Sharing Vitality

注脂肉、重組肉、未來肉

到底有什麼不同?

張秀禎　營養師

2022. 12. 21

重組肉及**注脂肉**食品標示規定 【發布日期：2022-05-30】

發布單位：食品組

- **重組肉及注脂肉食品標示規定**
- 一、本規定依食品安全衛生管理法第二十二條第一項第十款及第二十五條第二項訂定之。
- 二、本規定所稱**重組肉食品**，指以禽畜肉或水產品為原料，**經組合、黏著、壓型或其他方式**，以一種或多種加工過程製造之產品，且該產品外觀易造成消費者誤解為單一肉(水產品)塊(排、片)之產品。
- 三、本規定所稱**注脂肉食品**，指以畜肉為原料，經油脂或以**油脂混加**食品原料、**食品添加物注入、調理**過程製造之產品。
- 四、包裝重組肉、注脂肉食品應以中文於品名顯著標示「重組」、「注脂」或等同字義說明，並加註「僅供熟食」或等同字義之醒語。

重組肉及**注脂肉**食品標示規定 【發布日期：2022-05-30】

發布單位：食品組

- 五、具稅籍登記之食品販賣業者，**販售散裝重組肉、注脂肉食品**，應於販售之場所，以中文於品名顯著標示「重組」、「注脂」或等同字義說明，**並加註「僅供熟食」或等同字義之醒語**。
- 前項標示得以卡片、標記（標籤）、標示牌（板）或其他相類型式，採懸掛、立（插）牌、黏貼或其他足以明顯辨明之方式為之。以標記（標籤）標示者，其字體長度及寬度各不得小於零點二公分；以其他標示型式者，各不得小於二公分。
- 六、直接供應**飲食場所**販售重組肉、注脂肉食品，應於供應之飲食場所，以中文顯著標示該食品為「重組」、「注脂」或等同字義說明，並加註**「熟食供應」或等同字義之醒語**。
- 前項標示得以卡片、菜單註記、標記(標籤)、標示牌（板）或其他相類型式，採張貼懸掛、立（插）牌、黏貼或其他足以明顯辨明之方式為之。以菜單註記、標記（標籤）者，其字體長度及寬度各不得小於零點二公分；以其他標示型式者，各不得小於二公分。

注脂肉 (Artificial Marbling Meat)

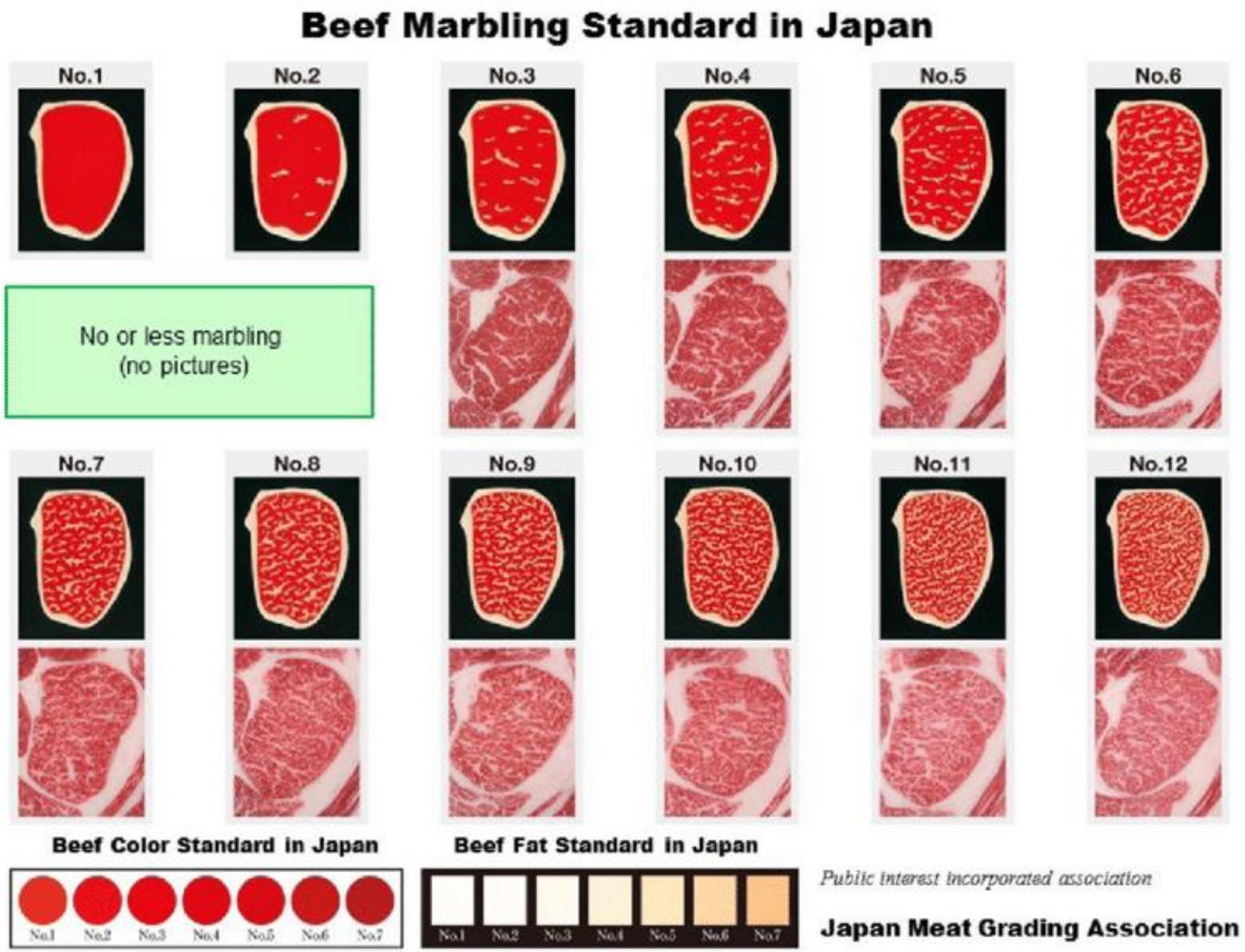
- 注脂肉食品之定義：指以畜肉為原料，經油脂或以油脂混加食品原料、食品添加物注入、調理過程製造之產品。
- 所注入油脂以該動物脂肪油脂、植物油如椰子油等為主。

此法條為民眾把關吃到真油花還是人工油花

https://www.smokefireandfood.com/forum/index.php?thread/5591-artificial-marbling-have-you-tried-it/

日本和牛分級標準

- 油花
- 肉色



https://www.researchgate.net/figure/Official-Beef-Marbling-Standard-including-Beef-Color-Standard-and-Beef-Fat-Standard_fig3_326103205

如何分辨注脂肉與正常肉?

https://www.newsmarket.com.tw/blog/161432/

重組肉 (Restructured Meat)

- 本規定所稱重組肉食品，指以禽畜肉或水產品為原料，經**組合、黏著、壓型或其他方式**，以一種或多種加工過程製造之產品，且該產品外觀易造成消費者誤解為**單一肉(水產品)塊(排、片)之產品**。

https://delishably.com/food-industry/Meat-Glue-What-It-Is-And-What-You-Should-Know

重組肉製造過程

轉麩胺酸醯胺基酶
(transglutaminase, TGase)

接合

入模

冷存
2~5℃
8~24小時

重組肉製造過程

冷存
2~5℃
8~24小時

酵素作用
時間

切開確認
是否完成
接合

Sharing Vitality

HEHO

注脂肉

用畜肉爲原料，經油脂或以油脂混加食品原料、食品添加物後所製造而成。

重組肉

禽畜肉或水產品爲原料，經組合、黏著、壓型或其它方式，加工製造而成。

以上加工食品皆需充分烹調至全熟再食用

偽霜降 假雪花 仿和牛

原肉塊、重組肉、注脂肉

高敏敏 營養師

看清成份標示!你吃的是哪一種?

品項	原肉	重組肉	注脂肉
特徵	用湯匙刮 可以刮出血水	每片大小與外型 相當一致	油花像是蜘蛛網狀 均勻但不自然 用湯匙刮可以刮出油脂
成分	牛肉	牛肩胛肉、品質改良劑、乳清蛋白、焦磷酸鈉、抗氧化劑、鹿角菜膠、牛肉精粉、大骨粉	牛肉、牛脂、葡萄糖、營養添加劑、鹽、黏稠劑、酵母萃取物、乳清蛋白水解物、洋菜、品質改良劑、抗氧化劑、調味劑、水果酵素粉

版權所屬 © https://remincare.com/高敏敏營養師

Sharing Vitality

Sharing Vitality

未來肉? 植物肉?

新豬肉? 超越肉?

https://vegemap.merit-times.com/veganews_detail?id=4862

圖 / 取自香港消費者委員會

未來肉究竟是什麼？

- 成分：水、**豌豆分離蛋白**、芥花籽油、椰子油、增稠原料、馬鈴薯澱粉、香料、麥芽糊精、酵母萃取物、鹽……等20多種。
- 更簡單地說，接近多應用性的傳統素肉排。

https://www.foodnext.net/science/machining/paper/5593686979

Sharing Vitality

未來肉

- 要讓過去習慣吃肉的人投入植物肉的懷抱，除了口感之外，色澤、風味也是重要的影響因素。
- Impossible Foods來說，便透過專利技術製成的**大豆血紅蛋白**，提供植物肉近乎於生肉**一般的色澤**及**血肉味**；
- Beyond Meat 則選擇用天然紅甜菜根色素**複製真肉的血色**。
- 台灣業者也受國外此波浪潮影響，不管是素食大廠松珍生技的素絞肉，或是新興品牌VVeat的蔬食漢堡排，**皆可見甜菜根的應用**。
- 營養添加、風味添加

https://www.foodnext.net/science/machining/paper/5593686979

Looks Like the Real Beef Burger

BEYOND MEAT®

IMPOSSIBLE™

複製真肉的血色

https://www.greenqueen.com.hk/beyond-meat-vs-impossible-foods-burger/

Sharing Vitality

Sharing Vitality

傳統素肉 VS. 植物肉

產品俗稱	傳統素肉	1代植物肉	2代植物肉
發展年代	豆腐生產見於宋代，素雞、素鴨於1960年代興起	最早見於Mc.Anelly（1964）專利，工業化生產於1970年代後期	技術源於1980年代日本及法國，90年代中期美國開始研究
擠壓機	無	單螺桿／雙螺桿擠壓機	帶冷卻模頭的雙螺桿擠壓機
原料	以大豆為主，伴隨小麥蛋白	較廣泛，以濃縮蛋白／豆粕為主	要求較嚴格，以分離蛋白或低變性脫脂豆粉為主
水分	15～70%	10～40%	40～70%
產品特性	無組織纖維特徵、有特殊咬感、生產工藝多為蒸煮及油炸、無肉味	水分含量低、膨化海綿結構、產品多樣化、使用前需復水處理	水分高，具有類肉的纖維化質地，可即食
用途	作為烹調主產品，需後期烹調食用，直接食用無肉纖維及肉味感，可供一般蛋白質來源	代替部分肉類蛋白，以提高產品吸油及吸水性，廣泛用於麵食、肉類及調理品（纖維狀食品）	作為主產品，並可以應用於多種烹調加工或冷凍食品領域上
市場發展	工藝／技術成熟，市場多為一般初級加工品	工藝／技術成熟，市場主流產品	技術／工藝近成熟，今後發展方向

資料來源：大成長城

https://www.mirrormedia.mg/story/20210820ind005/

英國植物肉牛排 Plant-Based Steak

The steak will be 'market-ready' in a year's time, although it's unknown exactly when it will be available in the UK. The project is being led by Martin Hofmann, a material scientist at ETH Zürich in Switzerland.

