



In vitro cattle stem cell cultivation to serve the
generation of a cell-based cultured meat

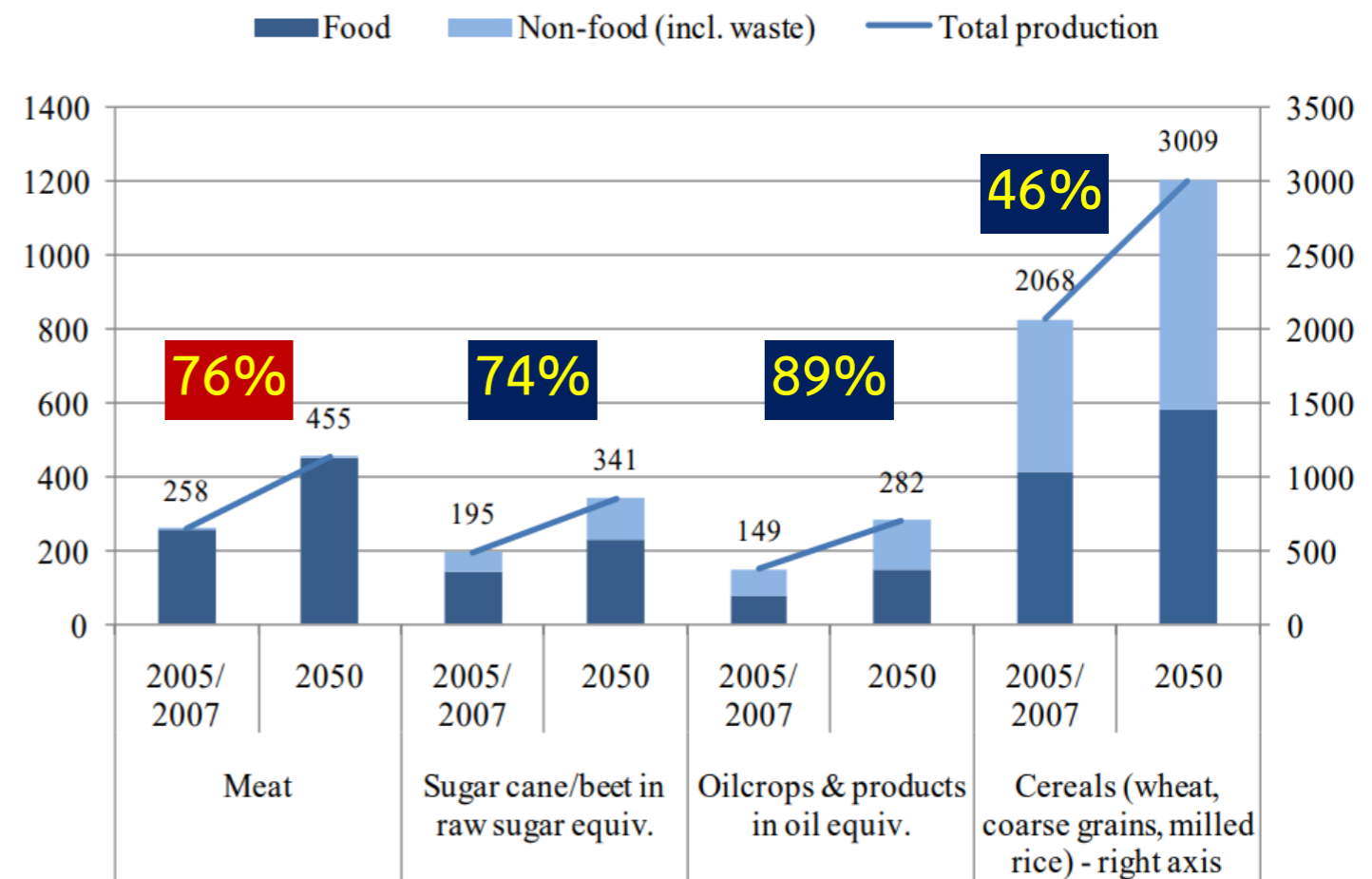
