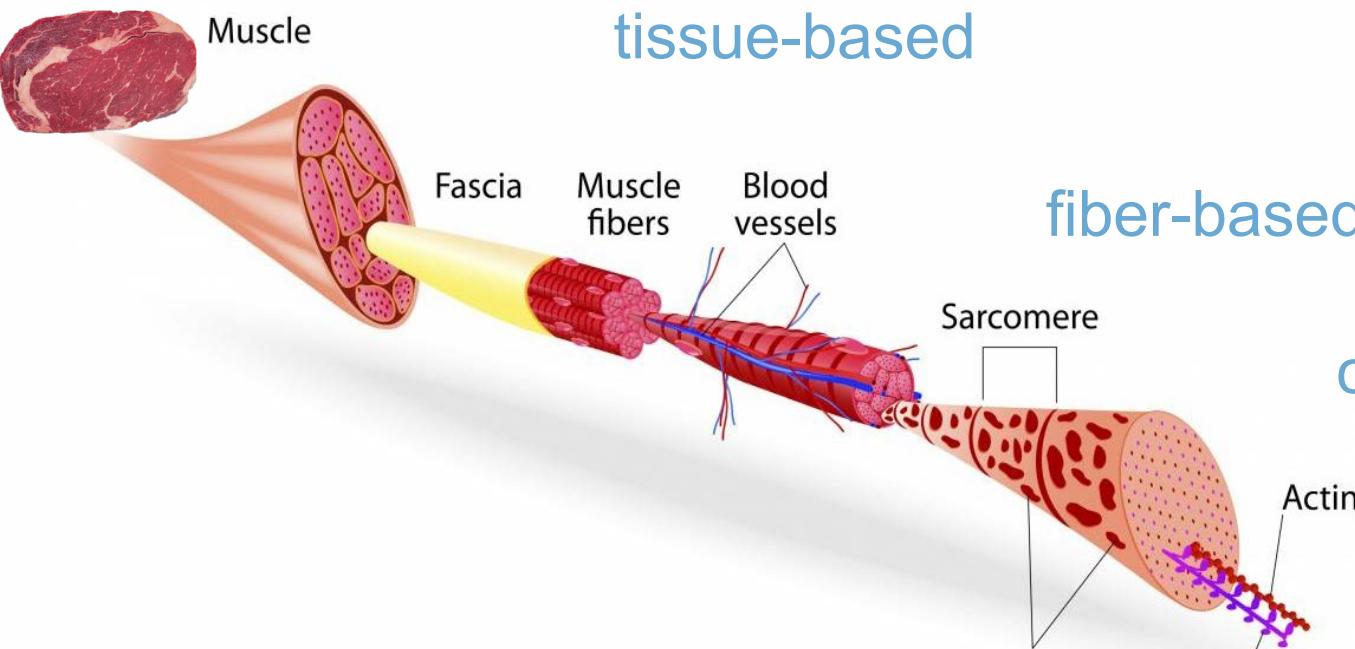
3D culture of muscle and fat cells to grow meat: current state of the art

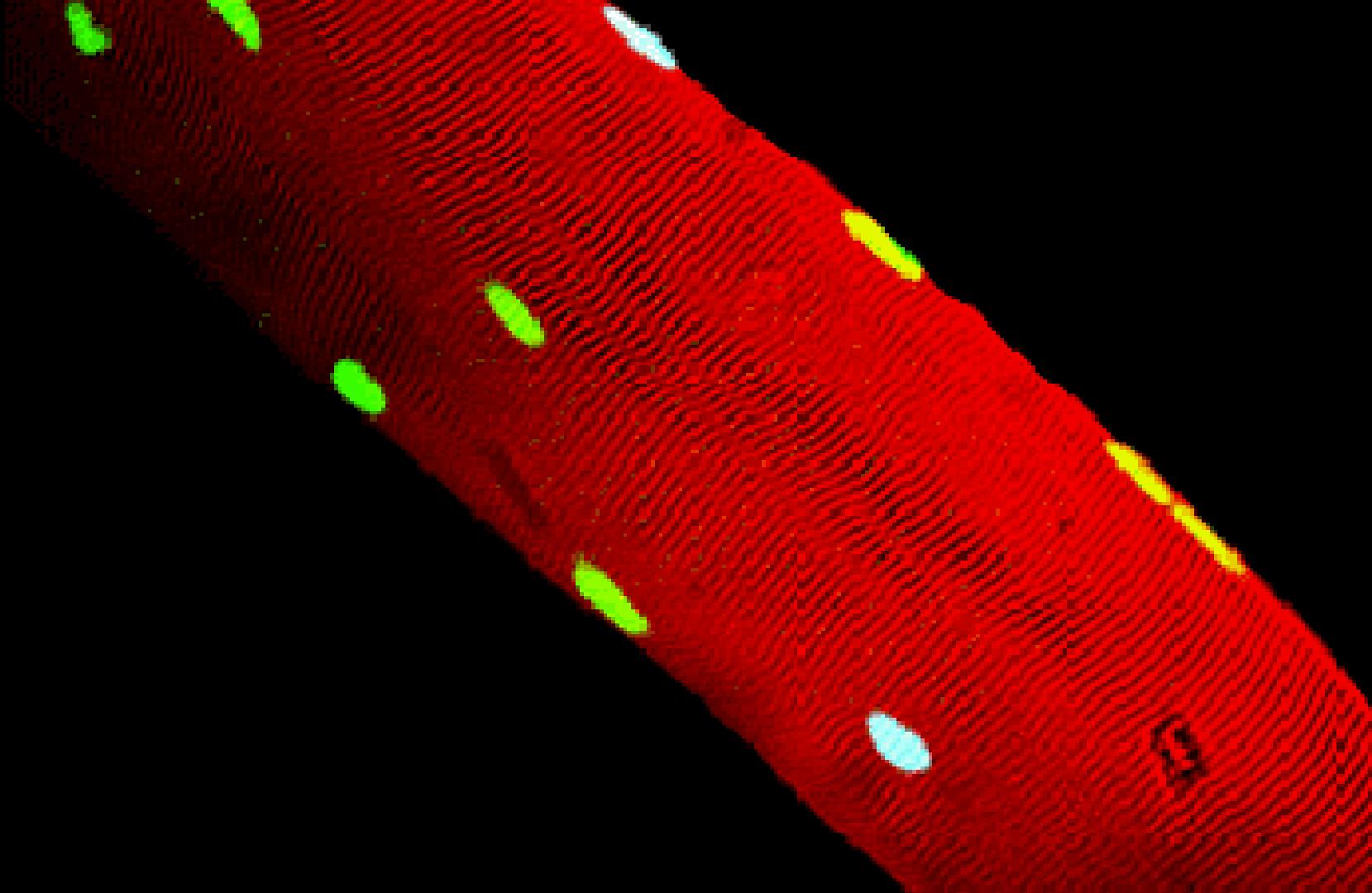


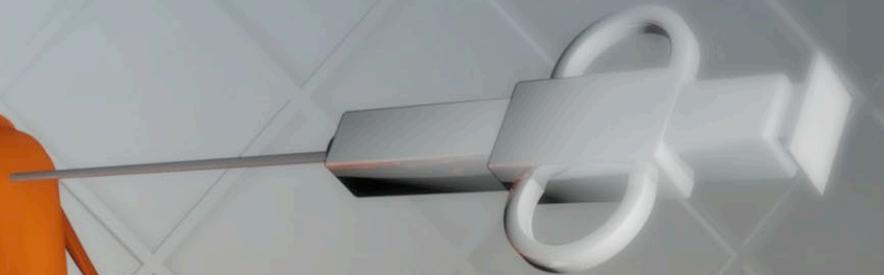
Mark Post, Maastricht University
CSO MosaMeat, B.V.
@MarkPost6