For his **plant-based steak**, Hofmann combines **pea protein** with **carrot, pea and wheat fibres**, as well as **oil**, water, flavours and spices. Both the pea protein mixture and the **fake animal fat (oil, water and additives such as vitamins)** are then forced into their own specially designed tubes.

PUBLISHED: 12:13 GMT, 31 March 2022 | UPDATED: 11:47 GMT, 4 April 2022

https://www.dailymail.co.uk/sciencetech/article-10671663/Scientists-develop-plant-based-STEAKS-pea-protein-fat-marbling-real-deal.html

未來肉與真肉的營養素比較（每百克）

Learn Eating

Sharing Vitality

部位	Beyond Meat	Impossible Burger	OmniPork	牛絞肉（85%瘦肉）	火雞絞肉
熱量 kcal	221	212	78	212	150
碳水化合物 g	3	8	2.5	0	0
蛋白質 g	18	17	14	19	19
油脂 g	16	12	0.9	15	8
飽和脂肪酸 g	5	7	0	5	2
膽固醇 mg	0	0	0	71	71
鈉 mg	**345**	**327**	**384**	**71**	**62**
膳食纖維 g	2	3	5.2	0	0

好食課，文/ 楊婷貽 營養師 https://www.learneating.com/nutrition/foodnutrition

食力 foodNEXT

植物肉 vs 動物肉 優劣比較表

動物肉		植物肉
勝	蛋白質完整性	
	蛋白質消化率	部分勝
	飽和脂肪含量	部分勝
	膽固醇含量	勝
需考量烹調時的鹽添加量	鈉含量	需考量烹調時的鹽添加量
	膳食纖維含量	勝
	鐵、鋅	部分勝
	B 群	部分勝
	鈣質	部分勝
食材本身即含胺基酸、油脂、血紅蛋白	風味	需仰賴辛香料、蔬果製品、酵母萃取物、大豆血紅蛋白等額外添加調味

資料來源：《食力》整理。

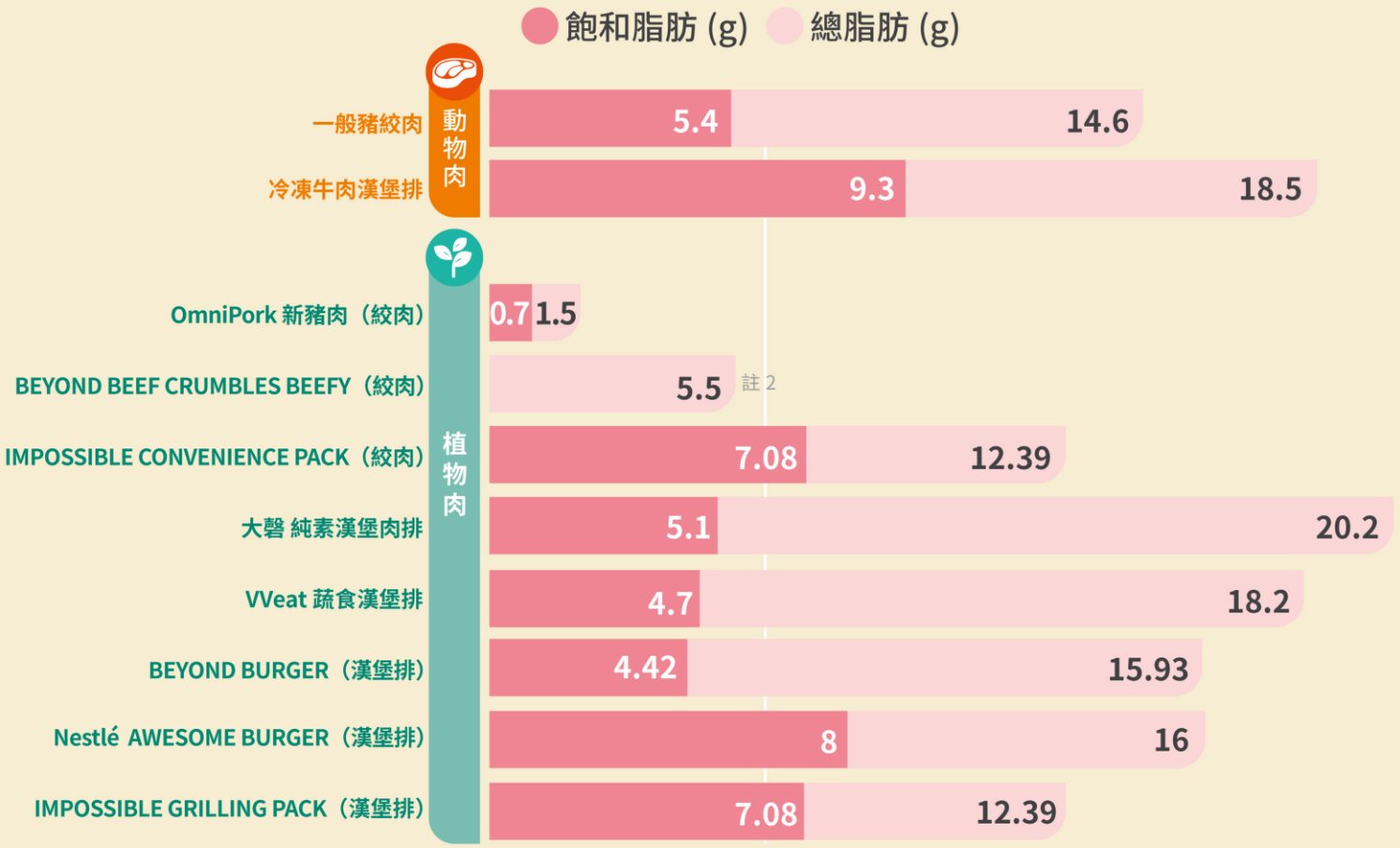
https://www.foodnext.net/issue/paper/5975508139

Sharing Vitality

食力 foodNEXT

Sharing Vitality

植物肉的飽和脂肪，可能不比紅肉少！



單位：以每100公克產品含量來計算。
註1：「IMPOSSIBLE CONVENIENCE PACK」、「Nestle AWESOME AWESOME BURGER」、「IMPOSSIBLE GRILLING PACK」目前尚未在台販售。
註2：Beyond Meat CRUMBLES BEEFY（絞肉）的飽和脂肪為0。
參考資料：食藥署食品成分資料庫、各產品官方網站，《食力》整理。

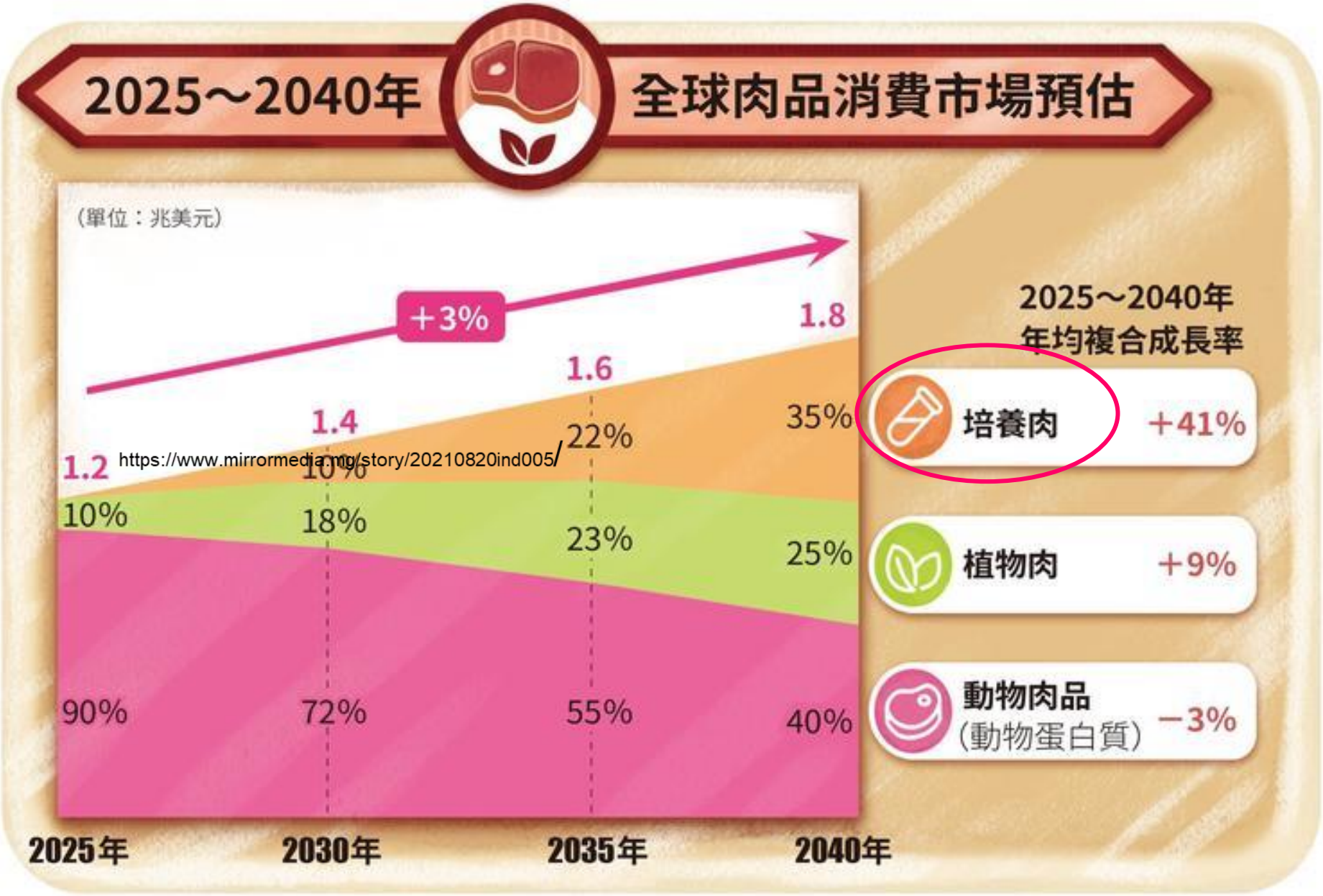
https://www.foodnext.net/issue/paper/5975508139