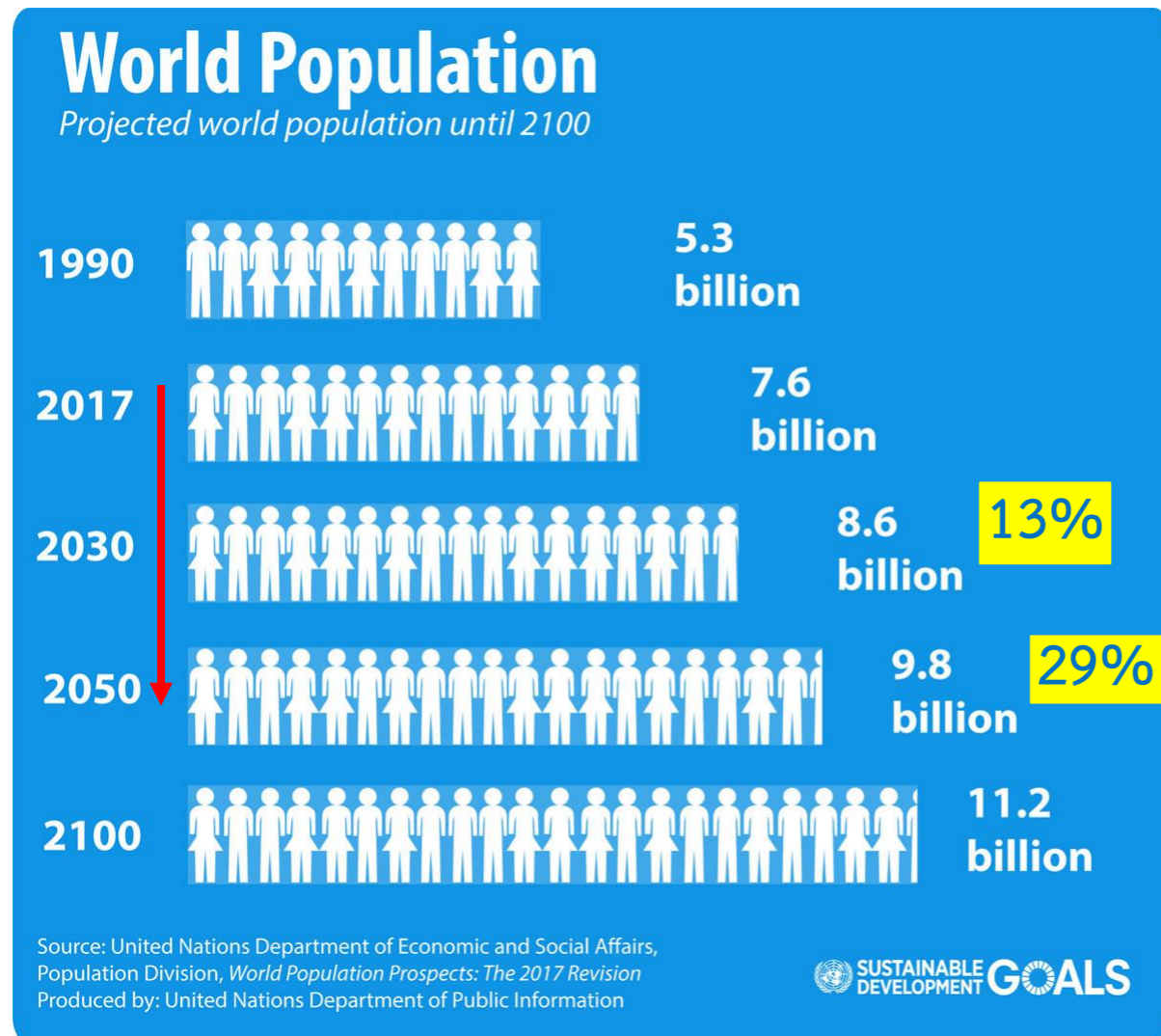
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Outline