ICOMST, 2019

diverging approaches

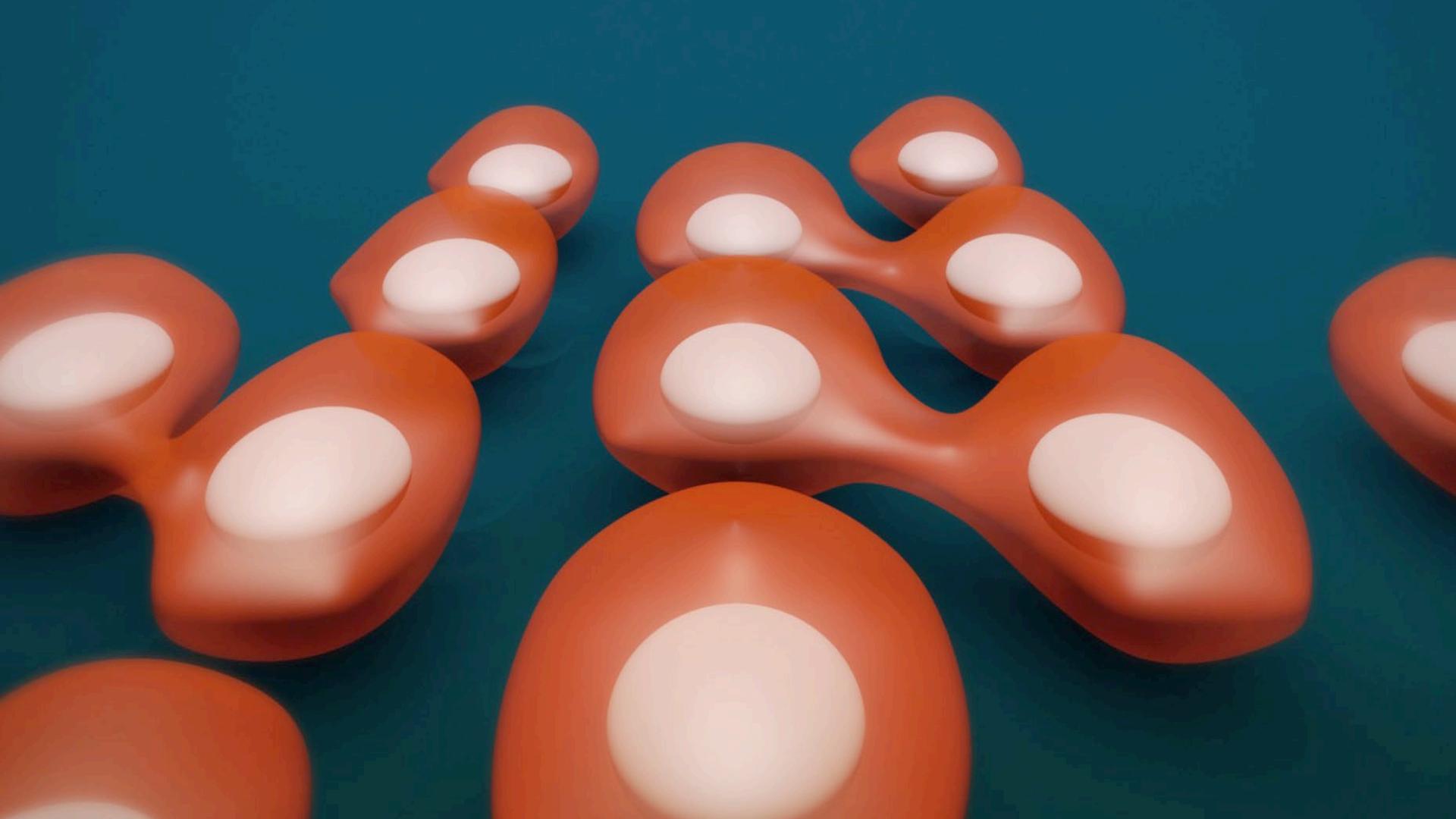




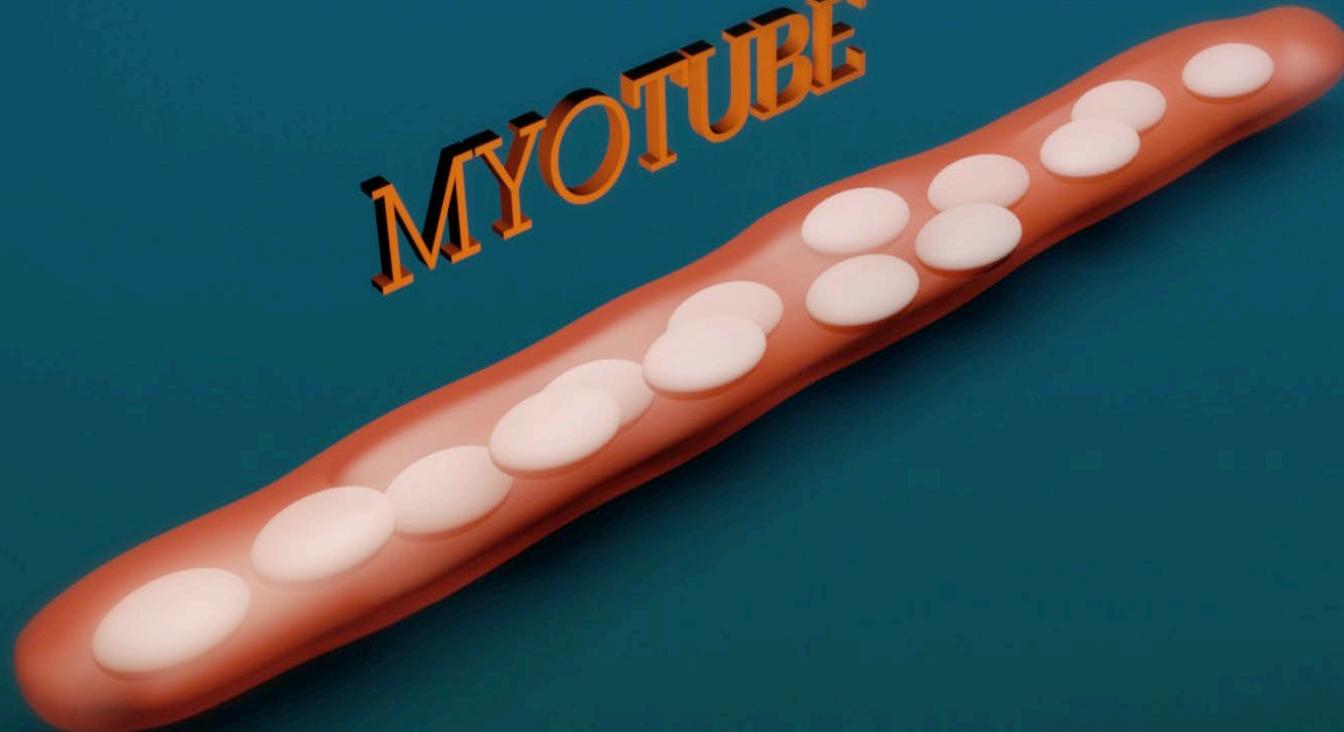




B I O P S Y



MYOTUBE



3 weeks

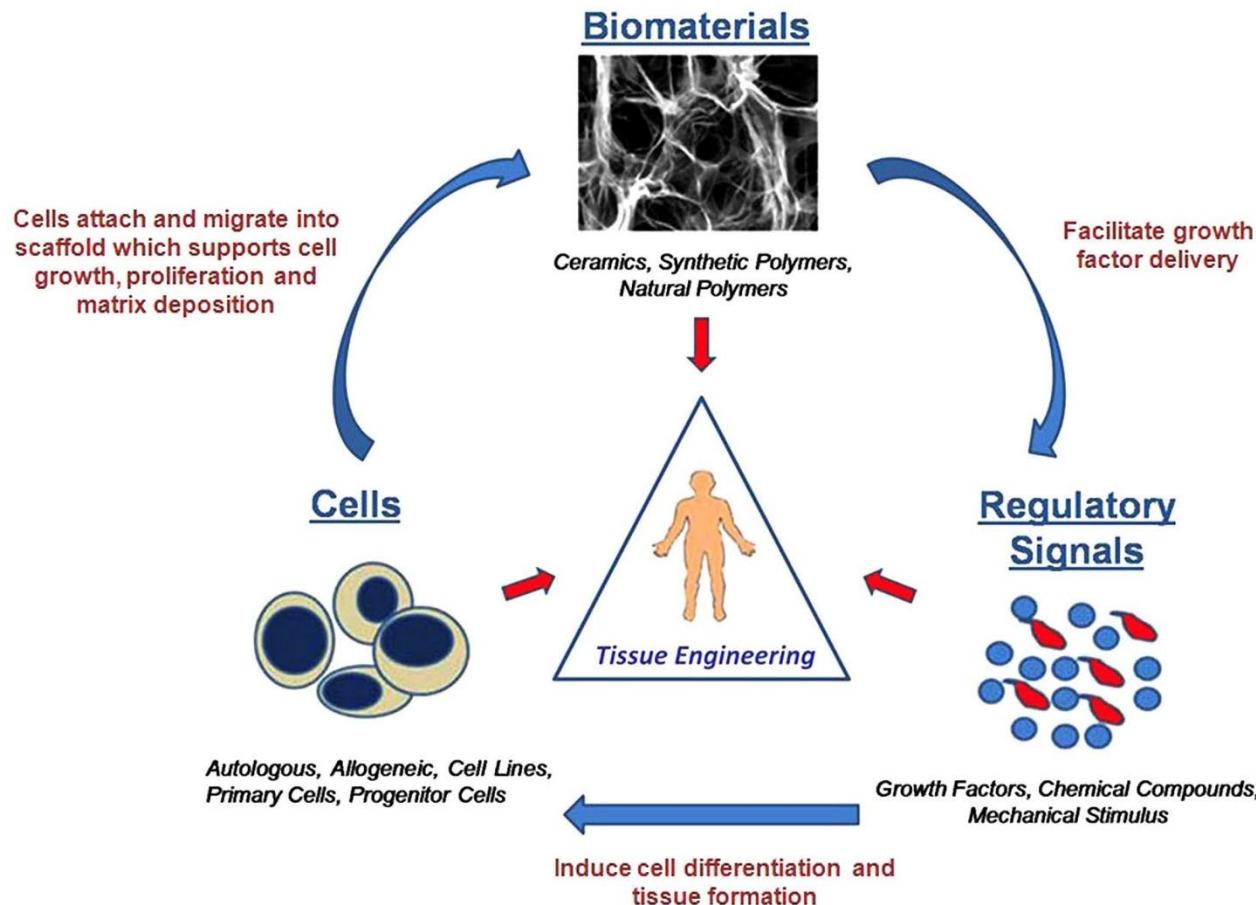




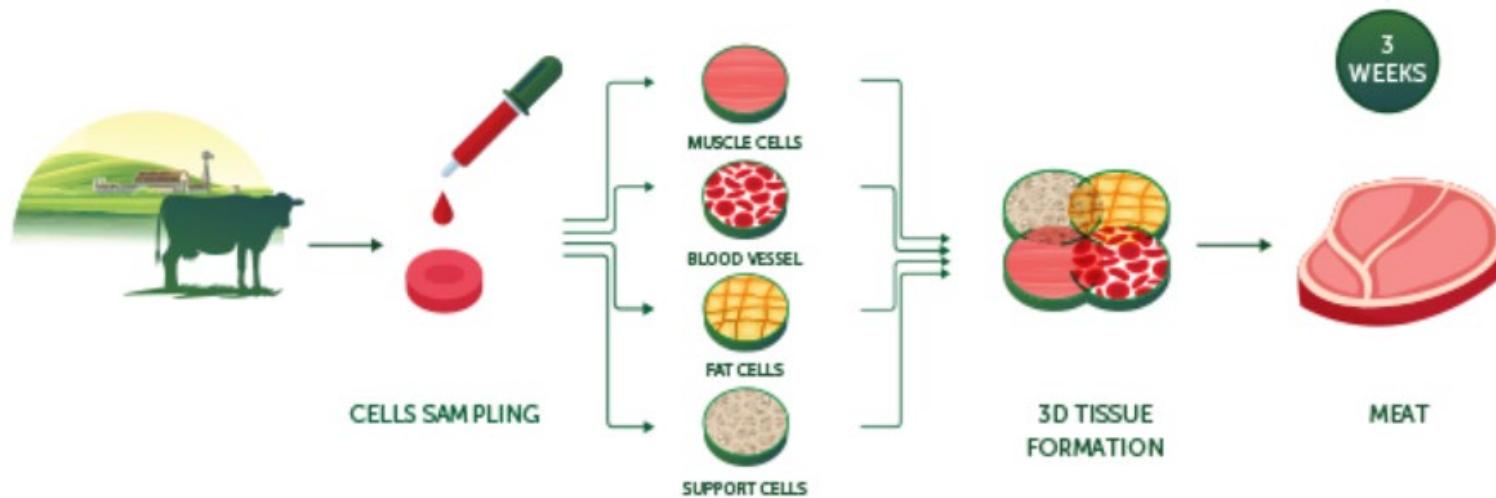


General tissue engineering principle

Murphy, *Eur Cell and Mat*, 2013



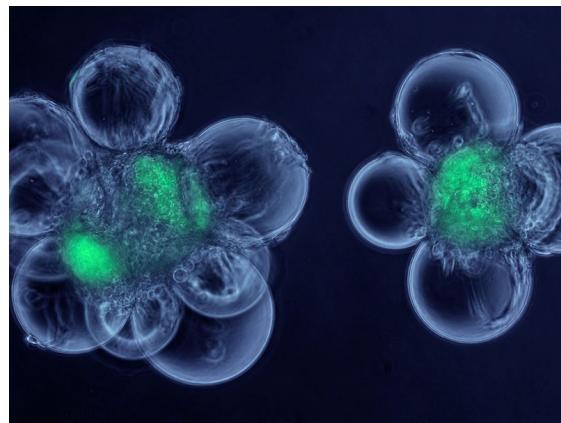
Tissue engineering for steaks: Aleph