食力 foodNEXT

Sharing Vitality

植物肉已調味！烹煮時須謹慎選用調味料

資料來源：各品牌產品營養成分標示，《食力》整理。



https://www.mirrormedia.mg/story/20210820ind005/

https://www.mirrormedia.mg/story/20210820ind005/

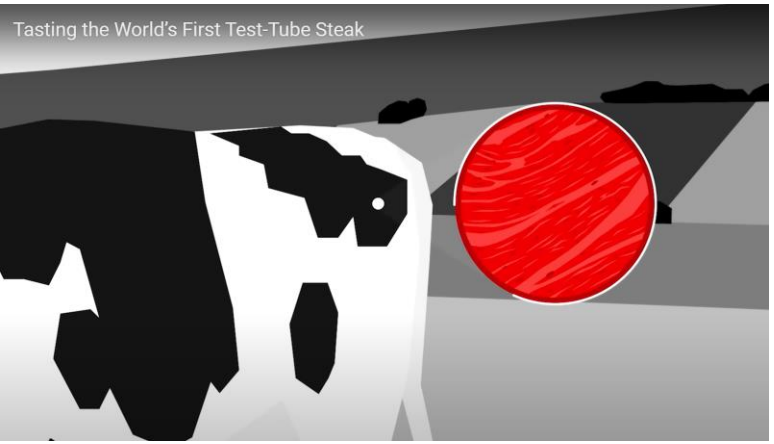
（註：%代表市占率） 資料來源：A.T. Kearney Analysis，食品研究所

Sharing Vitality

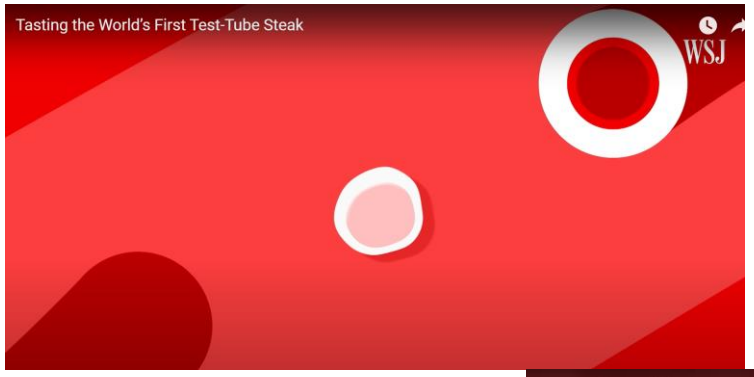
什麼是培養肉?
這肉從**實驗室**裡長出來的!!!

- **Artificial meat** is the idea of manufacturing meat and meat products through tissue engineering technology without using an actual animal. Artificial meat can also be termed as In vitro meat/ **Cultured meat**/Synthetic meat/**Laboratory grown meat**/Factory grown meat/Hydroponic meat/Test tube meat/Vat grown meat/Cell based meat /Victimless meat/**Clean meat** (Bonny et al. 2015;Verbeke et al. 2015).
- 人造肉是通過組織工程技術在**不使用實際動物的情況下製造肉類和肉類產品的想法**。 人造肉也可以稱為體外肉/培養肉/合成肉/實驗室種植肉/工廠種植肉/水培肉/試管肉/培養槽肉/細胞肉/少屠殺肉/Clean meat (Bonny et al. 2015；Verbeke 等人 2015）。