- Background
- Research design
- Current activities
- Future direction

World population, production and waste of the major consumable products (million tons)

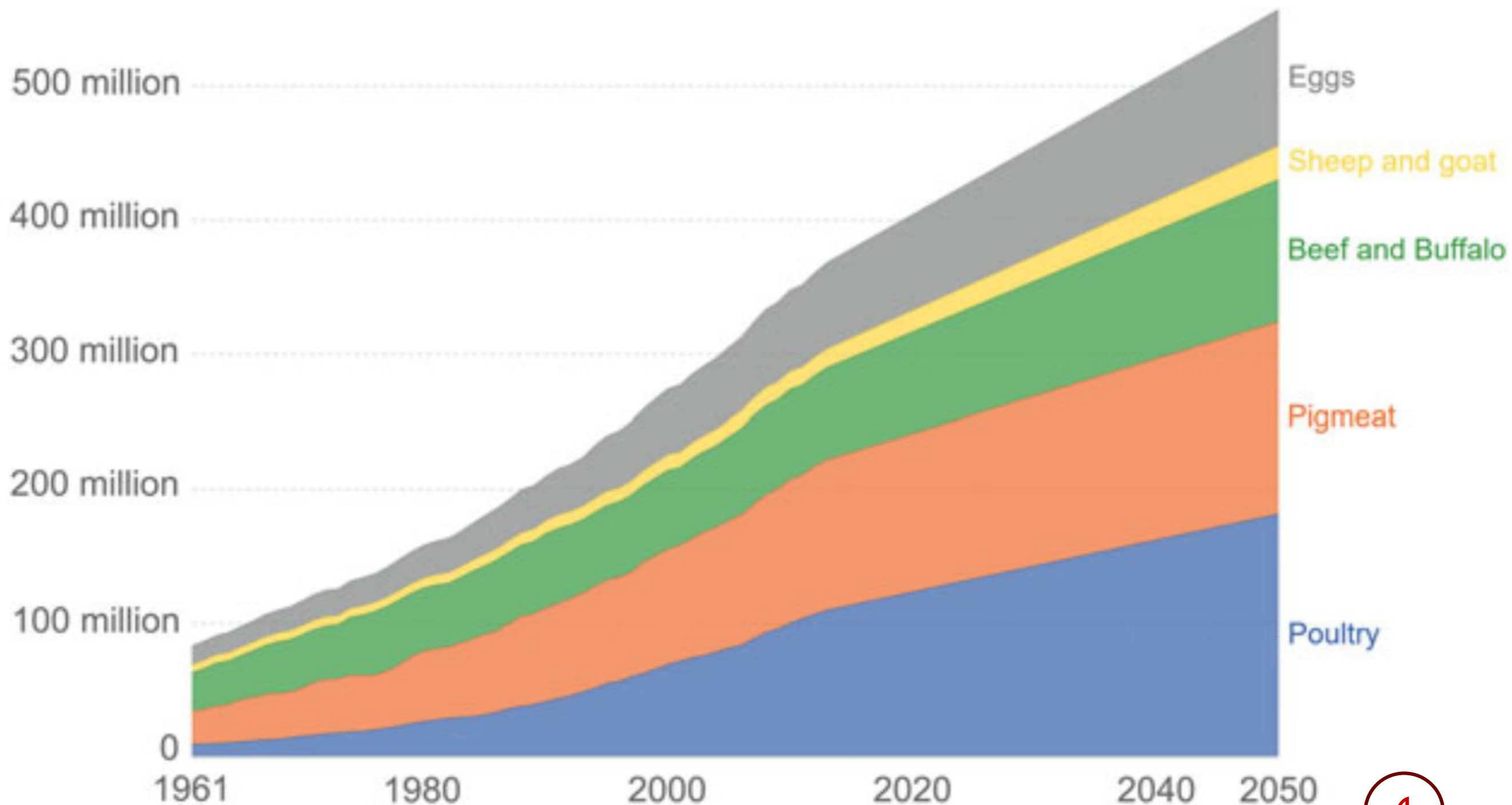


FAO 2012. World agriculture towards 2030/2050: the 2012 revision. The Food and Agriculture Organization (FAO),

The United Nation, retrieved on 15 May 2022 from <http://www.fao.org/docrep/016/ap106e/ap106e.pdf> and

1 June 2022 from <https://news.un.org/en/story/2017/06/560022-world-population-hit-98-billion-2050-despite-nearly-universal-lower-fertility>

Global meat demand





Caring | Connecting | Creating | Happiness

Impact of animal agriculture on the environment



มหาวิทยาลัยขอนแก่น
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DEFORESTATION
Every second, 1-2 acres of forest is cleared for animal agriculture. In the Amazon Rainforest, 91% of deforestation is due to livestock.