EFFICIENCY



culture
conditions

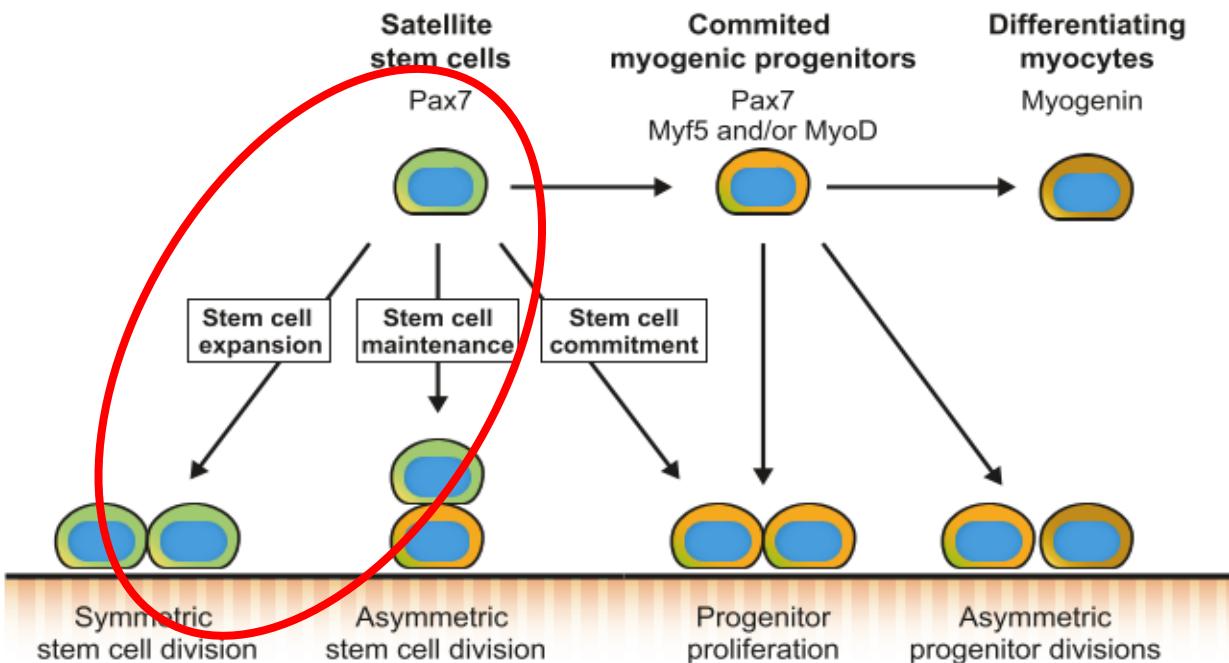


cell
selection



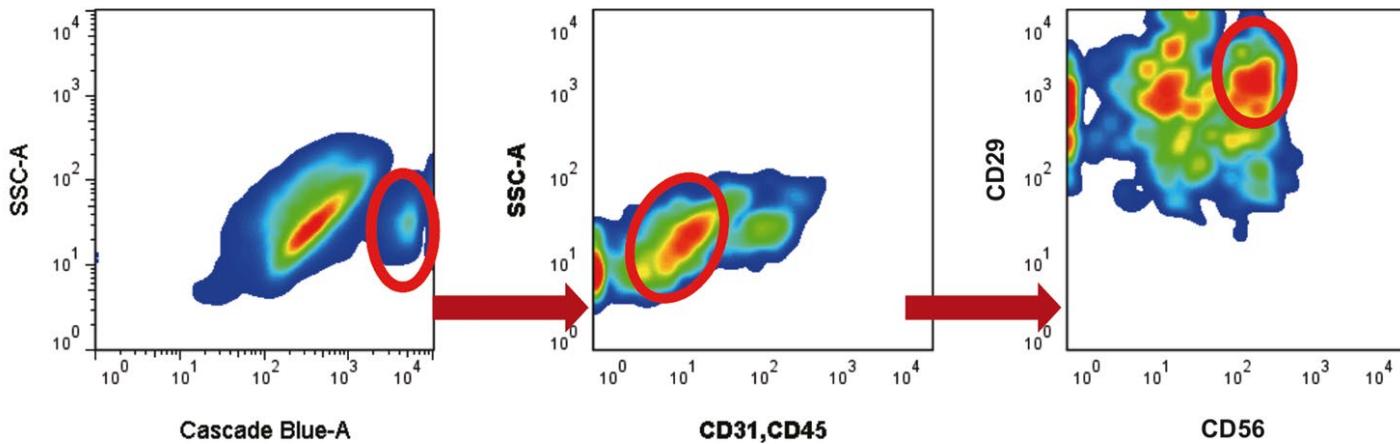
scale up

How to keep the stemness of bovine satellite cells?

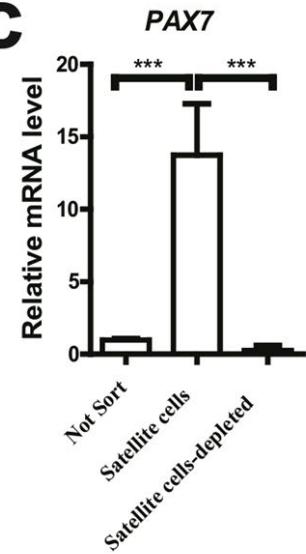


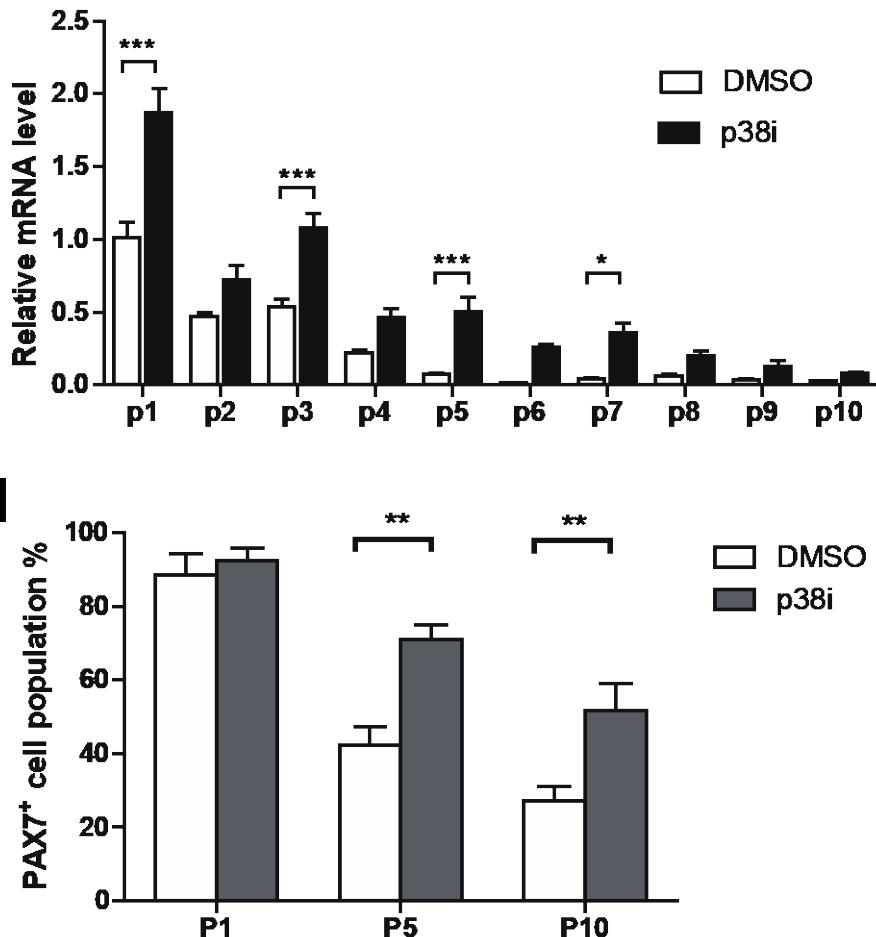
Cell selection

b

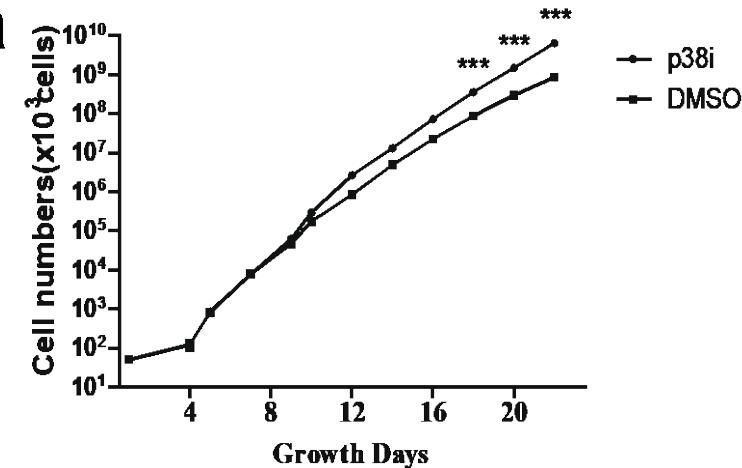
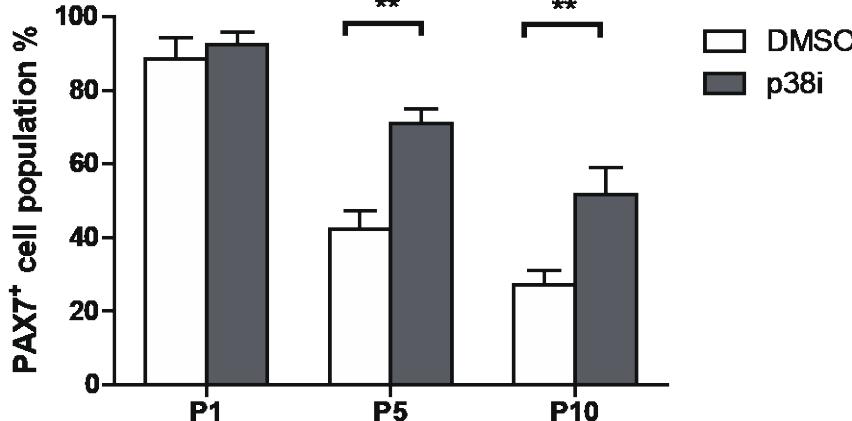