世界上第一片試管牛排

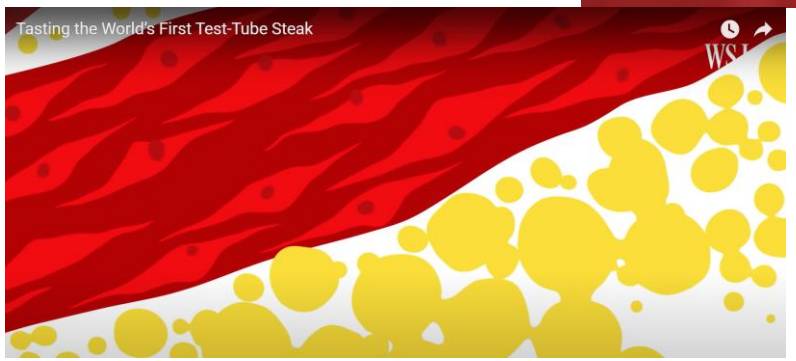


抽取組織細胞，
放入細胞培養液體



細胞不斷分裂，
持續供應營養物質

https://www.youtube.com/watch?v=bjSe-0vSRMY

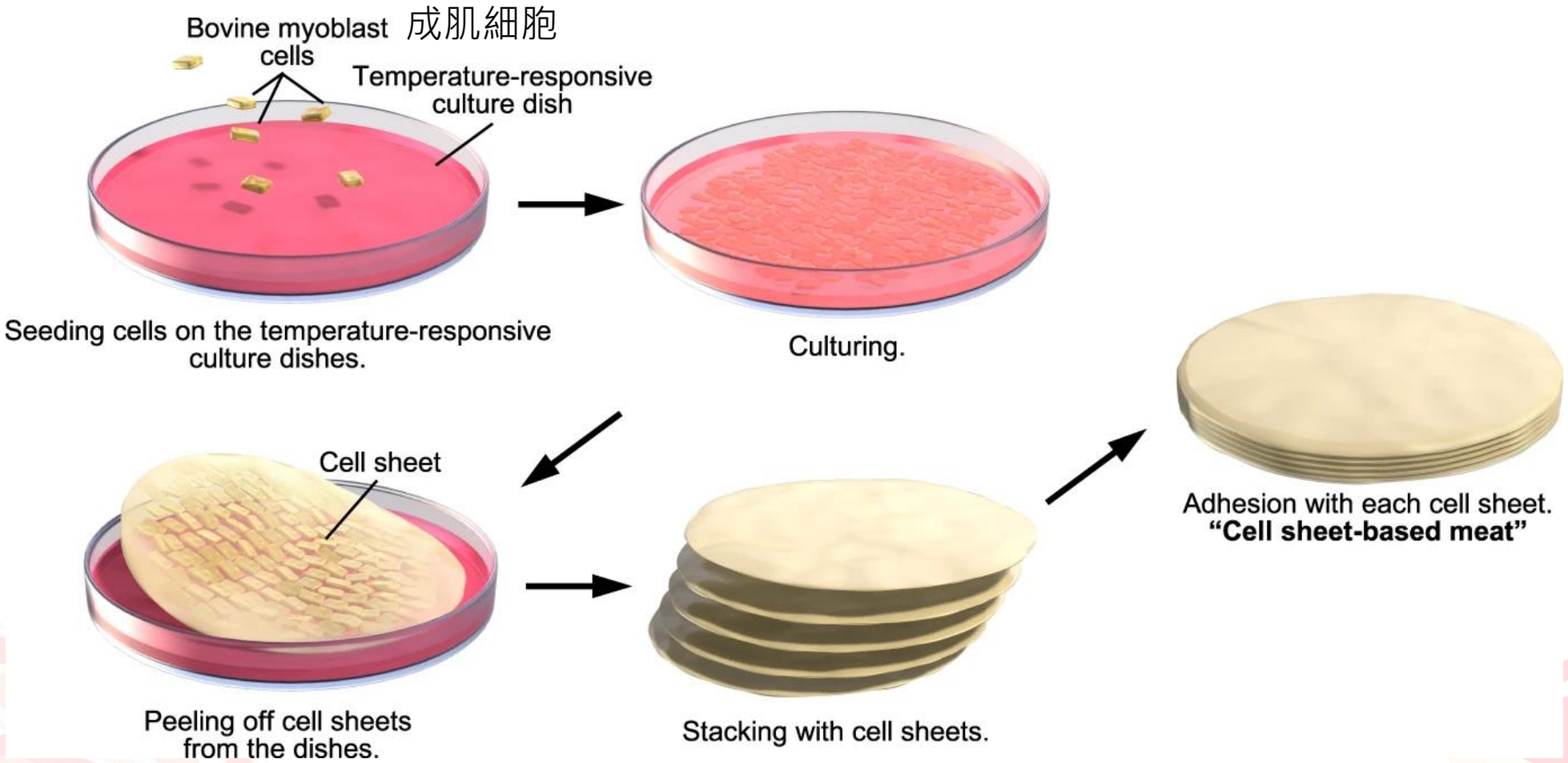


細胞組織分化，
產生肌肉及脂肪細胞

世界上第一片試管牛排

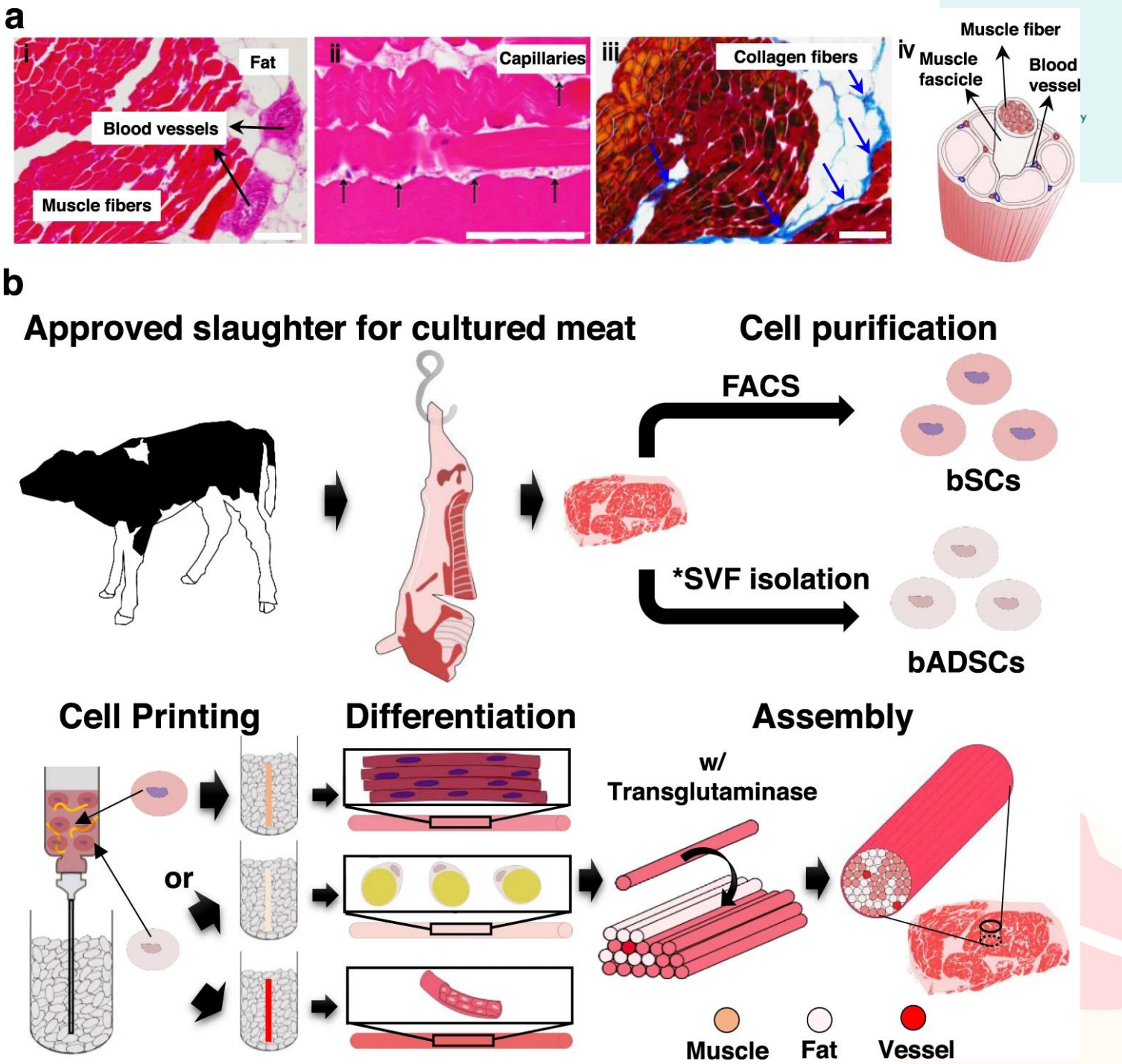
https://www.youtube.com/watch?v=bjSe-0vSRMY

Lab Meat/ Cultured Meat 實驗室培養肉



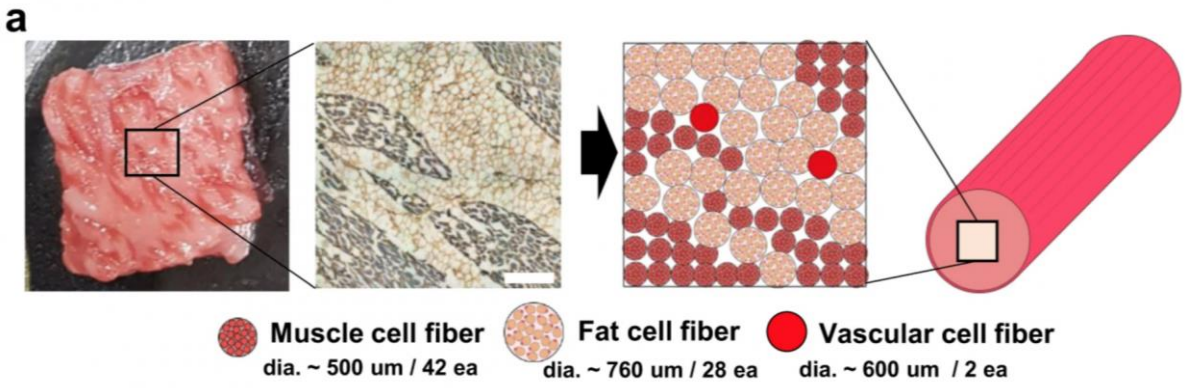
https://www.nature.com/articles/s41538-022-00155-1/figures/1

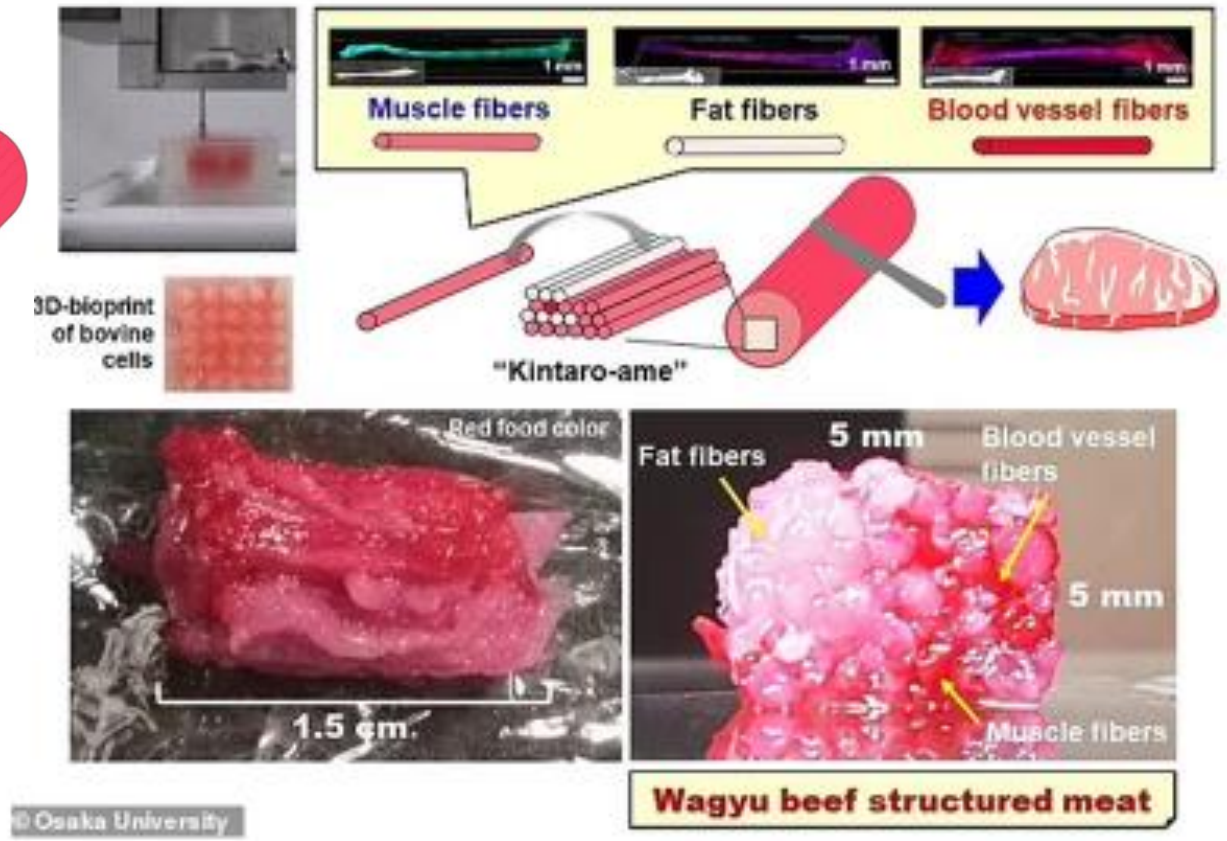
藉由**組織工程**跟**細胞**
3D列印技術作出
牛排質地組織



https://www.nature.com/articles/s41467-021-25236-9

藉由組織工程跟細胞3D列印技術作出牛排質地組織



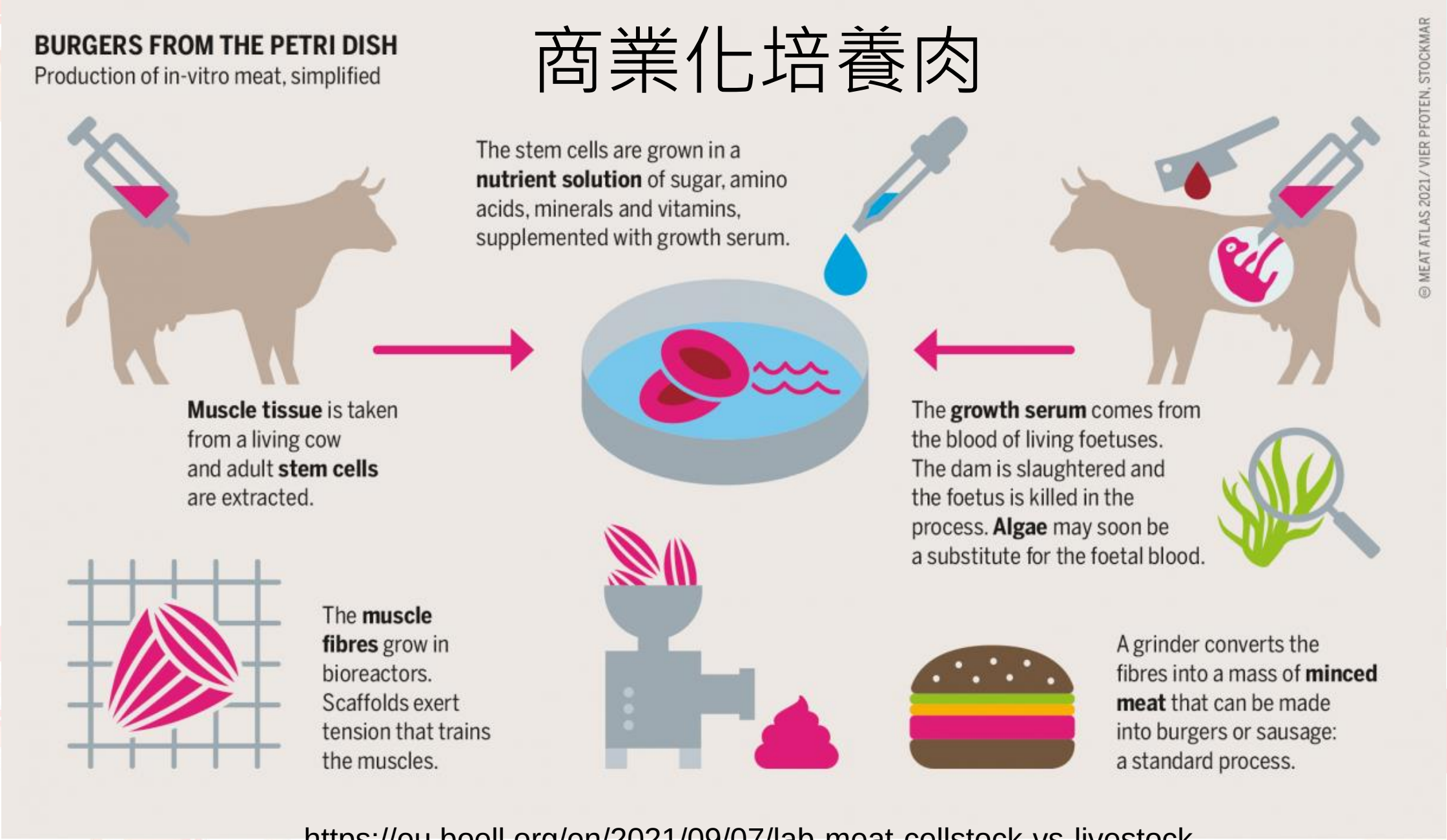


此 3D細胞列印牛排影片連結：
https://nerdist.com/article/3d-printed-wagyu-beef-japanese-researchers/