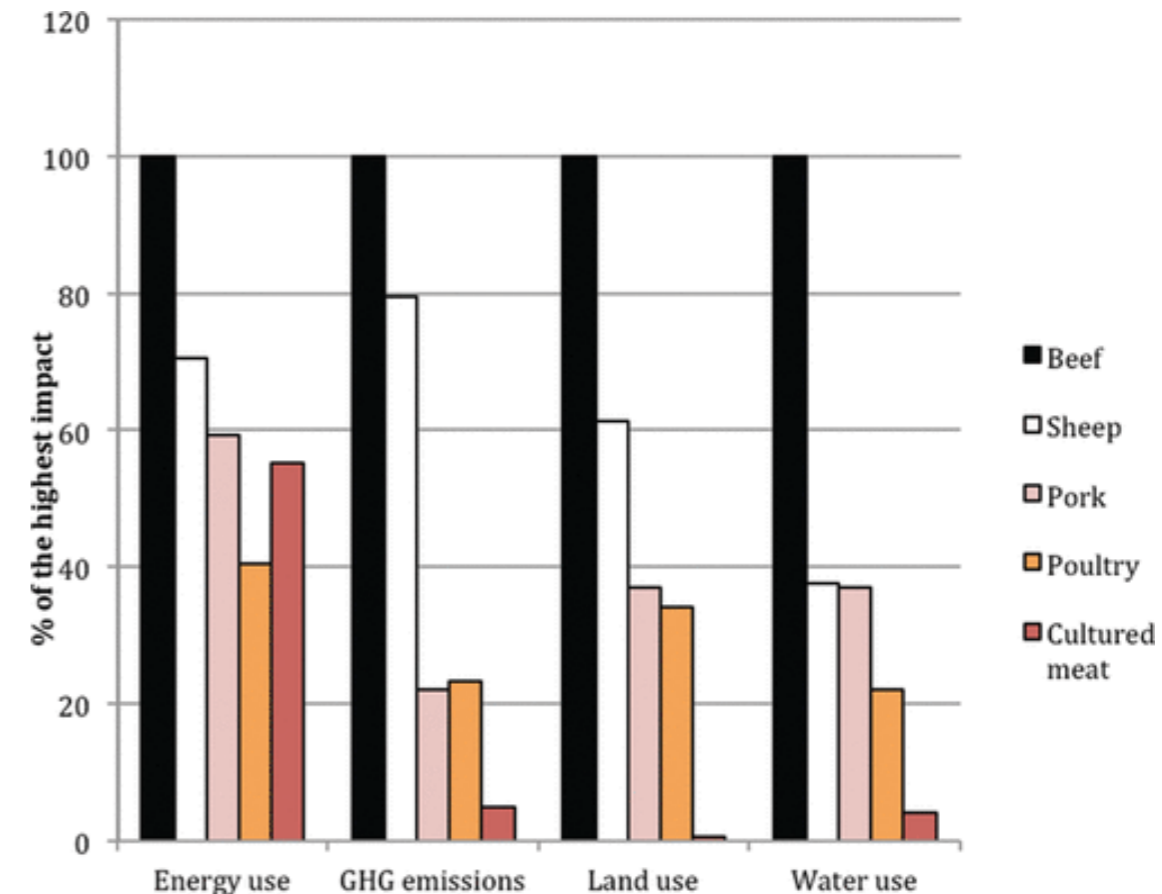
METHANE GAS
Animal agriculture is responsible for 18 percent of greenhouse gas emissions, more than the combined exhaust from all transportation.

LAND DEGRADATION
Beef needs 20 times more land per gram of edible protein than beans, peas and lentils.

WATER
Half of water in the U.S. is used for animal agriculture. It's used for irrigating crops the animals eat, drinking water, cleaning filthy factory farms, transportation, etc.

FEED
In the U.S., 67% of crops are used for animal feed. Only 27% of crop calories are consumed directly by people.

MOTHERLOVER.ORG



GHG = green house gas

On humans

- Health-related issues, e.g., transmissible diseases, hormone/drug/chemical usage