C



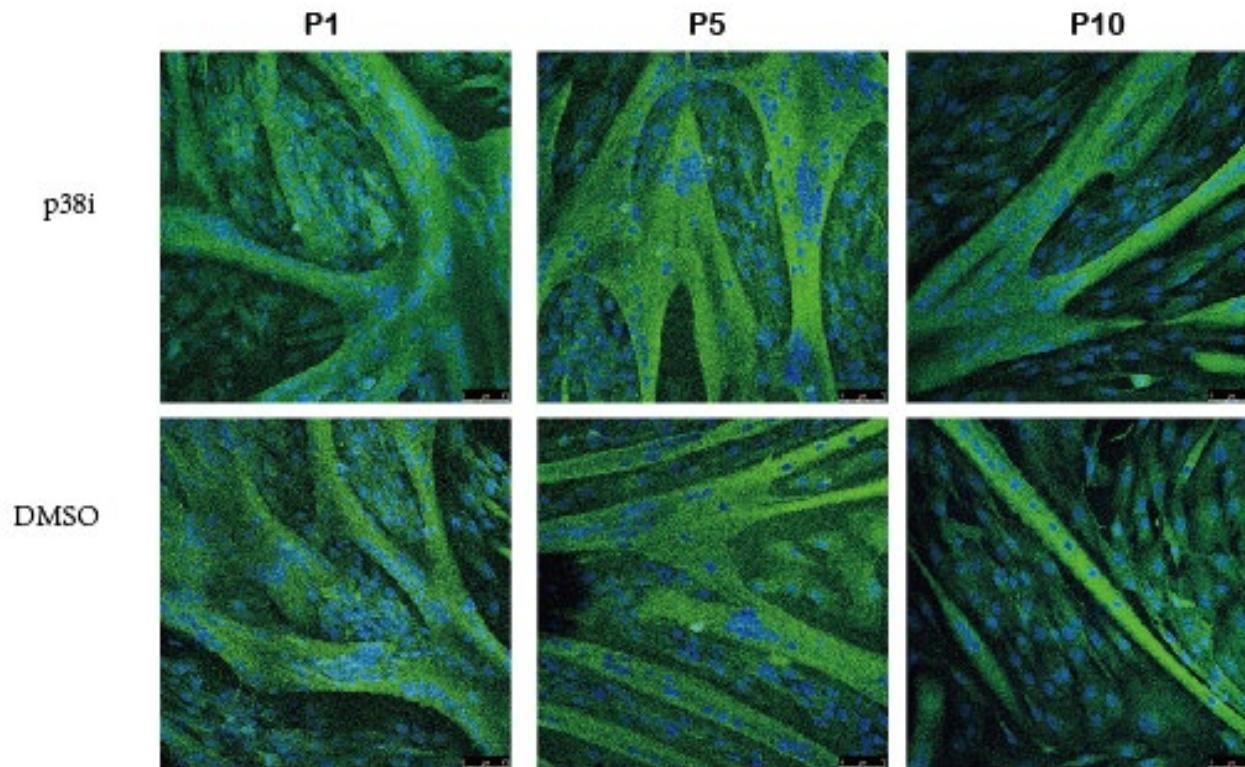
C**PAX7**

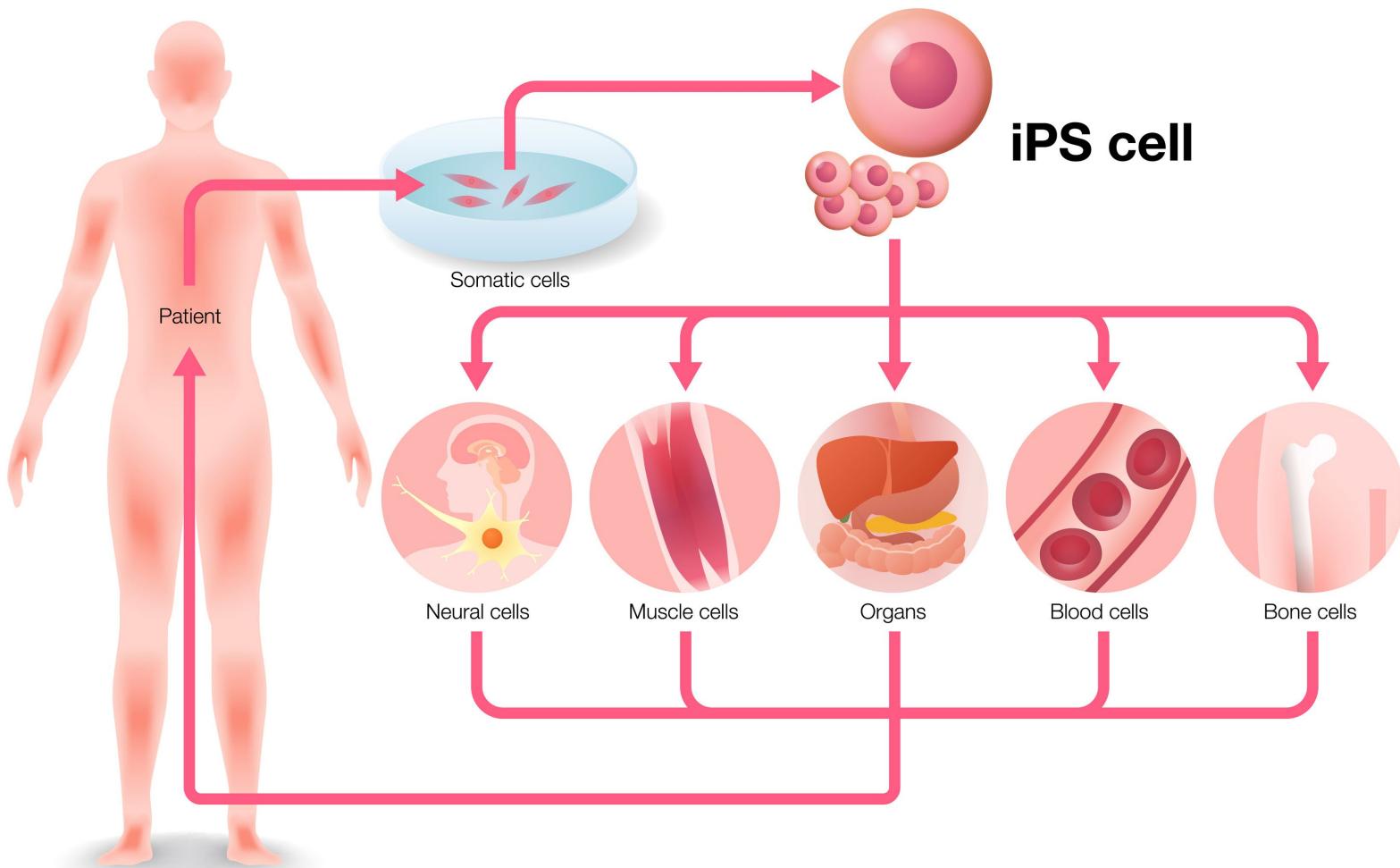
Ding et al, Sci Rep 2018

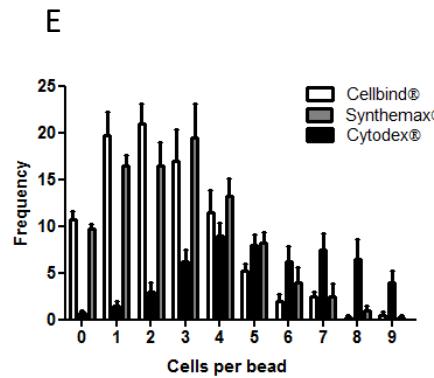
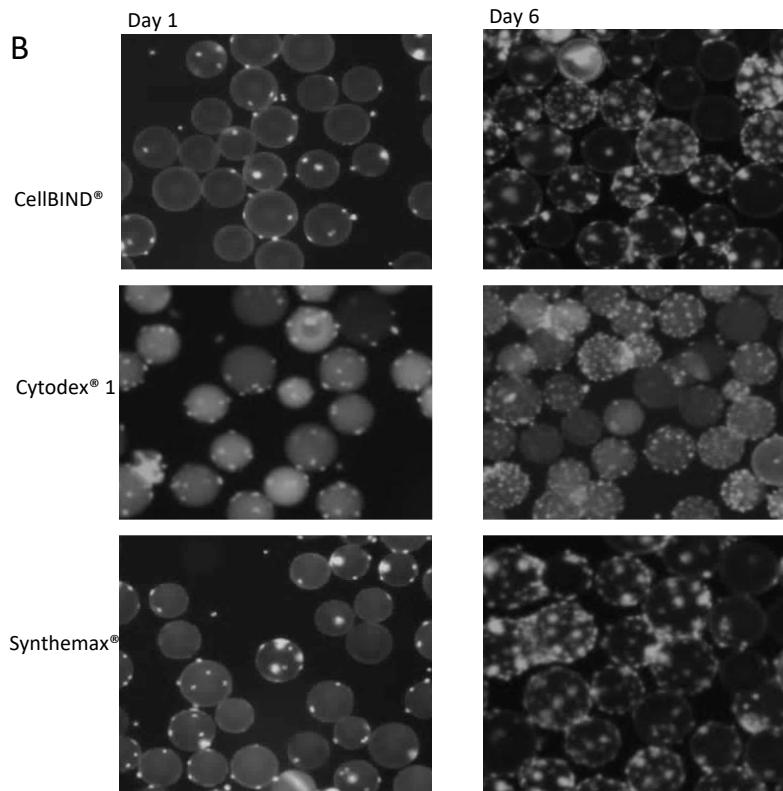
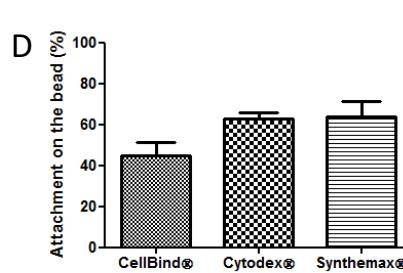
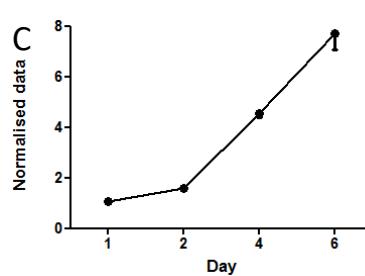
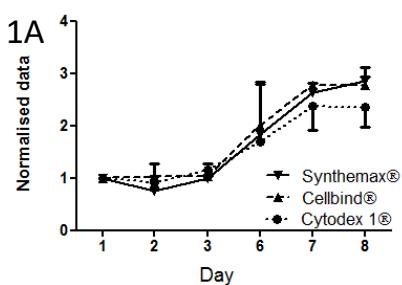
a**d**