https://www.nature.com/articles/s41467-021-25236-9

Sharing Vitality

商業化培養肉

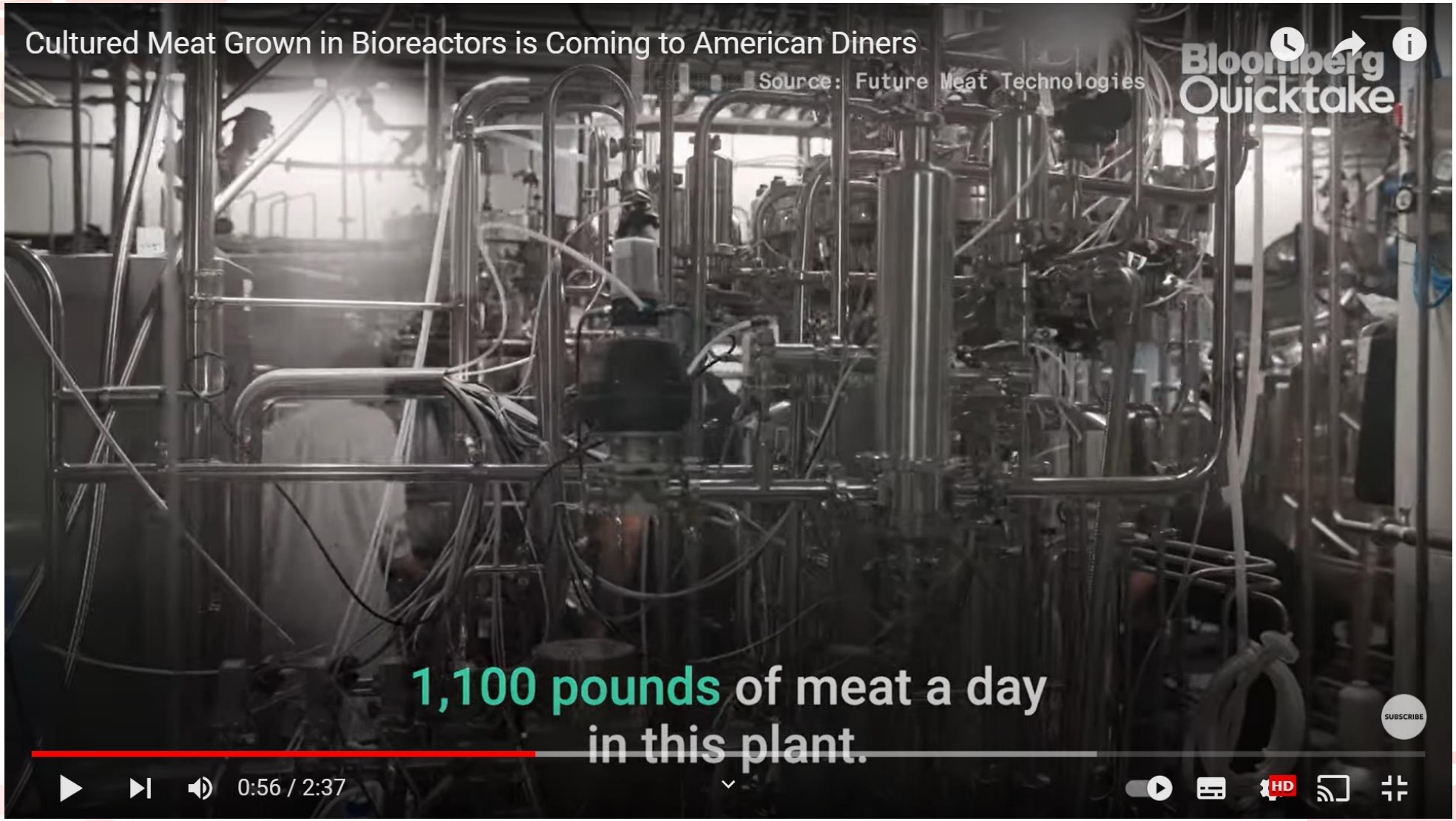


https://eu.boell.org/en/2021/09/07/lab-meat-cellstock-vs-livestock

商業化培養肉

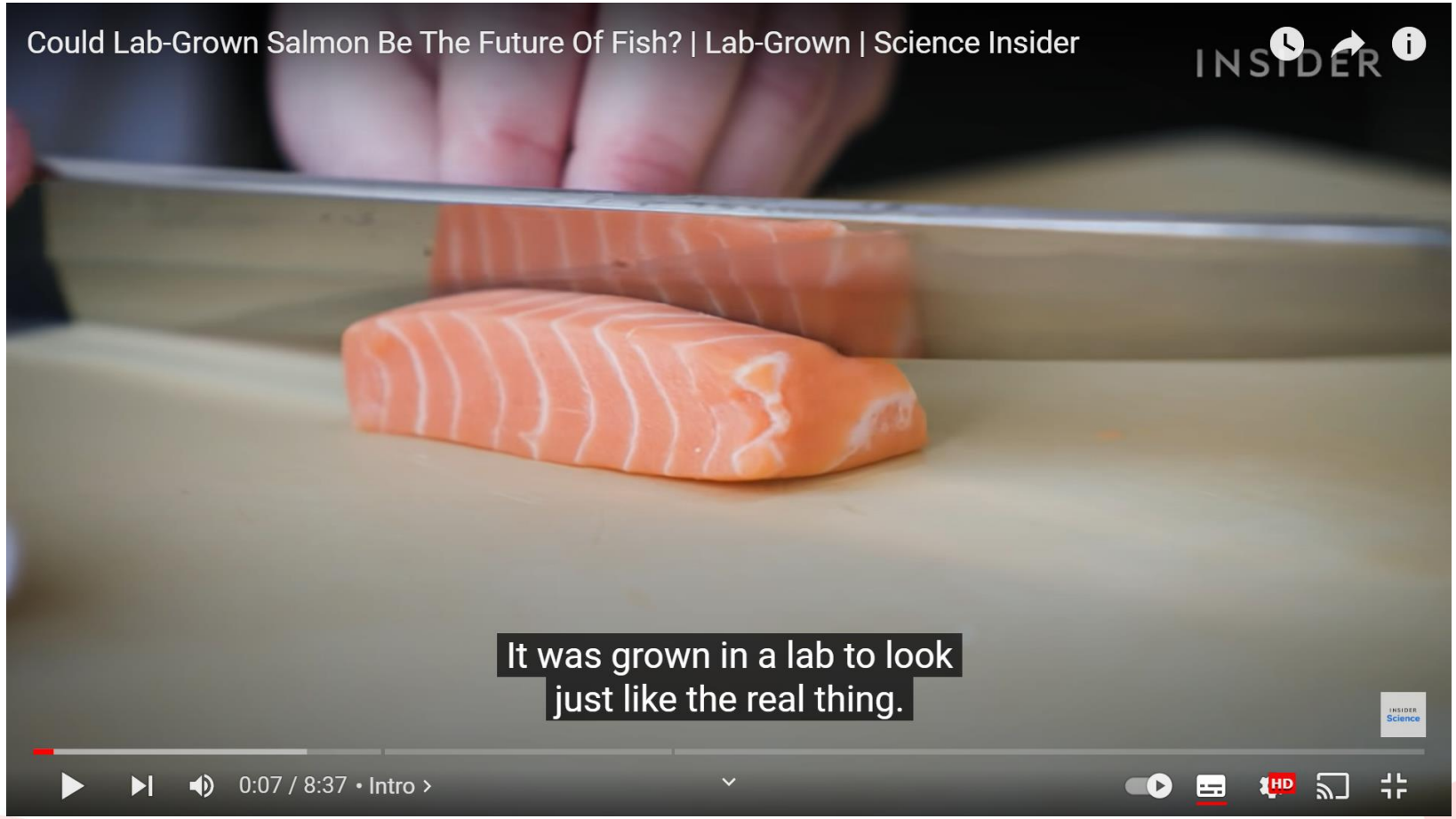
- 依照培養的動物細胞不同大約10~12天，或是將近2週的培育肉品時間。
- 但是要養一頭有商業價值的牛大約需要2年。