On animals

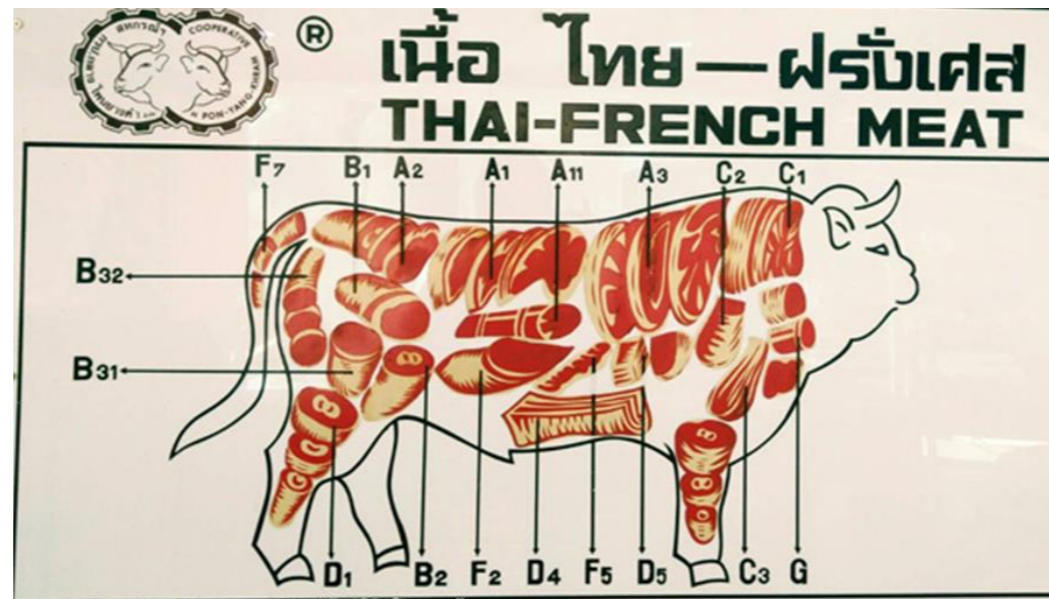
- Animal right/health

The Best Thai Beef; Thai-French Meat

from Pon Yang Kham Cooperative in Sakon Nakhon Province



Served at APEC 2022 summit



Thai-French hybrid beef cattle
Charolais (male) + Local cow (female)
“Geographical Indication” or GI in 2016



Tender and juicy meat
with marbling pattern

High quality meat with high production cost → the annual net return of production per head of cattle was THB 25,984.81. (Wiwatthanapornchai S, *Modern Applied Science*, 2019.)

Fatty acid composition of Pon Yang Kham Beef tallow

Table 1 Fatty acids composition of Pon Yang Kham beef tallow

Fatty acid	Percentage
12:0, Lauric acid	0.22 ± 0.00
14:0, Myristic acid	4.60 ± 0.03
14:1, Myristoleic acid	1.71 ± 0.02
15:0, Pentadecanoic acid	0.36 ± 0.00
16:0, Palmitic acid	24.39 ± 0.13
16:1, Palmitoleic acid	5.28 ± 0.03
17:0, Heptadecanoic acid	0.55 ± 0.01
17:1, Heptadecenoic acid	0.59 ± 0.00
18:0, Stearic acid	10.81 ± 0.07
18:1, n-9 Oleic acid	40.05 ± 0.23
18:2, n-6t Linolelaidic acid	1.55 ± 0.01
18:2, n-6c Linoleic acid	0.85 ± 0.01
20:1, Eicosenoic acid	0.23 ± 0.00
22:1, n-9 Erucic acid	0.06 ± 0.00
20:4, n-6 Arachidonic acid	0.04 ± 0.00
Unidentified	8.70 ± 0.47
Saturated fatty acids (SFA)	40.94 ± 0.19
Unsaturated fatty acids (USFA)	50.36 ± 0.29
Monounsaturated fatty acids (MUFA)	47.91 ± 0.28
Polyunsaturated fatty acids (PUFA)	2.45 ± 0.02