Ding et al, Sci Rep, 2018

Long-term p38 inhibition maintains differentiation abilities

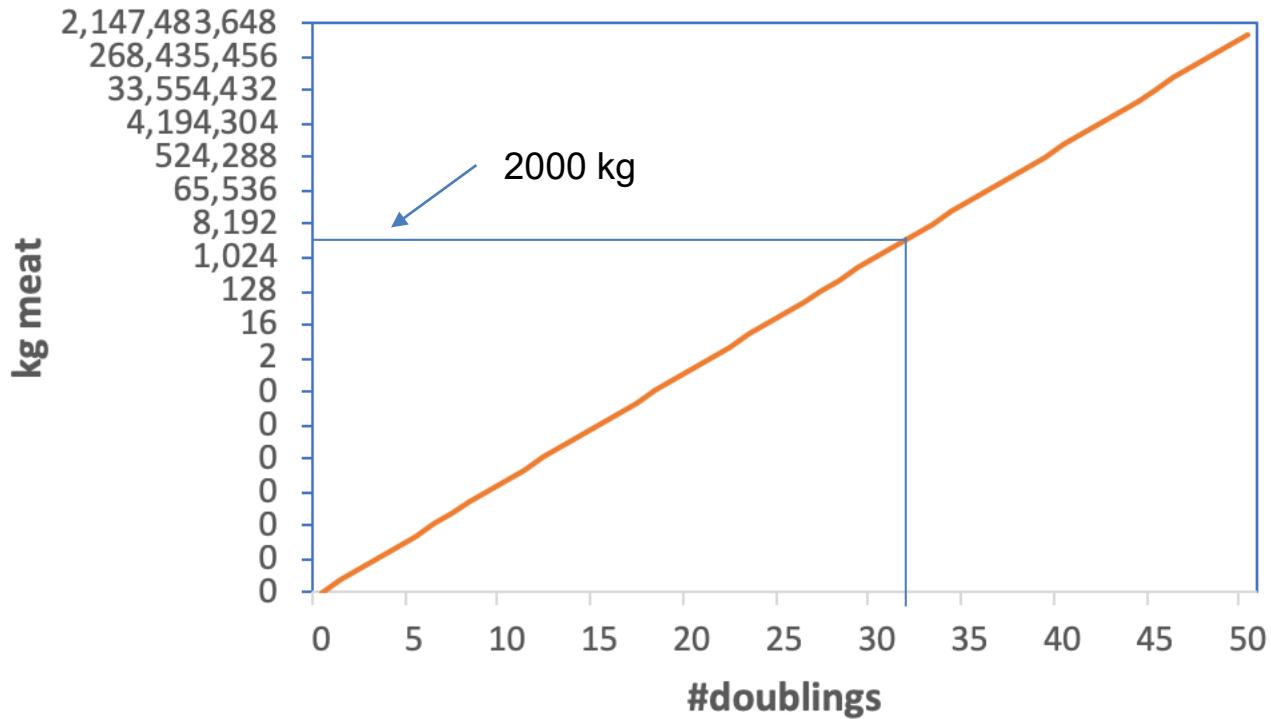




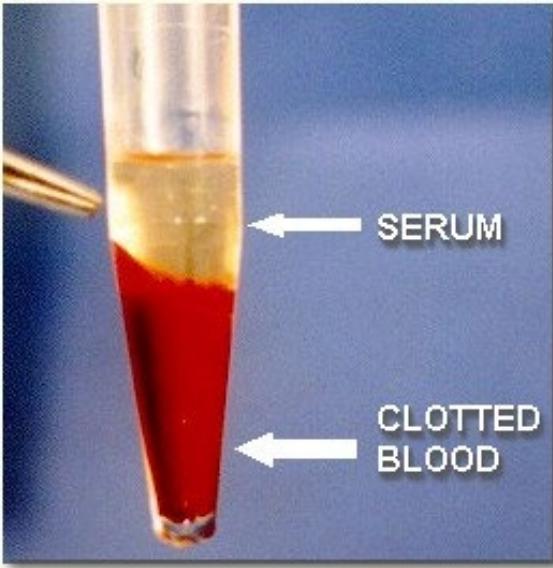


Verbruggen, *Cytotechnology*, 2018

kg meat from 1 biopsy



SUSTAINABILITY



serum

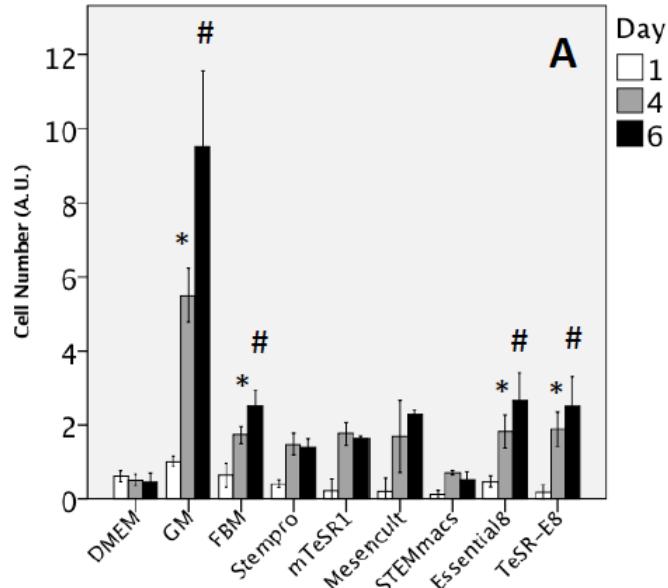
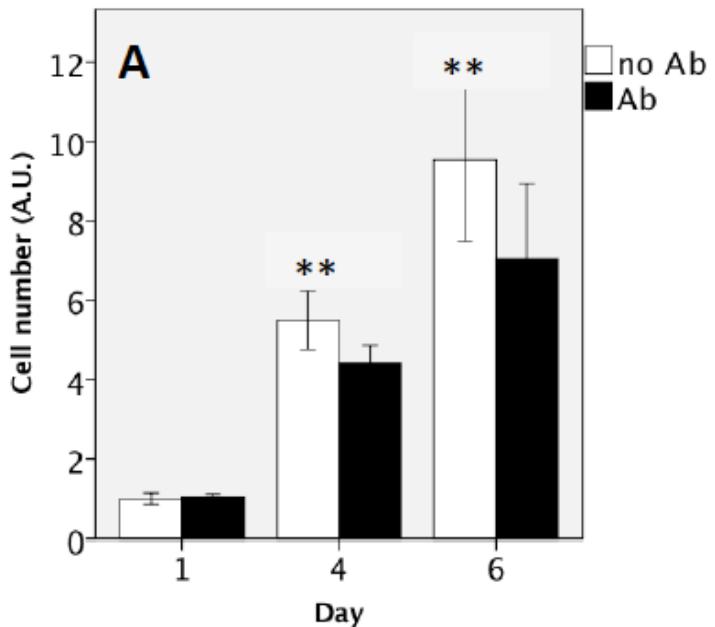