培養肉品工業化影片，Upside Plant：
https://www.youtube.com/watch?v=KSS9Em4a_qs



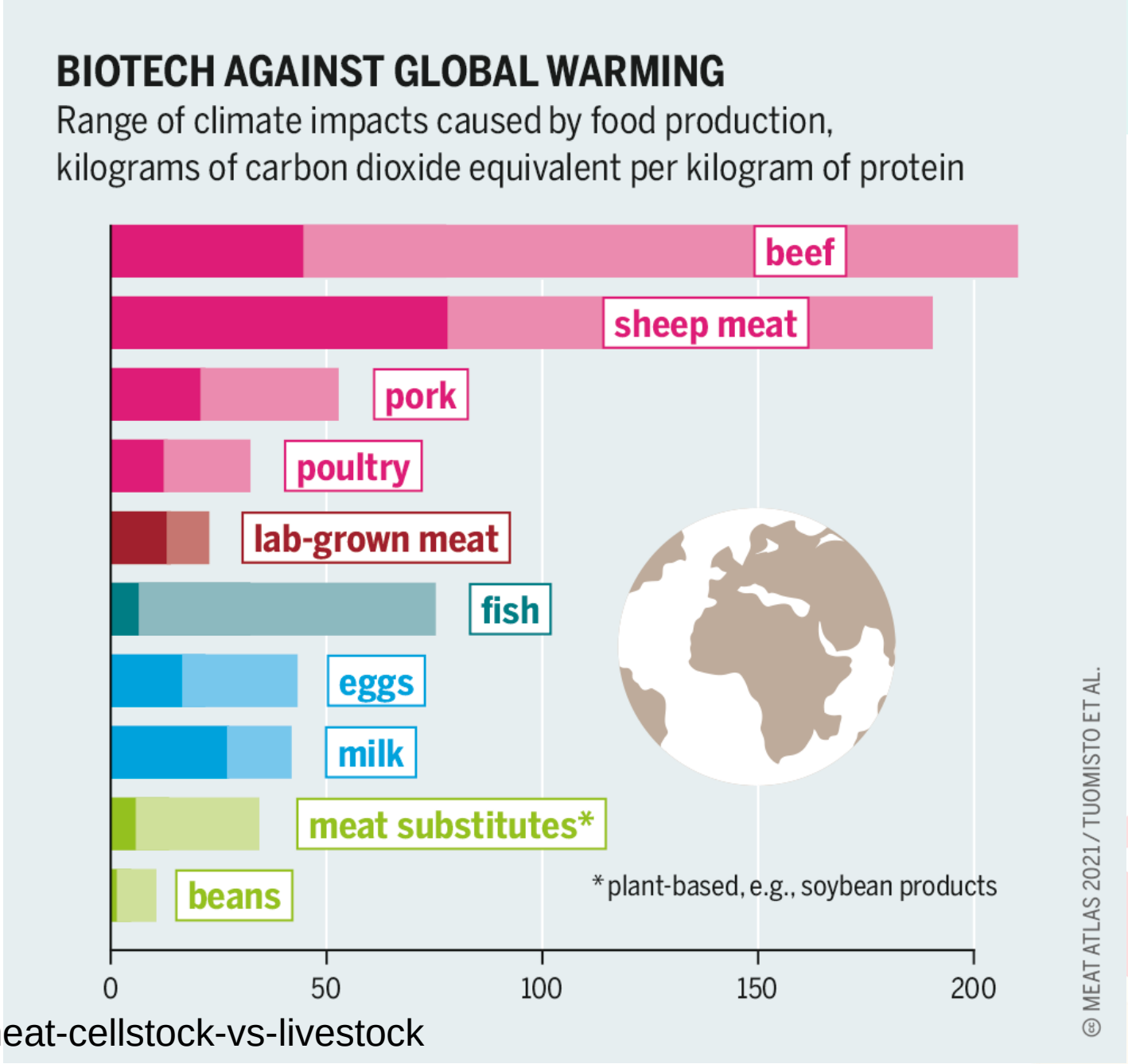
Future Meat Plant
https://www.youtube.com/watch?v=d1m6fBD8NUQ

細胞培養的水產品



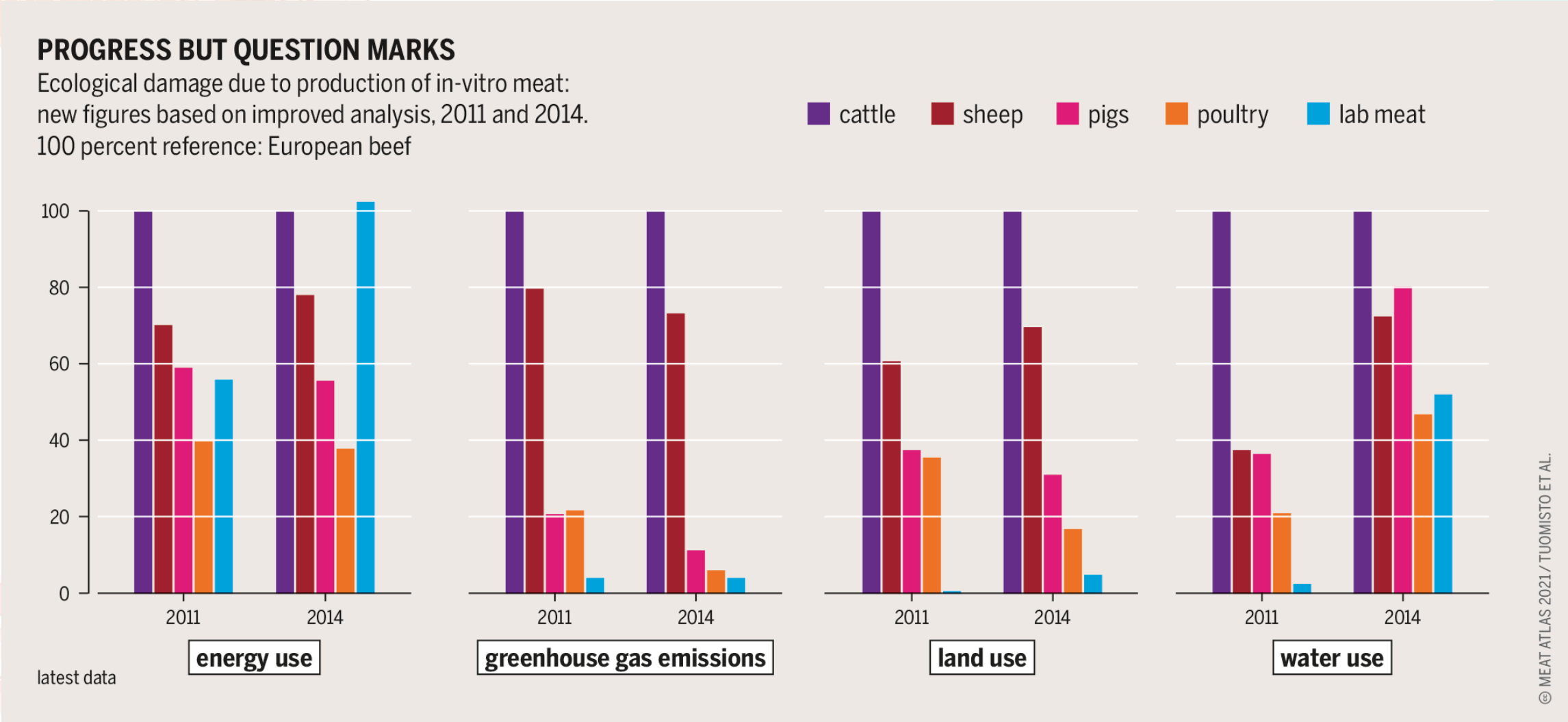
https://www.youtube.com/watch?v=OWRwrQI3XOY

- 生產牲畜產生大量的二氧化碳也與地球暖化有關



https://eu.boell.org/en/2021/09/07/lab-meat-cellstock-vs-livestock

培養肉對於地球環境的好處有哪些?



https://eu.boell.org/en/2021/09/07/lab-meat-cellstock-vs-livestock

Sharing Vitality

人造肉獲美國FDA認證！在台灣可能碰壁？

2019/06/06 10:17

台灣進入民主時代後，政治人物都很愛講
只是意願問題：只要政府有心，經濟就能
還停留在拚就能贏的階段。造成工時才會

從「崛起」和「失落」來描述「台灣奇蹟
退」表徵的問題，來自於任何經濟體只要
謂知識問題,就是人力水平必須提升，和思

U.S. FOOD & DRUG ADMINISTRATION
Search Menu

Home / Food / Food Ingredients & Packaging / Human Food Made with Cultured Animal Cells

Human Food Made with Cultured Animal Cells

Share Tweet Linkedin Email Print

Human Food Made with Cultured Animal Cells

Inventory of Completed Pre-market Consultations for Human Food Made with Cultured Animal Cells

The ability to take a small number of cells from living animals and grow them in a controlled environment to create food made from cultured animal cells is an emerging area of food science. Advancements in cell culture technology are enabling food developers to use cells obtained from livestock, poultry, seafood, or other animals in the production of food.

There is currently no food made from cultured animal cells available for sale in the U.S.

Content current as of:
11/16/2022

Regulated Product(s)
Food & Beverages

2006/08/05 19:42

讚 2 分享 用LINE傳送

"素"假的！ 部分摻葷食

／台北市

您吃的素食，真的是純素嗎?這個數據，可能讓你很不安心。衛生署抽查市面上素食產品，二十三樣中，有十樣不合格，不合格率將近五成，有些是外包裝標示不明，還有四樣，竟然摻雜了豬牛魚等葷食成分。

傳統市場賣加工素食的攤販，不論豆腐豆干，黑輪，還是貢丸，想吃什麼全都有，這些產品經過烹調，就成了一道道美味佳餚，這一大口吃下去，當心吃到的，根本是葷的假素食。

假素食充斥 竟有逾5成摻肉

讚 LINE

2009/06/14 10:23

〔即時新聞／綜合報導〕市售素食竟傳出有超過五成含有肉品！根據媒體報導，調查局最新檢測發現，30件市售素食中，竟有17件驗出混有肉品，比例超過五成，相當誇張。

調查局以DNA檢測技術發現，有不肖業者加入牛肉漿或豬肉漿於素食中，欲使素食口感與真正肉品更相近。另外，還有部分業者因葷食、素食製造過程相同，使用相同工作檯、砧板及菜刀等，也使得殘留肉品混入素食中。

另外，這次調查中，包含素肉排、素火腿、素肉鬆、素水餃、素丸子等都被驗出含有肉品。調查局表示，若素食口感相當類似肉品，就極有可能含有葷食，提醒民眾多注意。

15種素料摻葷 衛署追查源頭

| 2004.06.11

植物肉以後

Like 31 電子報紙 1144觀看次 字級 大 中 小

【記者姜靖台北報導】素食裡竟摻有肉品！關懷生命協會最近送檢二十一種傳統市售加工素料食品，衛生署藥物食品檢驗局赫然發現其中有十五種攙雜動物成分，比例高達七成；進一步再主動抽檢市售素料也發現，部分素料也攙雜動物成分。