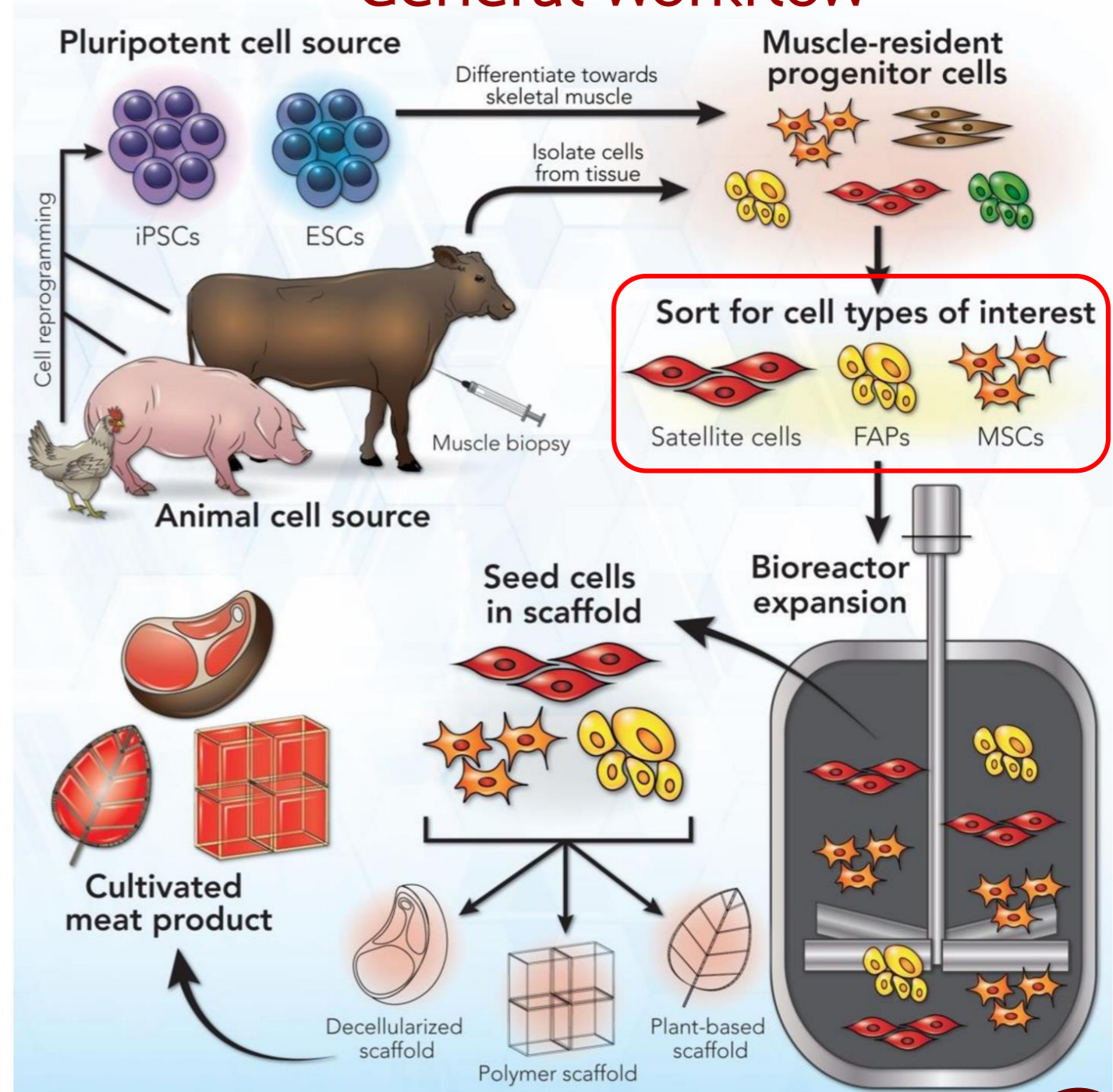
Fatty acids are reported as percentages of total fatty acids.

Alternative protein sources

1. Cultured Meat or Cultivated Meat
2. Plant-based Meat
3. Fermentation-enable Meat

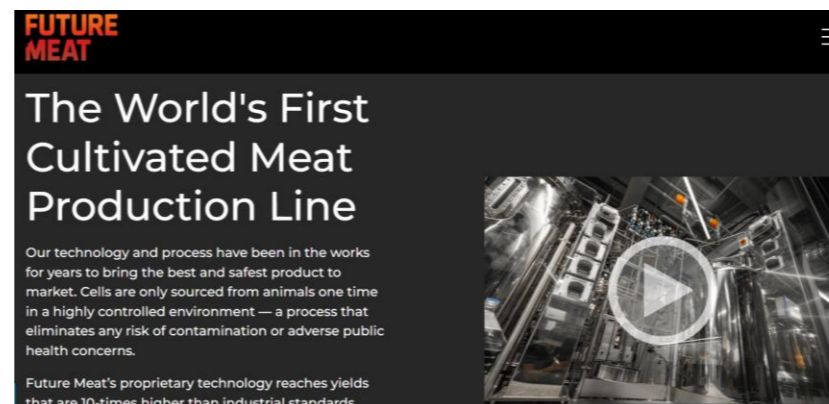
ESC = embryonic stem cells
 FAP = fibro-adipogenic progenitor cell, or adipocyte-derived stem cells
 iPSCs = induced-pluripotent stem cells
 MSCs = mesenchymal stem cells

General workflow



Origin of cells for cultured meat (Derivation of cell lines)