collagen

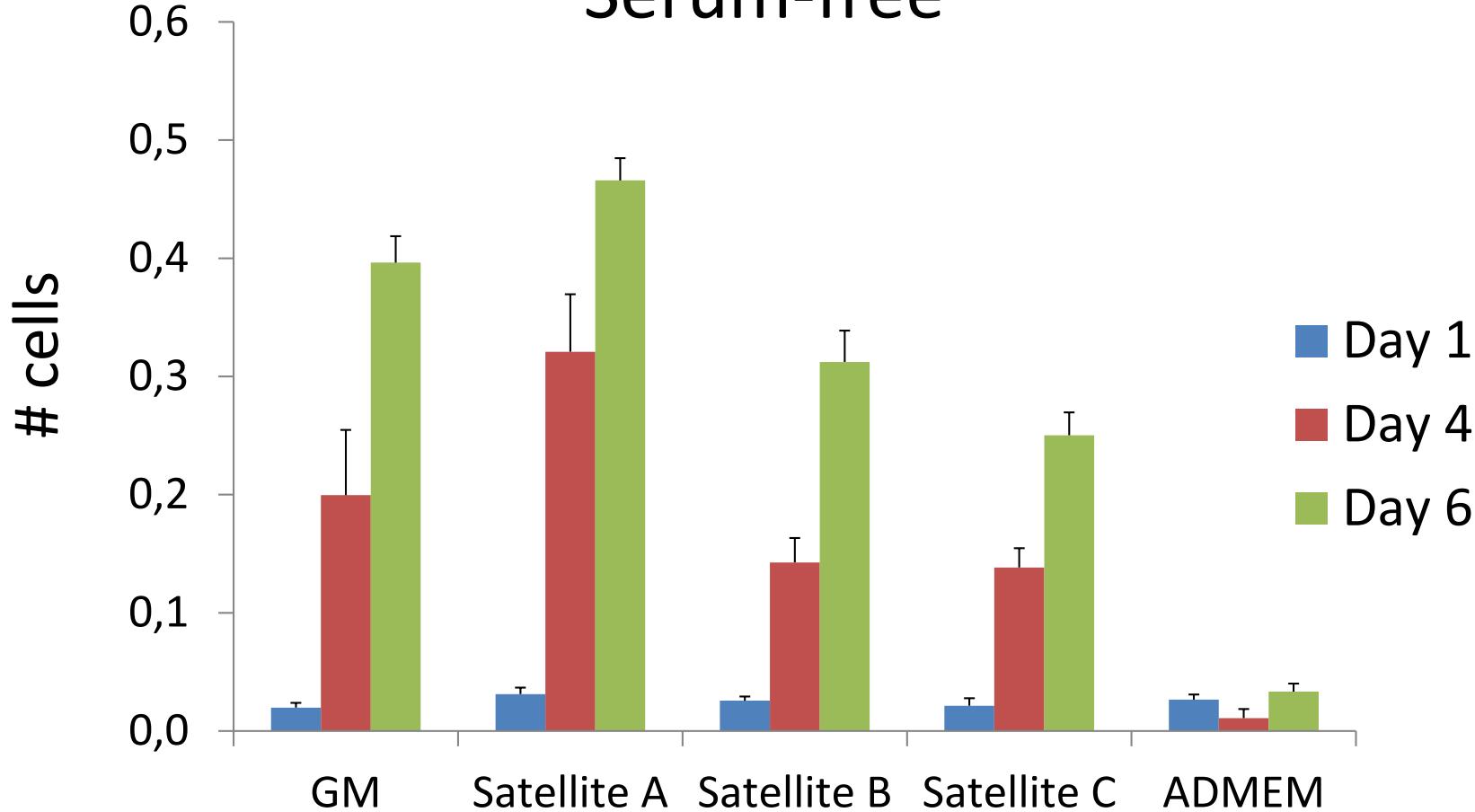


recycle

No serum, no antibiotics



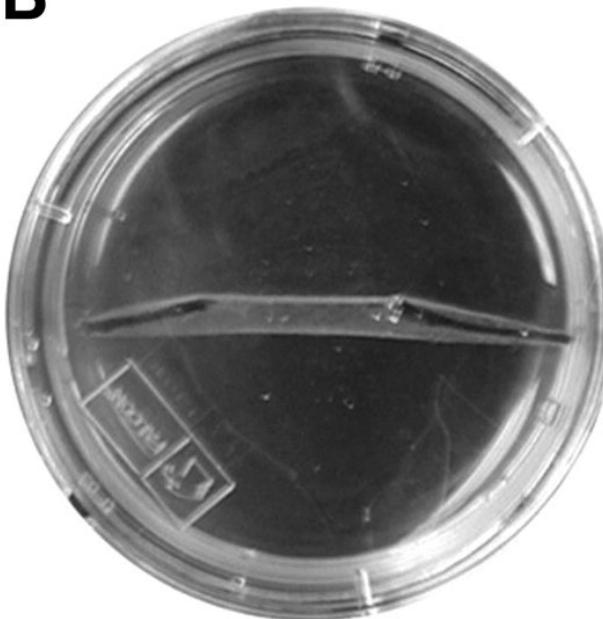
Serum-free

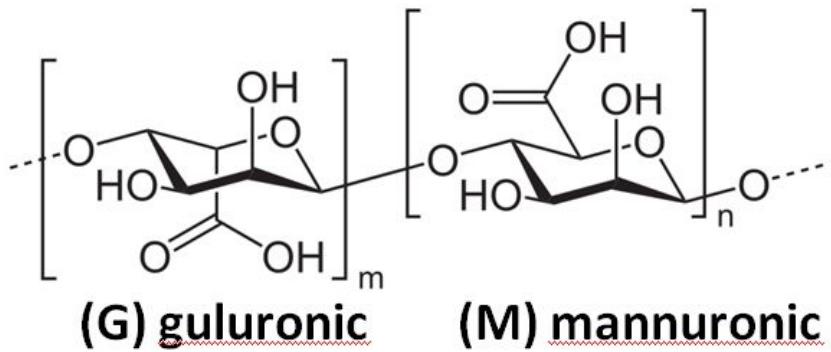


sustainability: gel contraction

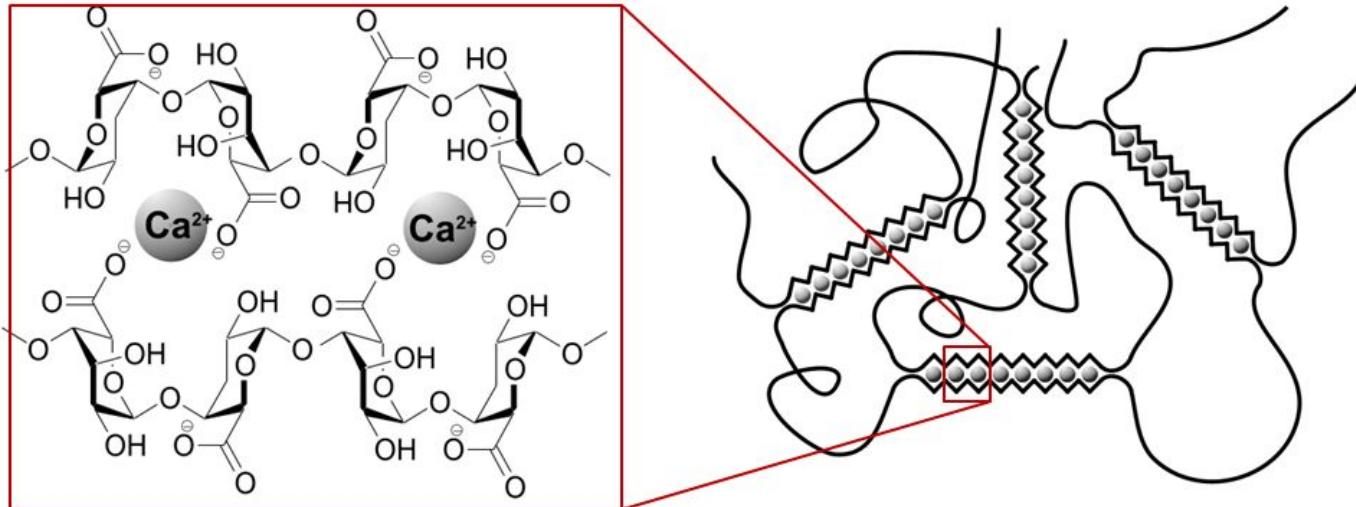


B





Ca²⁺



Alginate Contraction with myoblasts

Volume Change

20%

0%

-20%

-40%

-60%

-80%

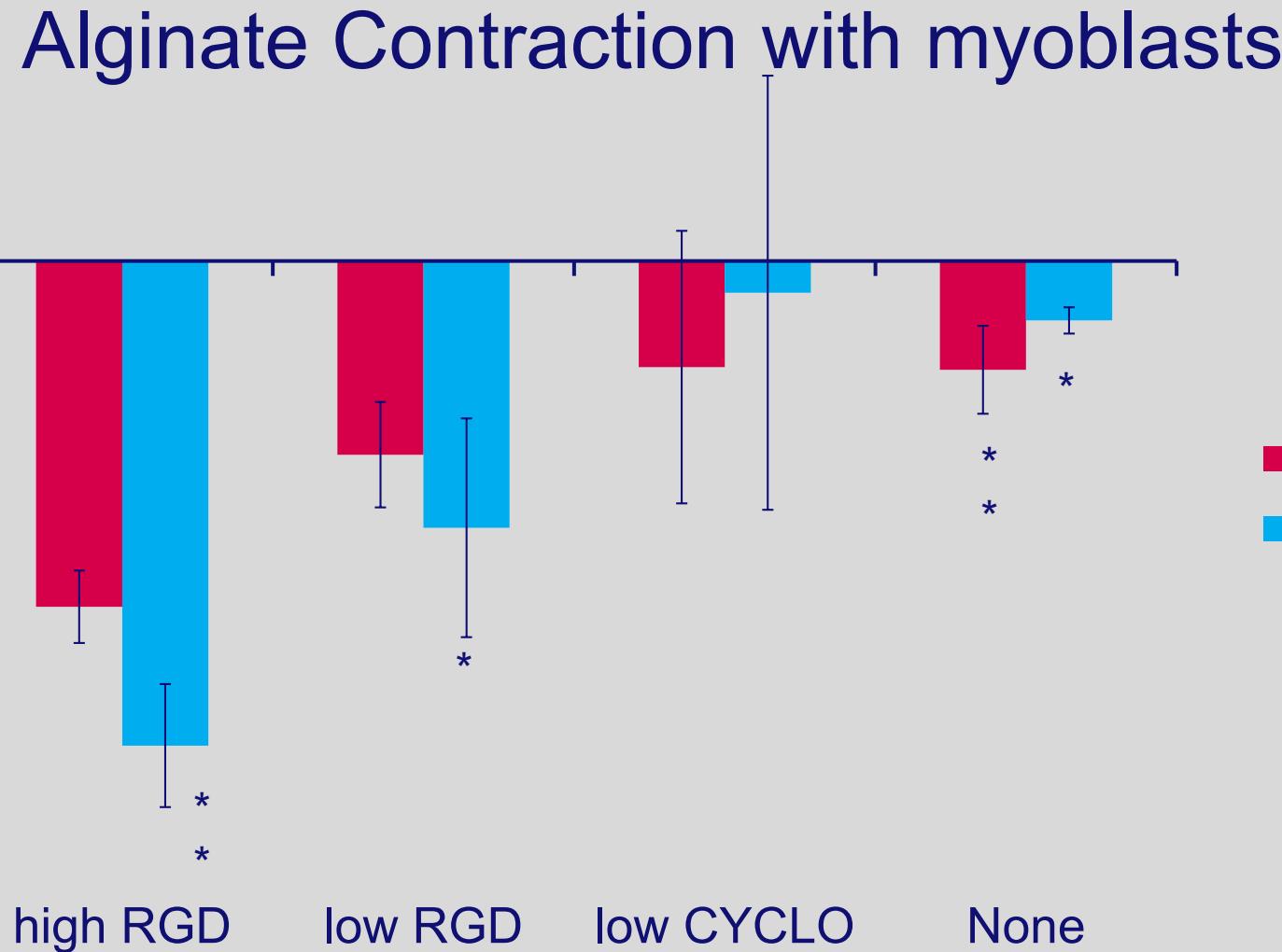
high RGD

low RGD

low CYCLO

None

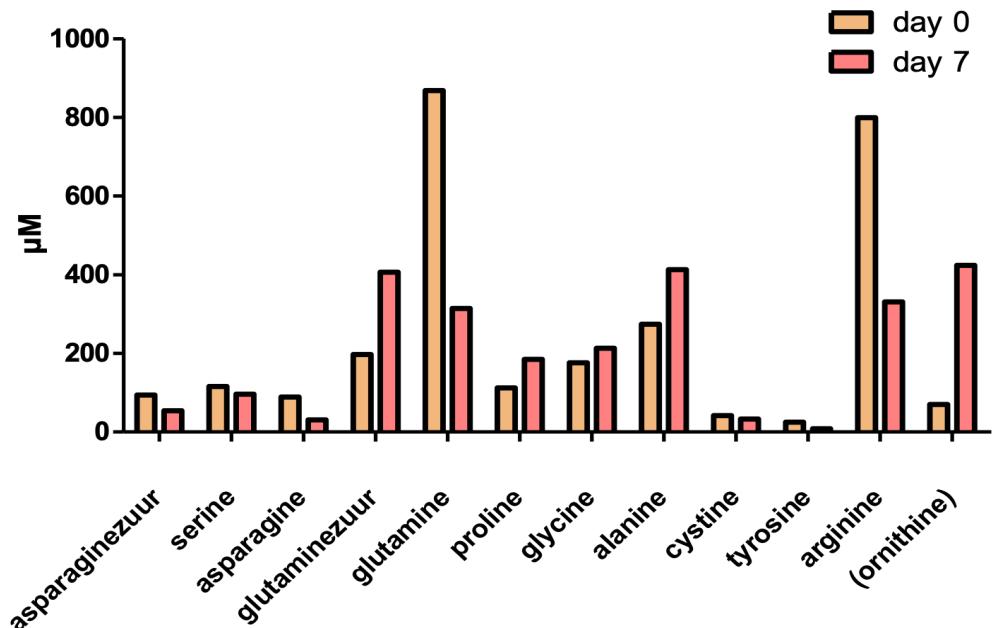
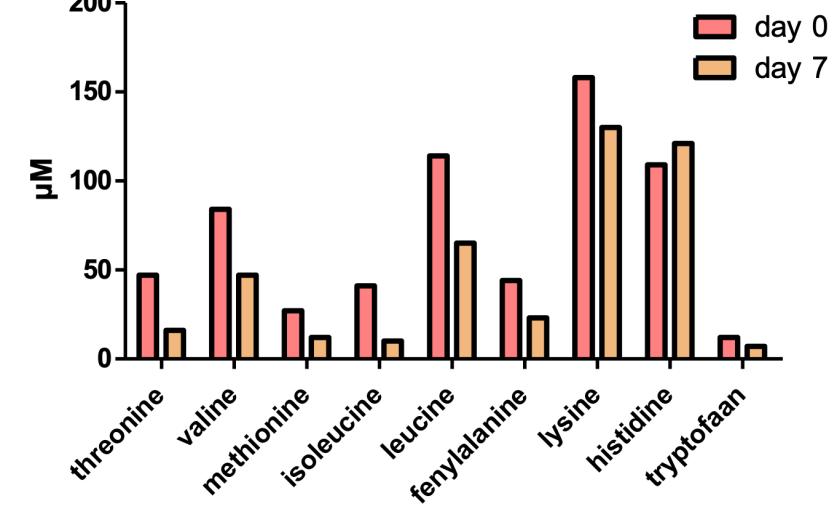
11 days
14 days