衛生署已請北市衛生局將問題素料封存，追查製造源頭，並呼籲民眾選購時要注意包裝完整及標示清楚的素料。

又見素肉摻葷！大圓滿火腿驗出雞成分

2017/07/31

0 讚 0 不愛 24446 0 0

Most Popular

1 讓經濟動物活得更快樂的「人道飼養」，正在畜牧產業崛起中！

2 【重量標示不明】買水產好像買冰磚？「包冰率」未標明惹爭議

3 「二氧化碳」將列食品添加物管理！2022年7月1日正式上路

4 麻油糯米雞飯讓你補過冬！口感Q彈、補身抗寒冬

5 【產地海域不明】混產地賺取價差亂象多！該如何強化產地標示規範？！

擔心吃到農藥超標的蔬果嗎？其實你有更好的選擇！

Sharing Vitality

後疫情時代
如何用飲食提升免疫力

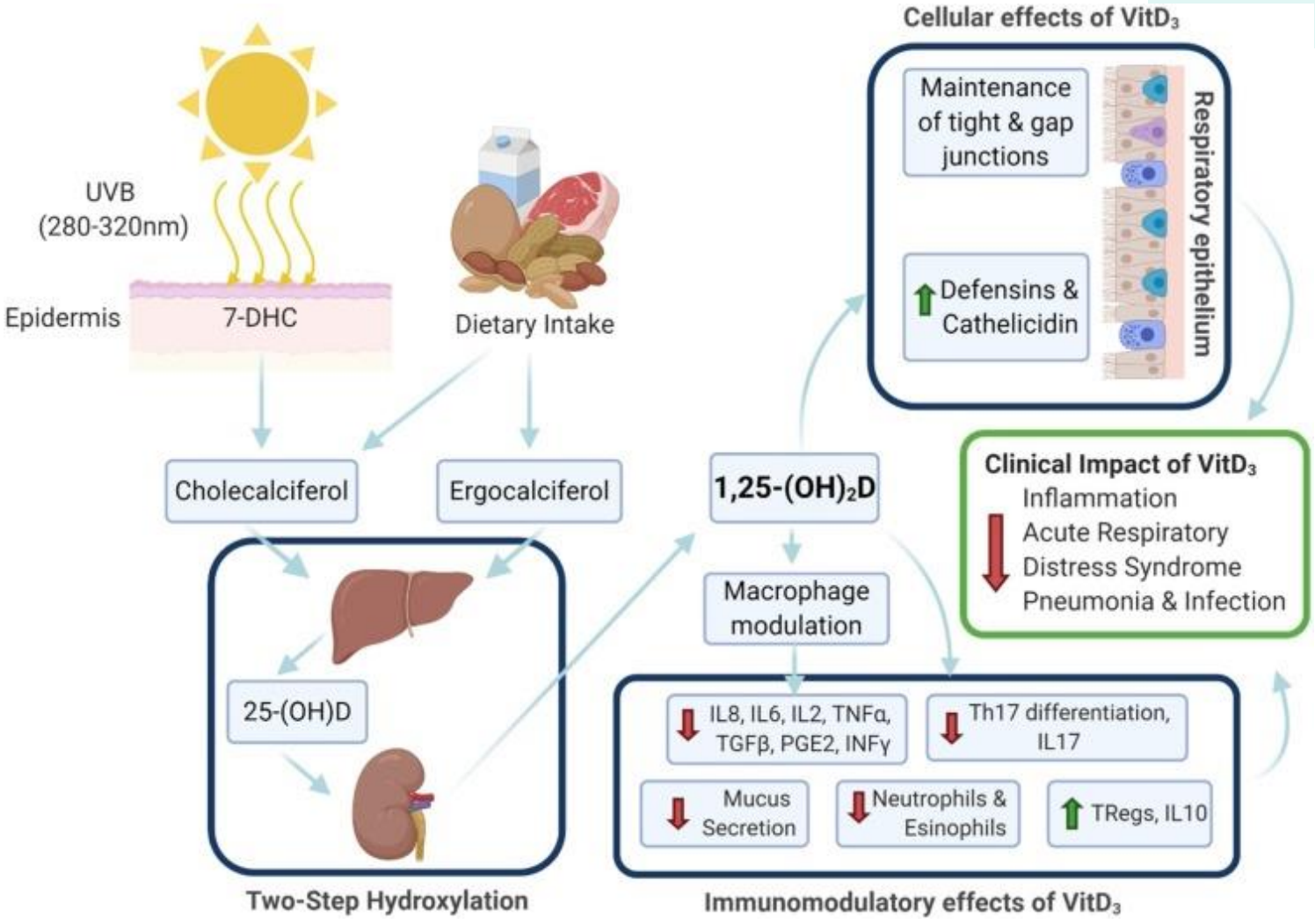
如何用飲食提升免疫力
提升免疫力的基礎營養概念

- **飲食要均衡**
- **飲水要充足**
- **蛋白質一定要足夠**：抗體的材料
- **好油也很重要：必須脂肪酸**(素食者可從堅果來)，黏膜系統健康、抗發炎
- **曬太陽**，或是補充**富含維生素D的食物**
- **攝取富含類胡蘿蔔素的食物**，讓身體轉換成維生素A，**增加黏膜系統健康**。
- **每日至少3蔬2果，補充維生素C**
- **礦物質**：鈣、鎂、**鋅**要充足
- **抗菌、抗病毒食材納入**：辛香料(大蒜、洋蔥、薑黃)、綠茶
- **補充益生菌**：養腸道好菌大軍

維生素 D 的免疫作用

- 維生素D2和D3對人體特別重要，進入血液循環後能調節鈣和磷的吸收，能促進骨骼生長和重構，也有助於提升免疫力。

- 當日曬充足時，人體便能自行合成維生素D3，但如果日曬不足則需要從食物攝取，維生素D2的食物來源以**植物類**為主，而D3的食物來源則以**肉類**為主。



https://pubmed.ncbi.nlm.nih.gov/33308613/

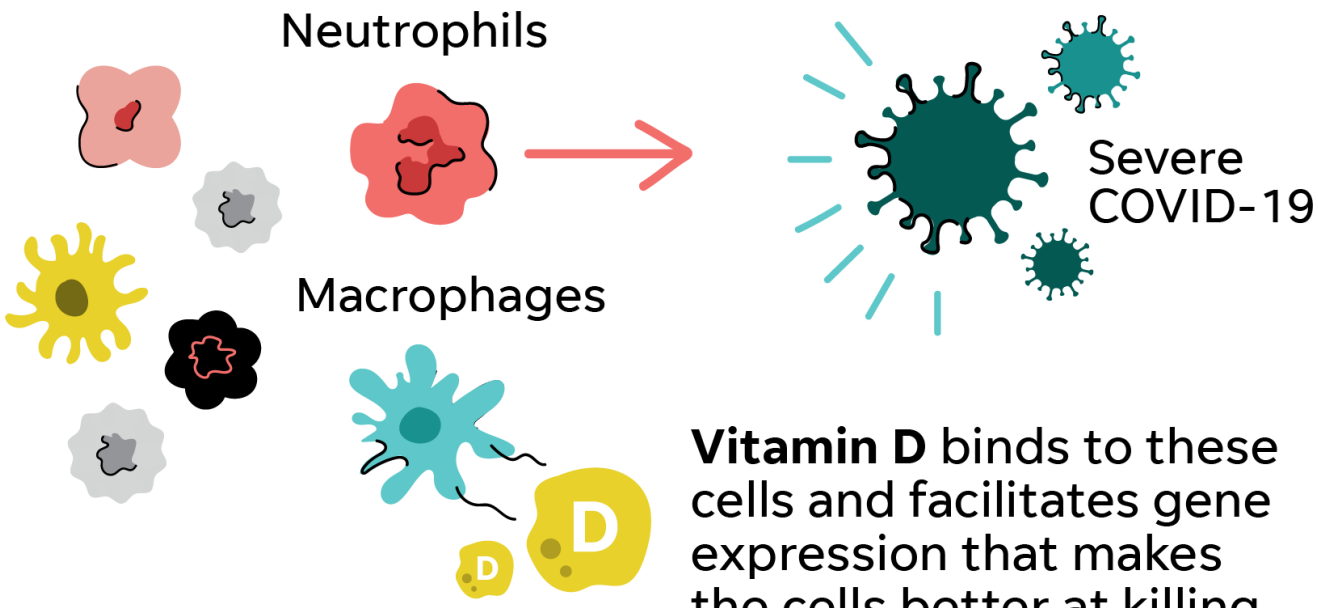
Vitamin D 之於先天免疫系統

Sharing Vitality

- Vitamin D 跟免疫細胞接合後，可活化免疫細胞，使之基因表現，讓免疫細胞有更強應對病原(COVID 19)的能力

Innate immune system

The innate immune system is the body's first line of defense. It activates macrophages, neutrophils and other cells to attack and destroy the outsider.



Vitamin D binds to these cells and facilitates gene expression that makes the cells better at killing pathogens.

Vitamin D之於適應性免疫系統

- Vitamin D 可降低專一性免疫細胞在肺泡因COVID 19引起的過度免疫反應<激素風暴>，使免疫細胞冷靜，以維持肺部細胞正常型態與機能。

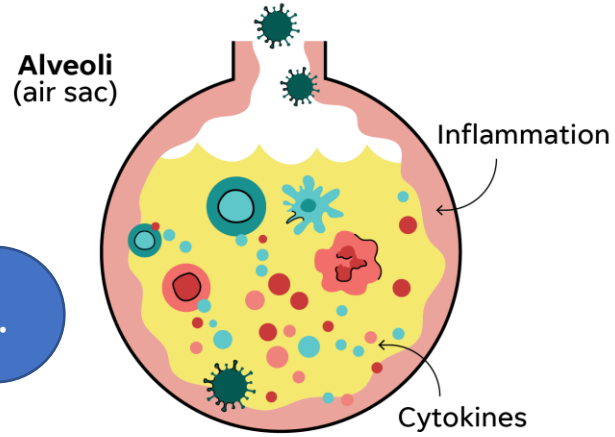
1.

The adaptive immune system

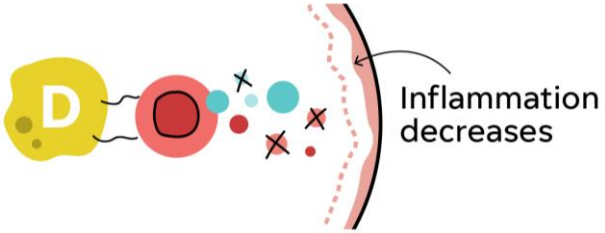
The second line of defense against pathogens is called adaptive immune response. The cells of the adaptive immune system are B cells and T cells. They produce antibodies that protect your body from a specific invader.

Cells of the adaptive immune system release **cytokines**, small proteins that attract more immune cells to the region, resulting in localized inflammation.

2.



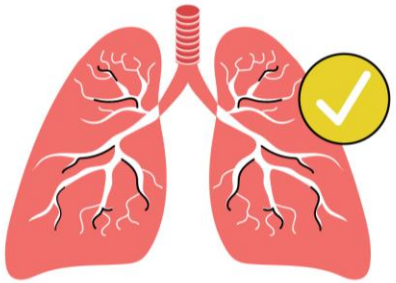
3.



As **Vitamin D** calms the adaptive immune system, cytokine levels drop and inflammation decreases.

With both innate and adaptive immune systems in check, ARDS and COVID-19 pose less of a risk.