1. Selection of spontaneous immortalized cells; SIC



Chicken

Lamb

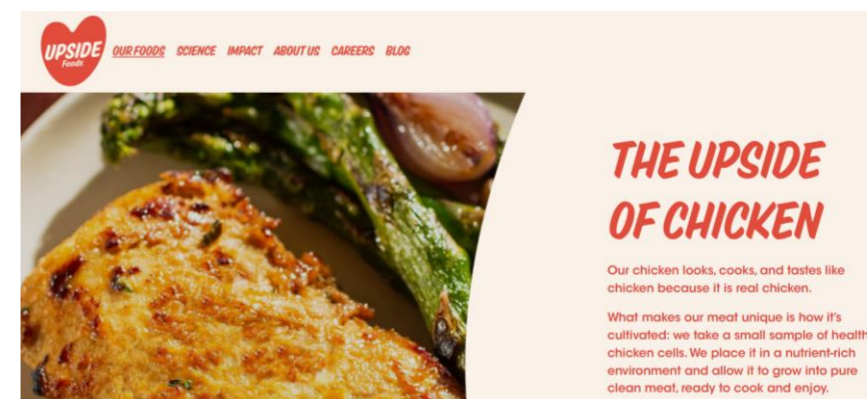
Pork

Beef

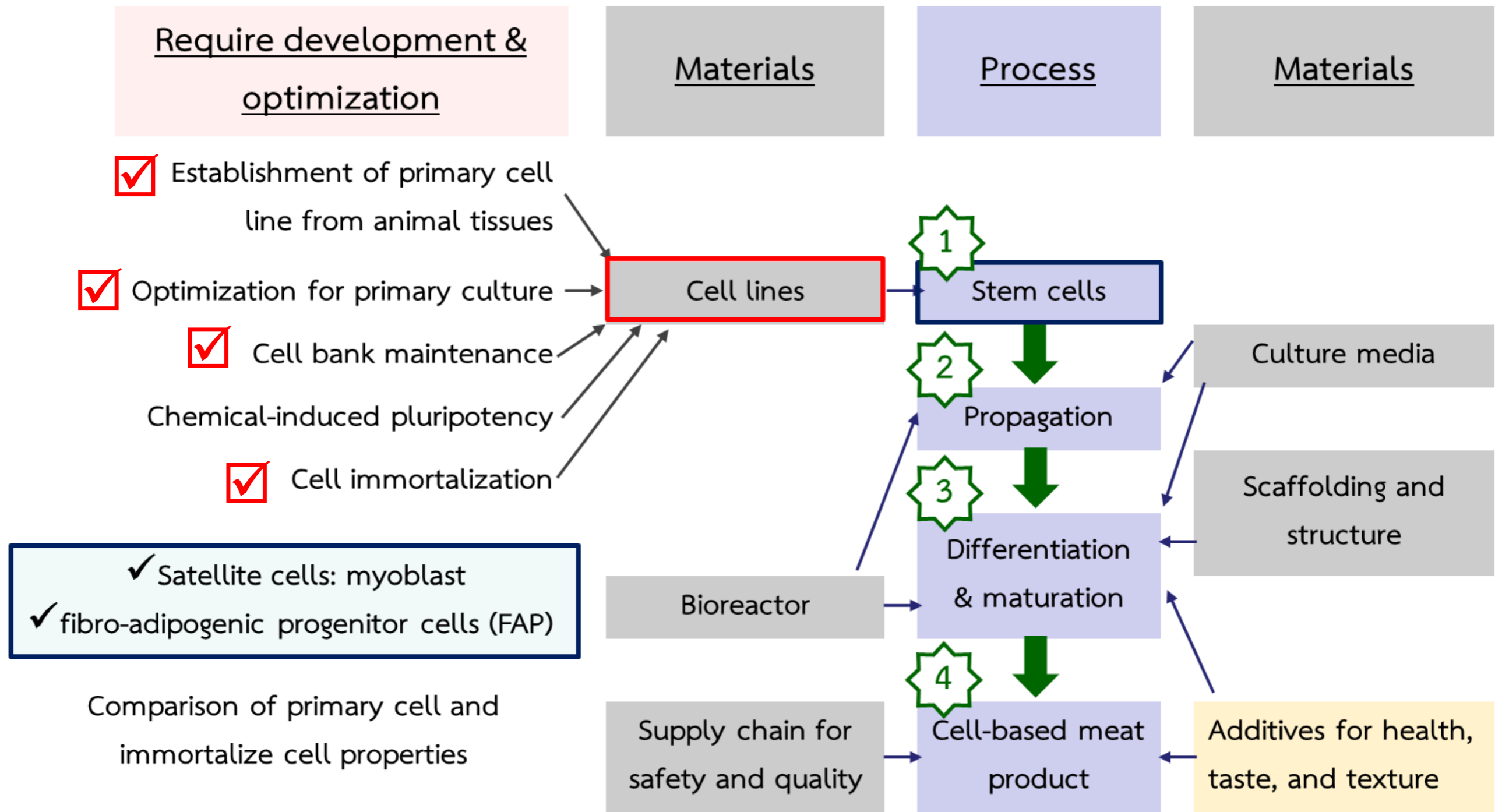
2. Induction of telomerase activities

3. Modulation of cell cycle control proteins

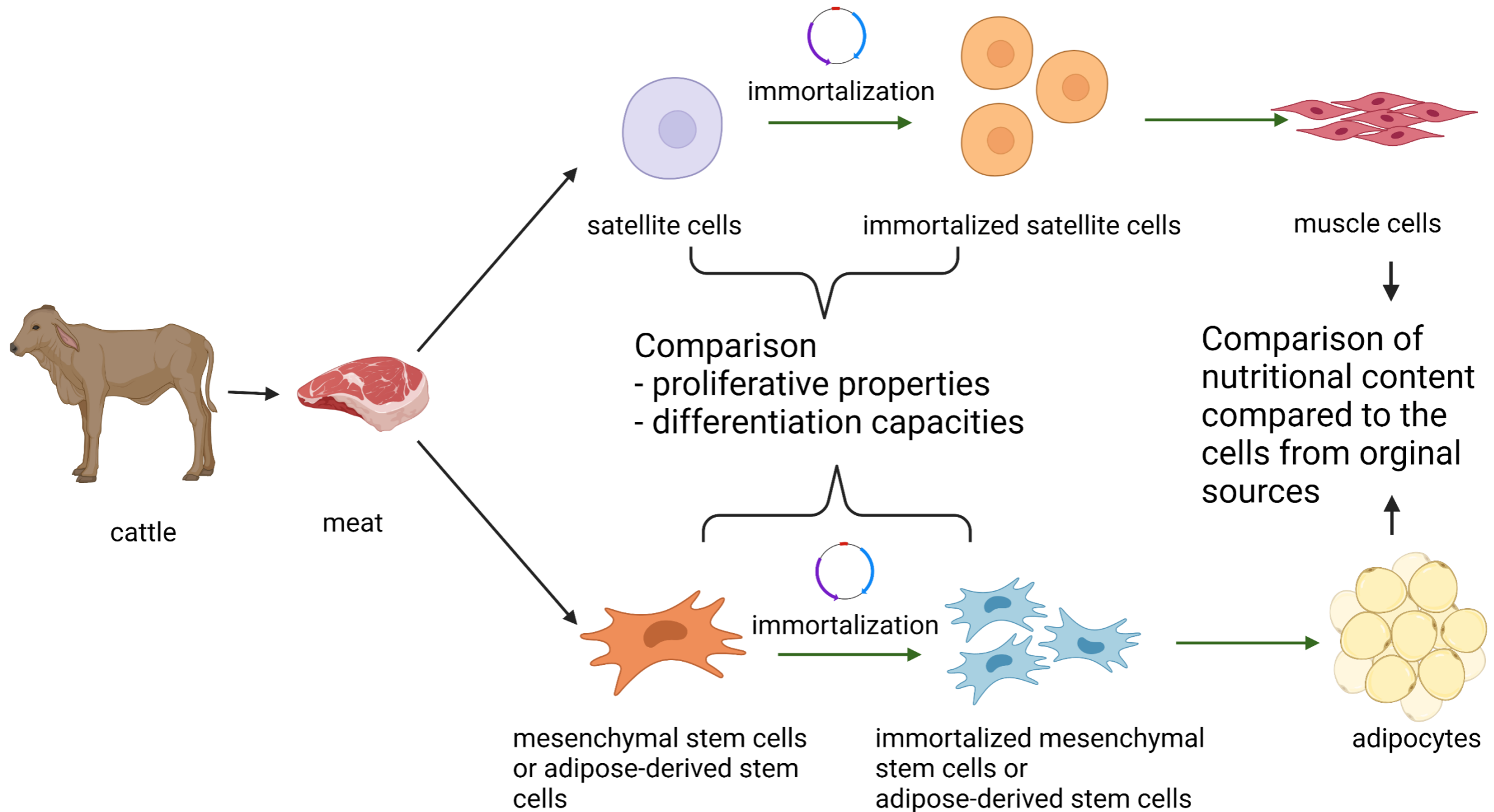
4. Combined techniques (2+3)



Development of cultivated meat



Simple scheme of current project



Future direction

- Scale-up technology; requirement of system and culture condition (harvesting, nutrient and oxygen delivery) → Bioreactor-based cell culture system
- Modification of nutritional content required for cell culture
- Scaffolding and multi-cellular culture system (adipocyte and ECM adding)
- Biodegradable materials with proper texture and nutritional content
- Cell organization; biomimicry
- Additives for flavor, health, and texture

Acknowledgements



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