Alternative polymers

- cellulose
- silk
- chitin
- carrageenan
- functionalization





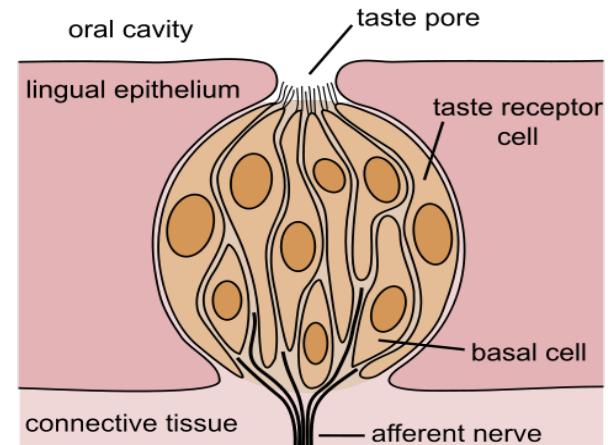
MIMICRY



color

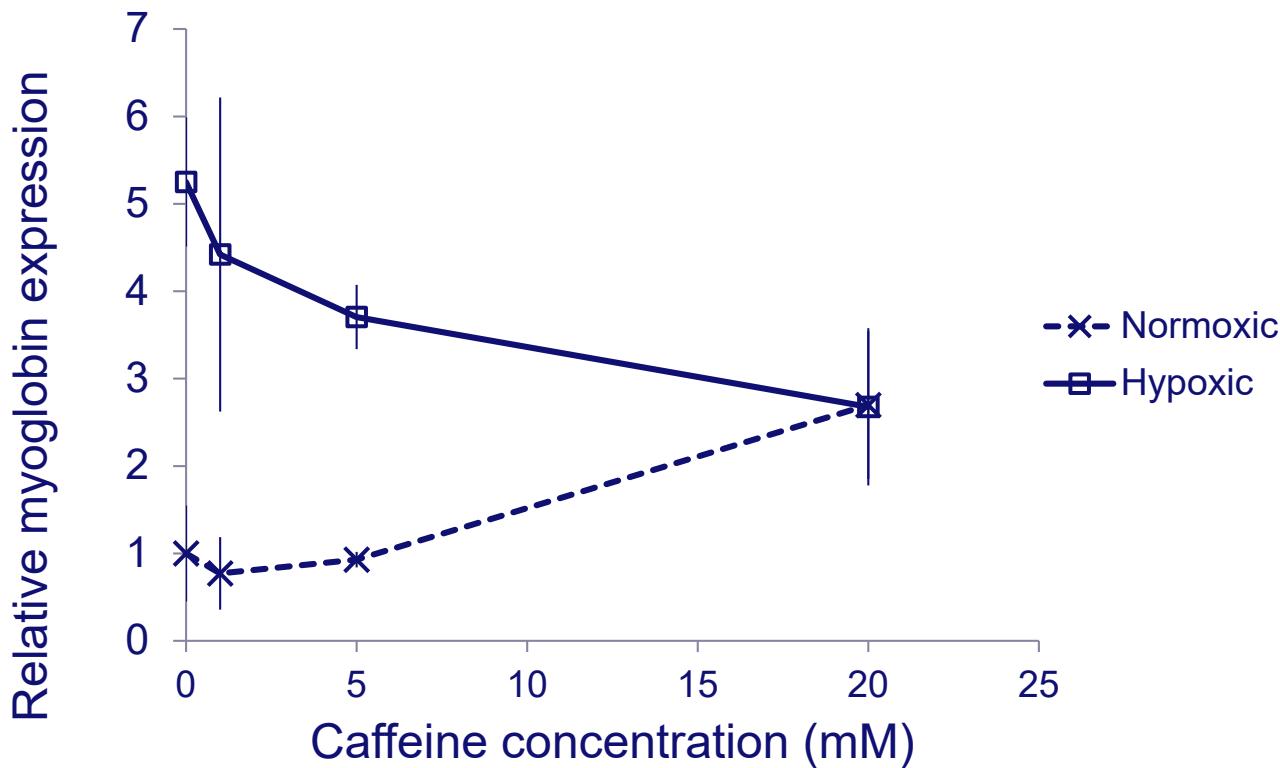


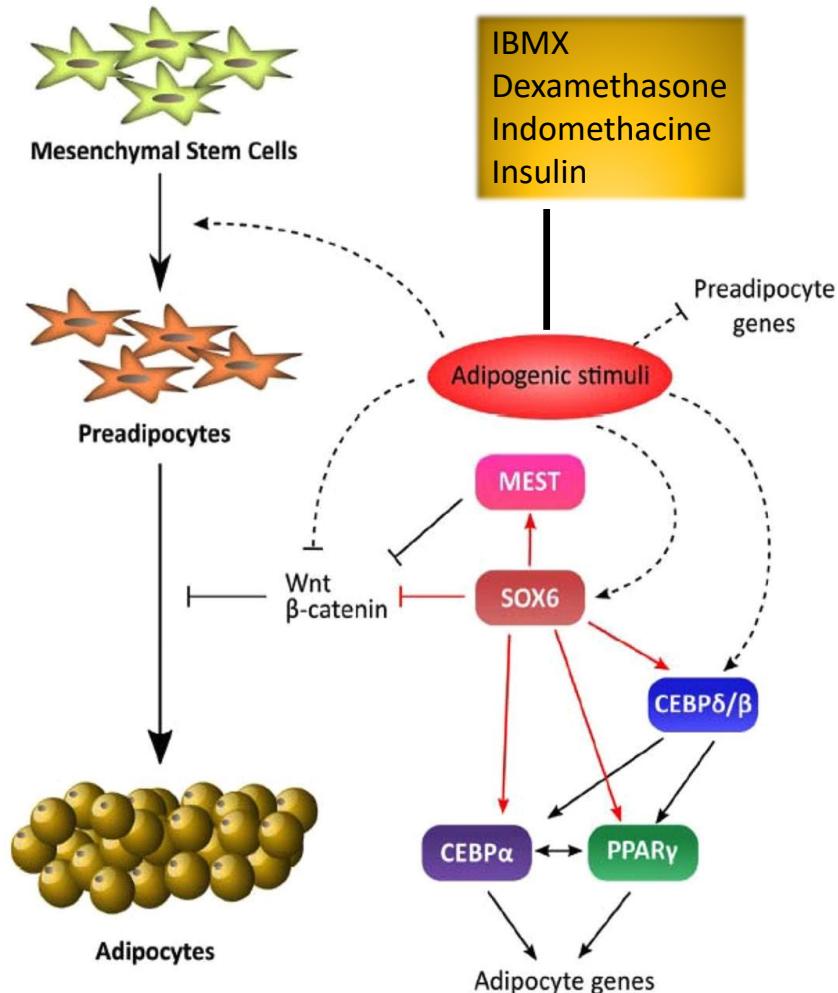
texture



taste

Color, Fe²⁺?

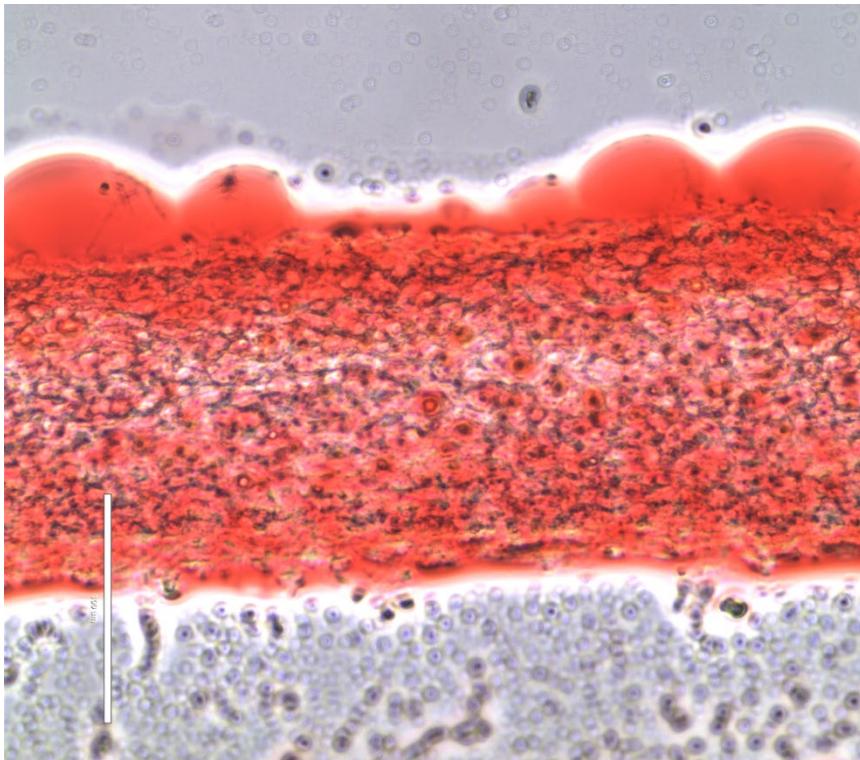




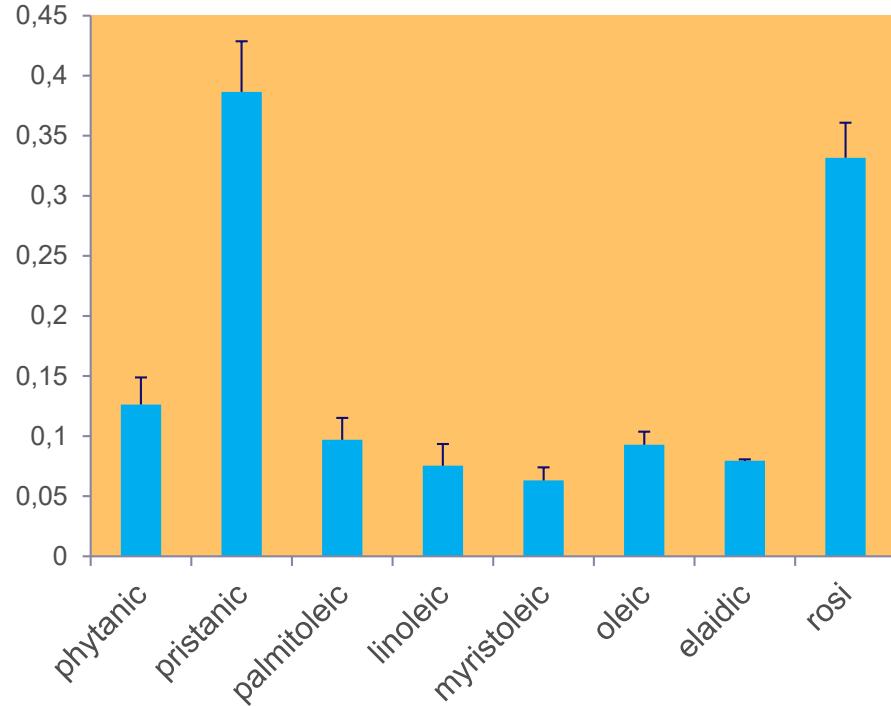
Leow et al, Development 2016

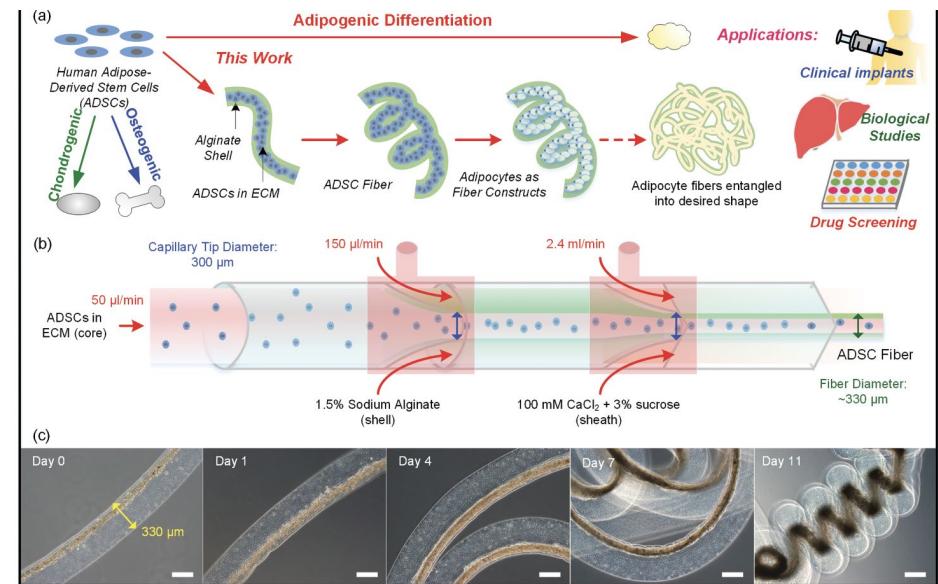
creating fat tissue

Bovine ADSC in alginate

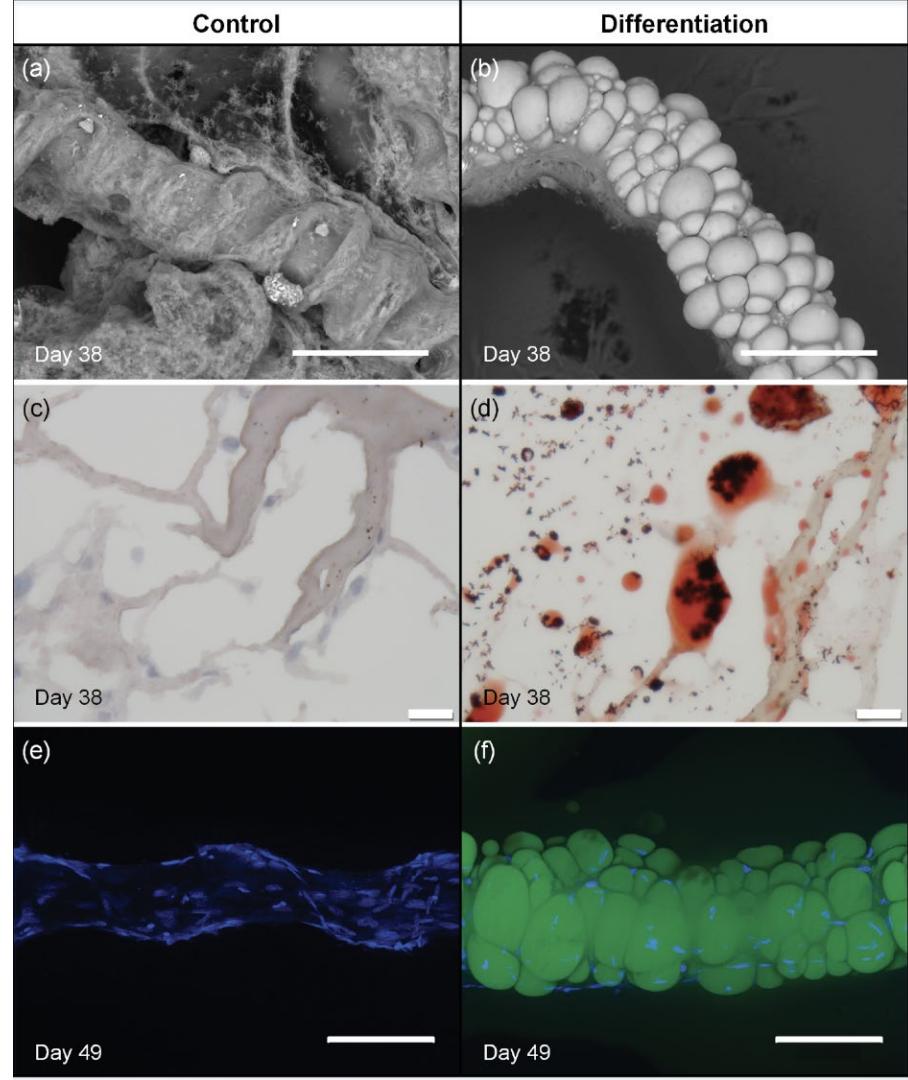


no insulin





Hsaio et al, Adv Healthcare Mat 2016

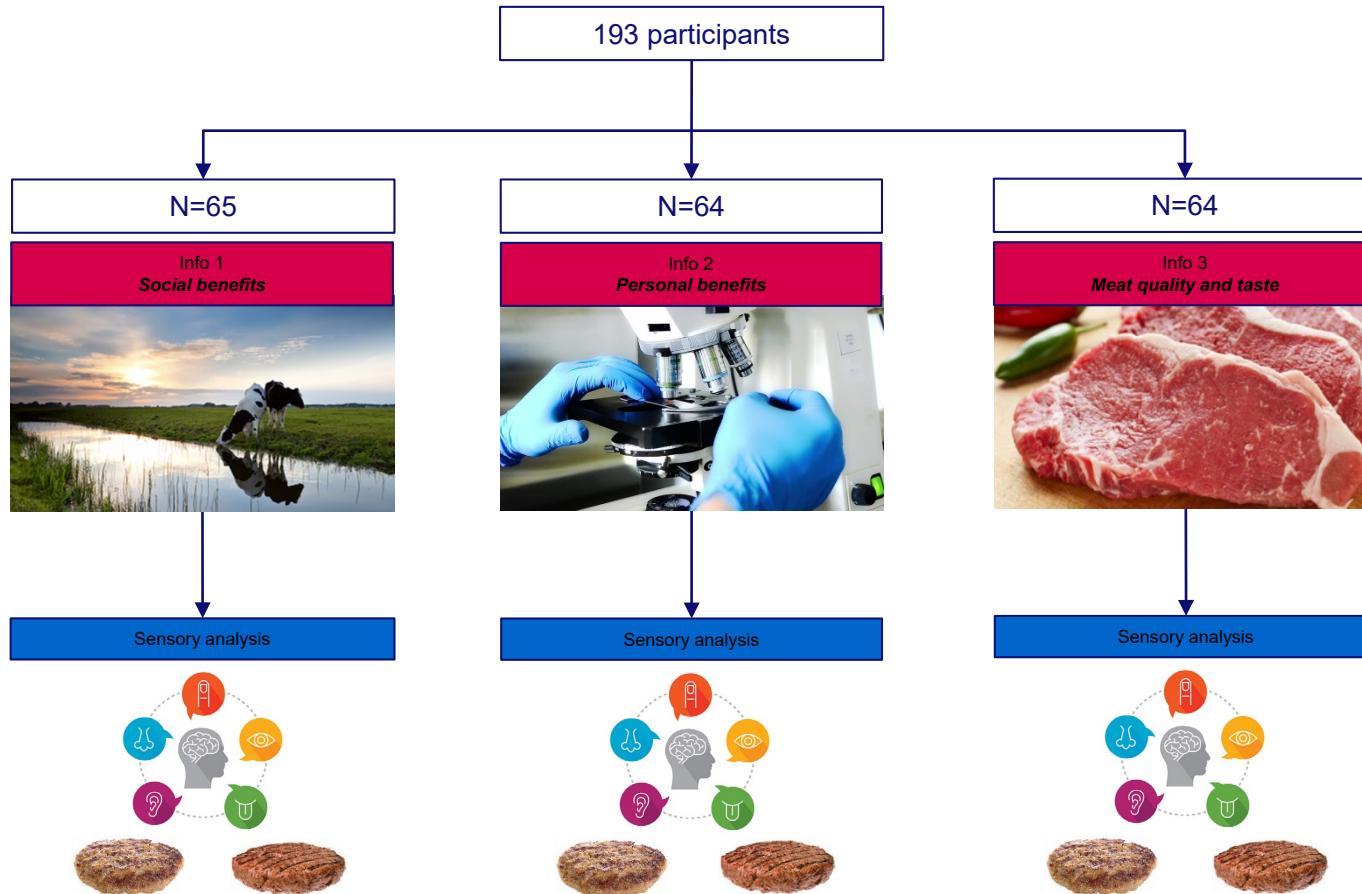


PREScription OF THE FUTURE

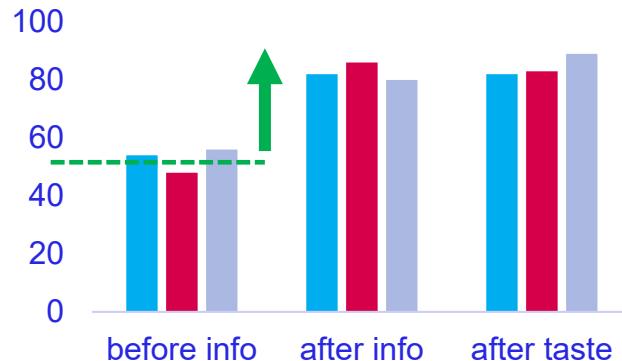




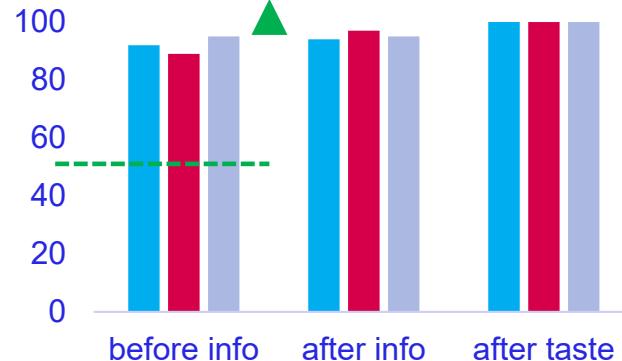
Are acceptance and taste dependent on type of info?



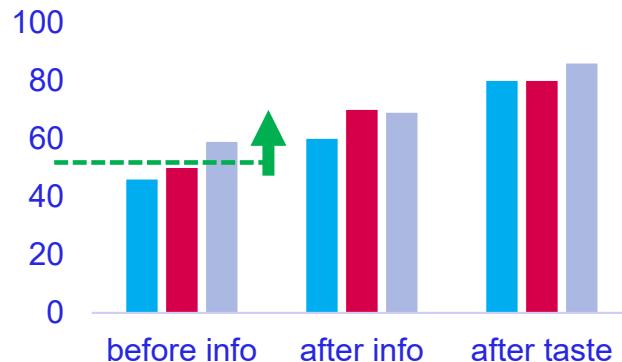
Favour?



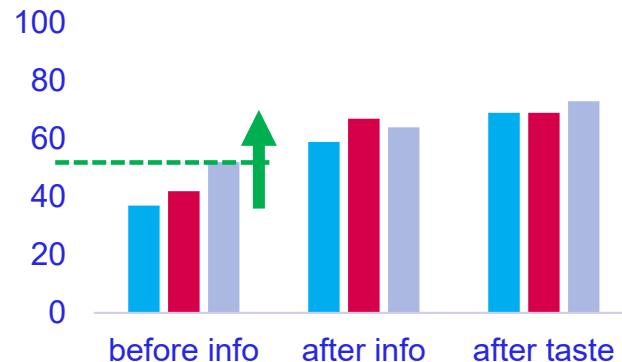
Taste?



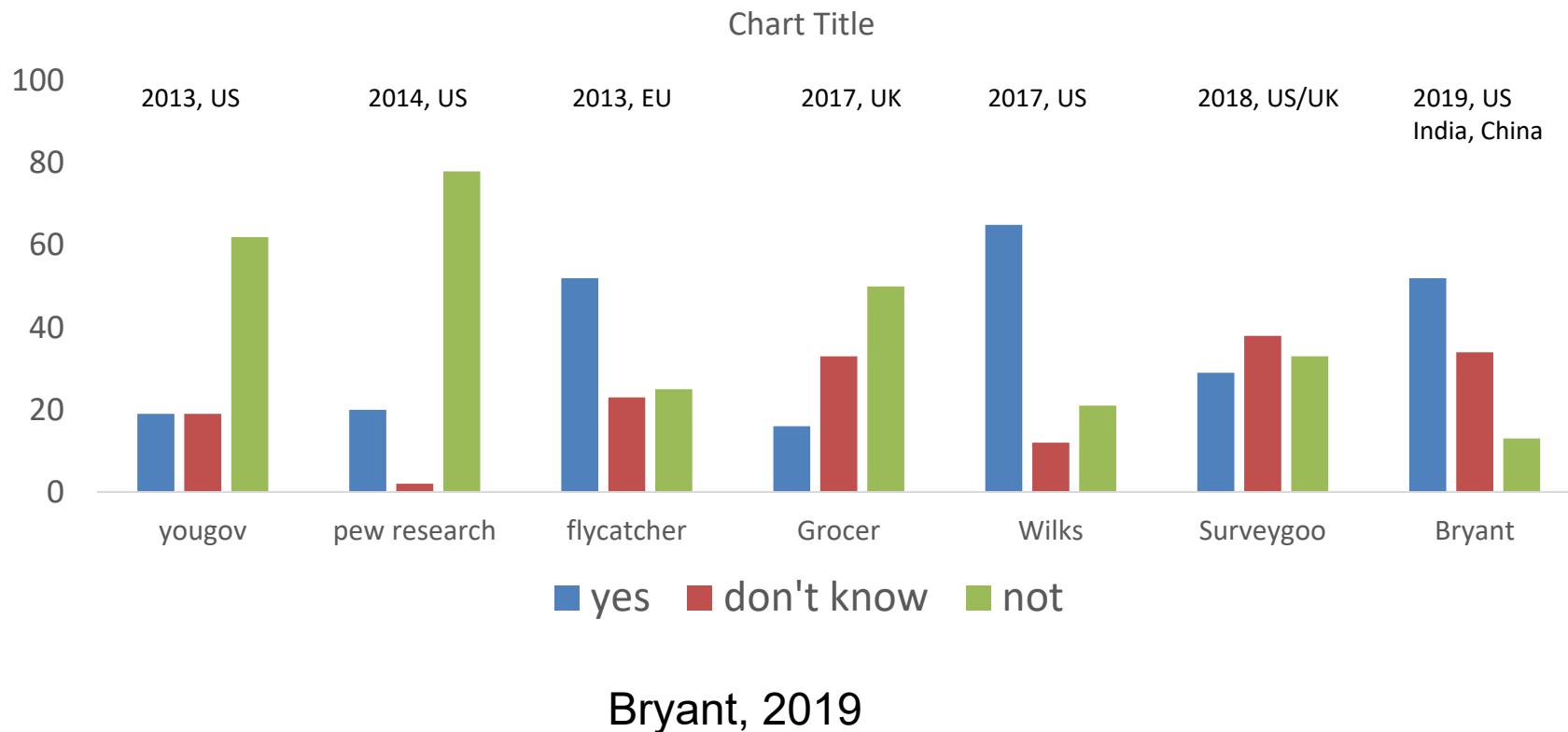
Buy?



Replace?



surveys



| | 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 |



€ 15/L
glucose, aminoacids, vitamins, minerals

Groeifactoren (6 eiwitten)



+



+





Appleton Meats

avant

BalleticFoods

biftek.co
beef tech

Biofood
Systems

BlueNalu

ClearMeat



Finless Foods

FORK&GOODE

FUTURE FIELDS



Integriculture



Meatable

MEMPHIS MEATS

MISSION BURBS

mosa meat

NEW AGE MEATS

SEAFUTURE
SUSTAINABLE BIOTECH

Shiok Meats



Suprême

WILD EARTH



~~GMO~~



efsa



European Food Safety Authority

Disruptive?

No, because:

- Still quite a bit of R&D required
- 3D full thickness steaks
- Regulatory approval
- Setting up a large volume global production system and accompanying supply chain of cell culture feeds
- Mass consumer acceptance (price, taste, availability)

Acknowledgements

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