4.



https://www.usatoday.com/in-depth/news/2020/06/09/vitamin-d-and-covid-19-could-low-vitamin-d-levels-affect-coronavirus/5274331002/

鈣質與免疫力

增強免疫力成分
維生素D x 鈣
日常容易攝取不足的營養
就靠飲食補回來！
日本健康最前線

免疫力
提升3方法！
MILK
乳製品
1天至少1品
以魚為主菜
曬太陽
一天至少20-30分鐘
日本健康最前線

Sharing Vitality

富含維生素D & 鈣質的食材

富含維生素D食材		
食材	一份量	維生素D含量
鮭魚	一切片(100g)	32g
蒲燒鰻魚	一串100g	19g
沙丁魚	一尾30g	15g
鯖魚	一切片100g	11g
鰤魚	一切片90g	7.2g
木耳	1g	4.4g
姬菇	1/4袋(25g)	0.6g
香菇	2個(30g)	0.6g

※參考資料來源：日經Health

富含鈣質食材		
食材	一份量	鈣含量
牛奶	200g	220mg
起士	20g	126mg
優格	100g	120mg
木棉豆腐	1/4丁(75g)	90mg
小松菜	1/4束(75g)	128mg

日本健康最前線

Sharing Vitality

開學營養補充抗疫情　乳品聰明好選擇

• 資料來源：國民健康署 • 建檔日期：109-03-03 • 更新時間：109-03-03

各級學校已經開學，擔心學童受武漢肺炎疫情影響的家長，可以多鼓勵小朋友補充乳品，透過足夠的營養來強化自身的抵抗力。根據2013~2016年國民營養健康狀況變遷調查結果顯示，約有8成以上學童每日攝取的乳品類不足1份（相當於1杯240c.c.的鮮奶或優酪乳）。乳品類不但有鈣質，還有優質的蛋白質、脂肪、維生素A、維生素B群等營養素。其中鈣質是構成骨骼、維持內分泌、免疫系統及神經傳導功能的重要物質；蛋白質也是構成免疫細胞的重要原料；乳脂肪中含有卵磷脂，是構成腦神經及細胞的必需成分，還能幫助脂溶性維生素吸收；維生素A和B群則參與生理代謝，並可維持免疫系統正常運作。

聰明選食 健康加值（每天早晚一杯奶 Every Day）

不只有鮮乳，像是優酪乳、起司、奶粉、羊乳等也富含同樣的營養，民眾可依自身需求選擇合適的產品，若有乳糖耐受不良的情況，可先從小份量開始嘗試，再慢慢增加攝取量，或是選擇乳糖含量低的優酪乳、起司，可避免引起腸胃不適。

Sharing Vitality

在疫情之下，增加自我防禦力!

額外的營養補充

- We propose that a nutritional supplement (e.g. containing **vitamins A, B6, B9, B12, C, D and E and the minerals Zn, Cu, Se and Fe**.
- A randomised controlled trial **of ≥5 servings of fruits and vegetables** per d compared with ≤2 servings in people aged 65–85 years reported a better response to pneumococcal vaccination in the group consuming the higher amount of fruits and vegetables
- 一日3蔬2果!!!
- 優質的蛋白質補充

British Journal of Nutrition

British Journal of Nutrition, page 1 of 2
© The Author(s), 2021. Published by Cambridge University Press on behalf of The Nutrition Society

Letter to the editor

Optimising COVID-19 vaccine efficacy by ensuring nutritional adequacy

Now that a number of COVID-19 vaccines are being employed to control the current pandemic, we are concerned about the likelihood of a poor response in the frail or malnourished elderly which would reduce the effectiveness of the vaccination campaigns.

Older people have a weakened immune response[1,2] and are known to respond less well than middle-aged adults to many vaccines including the seasonal influenza vaccine[3,4]. We note that the Oxford vaccine trial recruited older participants with 'few comorbidities, [who] might not be representative of the general older population, including those living in residential care settings or older than 80 years'[5]. Both the 56–69 and ≥70-year-old groups showed a lower IgG response and lower neutralising antibody titres to a single dose of the Oxford vaccine than did the 18–55-year-olds[5]. Hence, in the real-world setting, weaker older people may not gain the desired clinical protection from the vaccine and resource may be wasted. Poor vaccination responses in older people are related not only to frailty[6] which cannot be easily remedied, but also to deficiencies in micronutrients, which can be addressed.

An effective immune response requires an adequate host nutritional status[7]. In recognising this, the European Food Safety Authority has authorised nutrient function health claims for vitamins A (including β-carotene), B_6, B_9 (folate), B_{12}, C and D, and the minerals Zn, Se, Fe and Cu based on scientific assessment of their contributions to the normal functioning of the immune system[8]. Each of these micronutrients, as well as vitamin E, has been shown to have multiple key roles in supporting the immune system and reducing the risk of infections. This is detailed in recent comprehensive reviews that attest the importance of individual micronutrients to the immune response and explain the multiple mechanisms of action involved[9,10]. Human studies, particularly in the elderly, have associated impairments in immune markers to low status of micronutrients such as vita-

for optimal selenoprotein function has been associated with better cure rate from COVID-19[12].

A cause-and-effect relationship between micronutrient status and vaccination responses has been demonstrated through randomised controlled trials. Such trials in older people have shown better responses to vaccination after an intervention. For example, a randomised controlled trial of ≥5 servings of fruits and vegetables per d compared with ≤2 servings in people aged 65–85 years reported a better response to pneumococcal vaccination in the group consuming the higher amount of fruits and vegetables[13]. A study of vitamin E demonstrated improvement in response to some vaccines in individuals aged over 65 years given 60 or 200 mg vitamin E/d compared with those in the placebo group[14]. Se supplementation (50 or 100 μg/d) in adults in the UK with low Se status improved some aspects of their immune response to a poliovirus vaccine and also reduced the emergence of mutant viral strains[15].

Nutritional deficiency and malnutrition are common in the elderly. In a systematic review of intake and deficiency of eight trace elements in adults ≥ 60 years in seven Western countries, consistent nutritional insufficiency was found for Se, Zn, iodine and Cu[16]. Notably, Zn deficiency was observed in 31 and 49 % of community-based women and men, respectively, and in 50 and 66 % of women and men in institutional care[16]. Se intake was similarly compromised with deficiency found in 49 % of women and 37 % of men in the community and in 44 % of women and 27 % of men in institutions[16]. Significant proportions of both populations showed insufficiency for Fe, iodine and Cu[16]. Specific to the UK, the 2019 National Diet and Nutrition Survey showed 'a sustained worsening of the dietary intakes and chronic shortages of several of the nutrients involved in supporting the normal immune functions'; these included vitamins A, B_{12}, C and D and the trace minerals Zn, Se and Cu[17]. Such micronutrient deficiencies may limit the effectiveness of the COVID vaccines.

額外的營養補充

- **Vit D**：調節身體的血鈣平衡及免疫調節，有助心肺功能和心血管健康。

食物來源：菇類（香菇、洋菇或蘑菇等），動物來源包括鮭魚、秋刀魚、鴨肉、雞蛋以及豬肝

- **Vit C**：可以增強免疫力、促進傷口癒合、抗氧化跟防癌。

食物來源：生菜與水果，如芭樂跟柑橘類等

- **Vit E**：美國研究指出，增加維生素E的攝取可以減少罹患心臟病、中風、癌症、糖尿病、白內障、感冒和其他感染性疾病的的危機、提升免疫力。

食物來源：核桃、腰果等堅果，橄欖油及酪梨。

- **Se 硒**：硒是穀胱甘肽過氧化酵素的成分之一，幫助人體清除有害的自由基。可減少罹癌風險，也可調節免疫力。

食物來源：巴西堅果、沙丁魚、蝦、火雞、木耳及**大蒜**等

- **Omega 3 脂肪酸**：必須脂肪酸，修護皮膚等黏膜組織，有優異的抗氧化性，有益於心血管健康。

食物來源：海洋魚類、亞麻籽、核桃等

Maturitas 143 (2021) 1–9

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Review article

Immune-boosting role of vitamins D, C, E, zinc, selenium and omega-3 fatty acids: Could they help against COVID-19?

Hira Shakoor [a], Jack Feehan [b,c], Ayesha S. Al Dhaheri [a], Habiba I. Ali [a], Carine Platat [a], Leila Cheikh Ismail [d], Vasso Apostolopoulos [b], Lily Stojanovska [a,b,*]

[a] Department of Food, Nutrition and Health, College of Food and Agriculture, Al Ain, United Arab Emirates University, United Arab Emirates
[b] Institute for Health and Sport, Victoria University, Melbourne, Australia
[c] Department of Medicine, Western Health, The University of Melbourne, Melbourne, Australia
[d] Clinical Nutrition and Dietetics Department, College of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates

ARTICLE INFO

Keywords:
COVID-19
SARS-CoV-2
Pandemic
Immunomodulation
Vitamin D
Vitamin C
Vitamin E
Zinc
Selenium
Omega-3

ABSTRACT

The world is currently in the grips of the coronavirus disease (COVID-19) pandemic, caused by the SARS-CoV-2 virus, which has mutated to allow human-to-human spread. Infection can cause fever, dry cough, fatigue, severe pneumonia, respiratory distress syndrome and in some instances death. COVID-19 affects the immune system by producing a systemic inflammatory response, or cytokine release syndrome. Patients with COVID-19 have shown a high level of pro-inflammatory cytokines and chemokines. There are currently no effective anti-SARS-CoV-2 viral drugs or vaccines. COVID-19 disproportionately affects the elderly, both directly, and through a number of significant age-related comorbidities. Undoubtedly, nutrition is a key determinant of maintaining good health. Key dietary components such as vitamins C, D, E, zinc, selenium and the omega 3 fatty acids have well-established immunomodulatory effects, with benefits in infectious disease. Some of these nutrients have also been shown to have a potential role in the management of COVID-19. In this paper, evidence surrounding the role of these dietary components in immunity as well as their specific effect in COVID-19 patients are discussed. In addition, how supplementation of these nutrients may be used as therapeutic modalities potentially to decrease the morbidity and mortality rates of patients with COVID-19 is discussed.

1. Introduction

Coronavirus disease (COVID-19) is a global public health concern caused by the novel coronavirus SARS-CoV-2 and represents a significant threat to healthcare worldwide. It was first identified in a cluster of patients with pneumonia symptoms in Wuhan city, China, in late 2019. Initially, it was referred to as 2019 nCoV but was later renamed as COVID-19 by the World Health Organization. It is considered to be similar to the Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS) viruses. The virus can be transferred from human to human through respiratory droplets, contact and fomites. SARS-CoV-2 has two principal strains: 'L type' (70 %) and 'S' (30 %), with the L type being the more aggressive and contagious [1,2]. Symptoms of COVID-19 vary from asymptomatic, to severe, and include fever, dry cough, pneumonia, malaise, acute respiratory distress syndrome [3]. Approximately 80 % of confirmed cases have mild or moderate symptoms, 13.8 % having severe effects and 6.1 % showing critical symptoms, with older adults (≥ 60 years) at higher risk of developing severe disease [4]. According to worldometer as of 29 July 2020, SARS-CoV-2 virus has affected over 20 million people worldwide, with more than 732,000 deaths. By the time this paper is published these values will be doubled. These figures are also likely to be significant underestimations, due to lack of testing, reporting, and other factors.

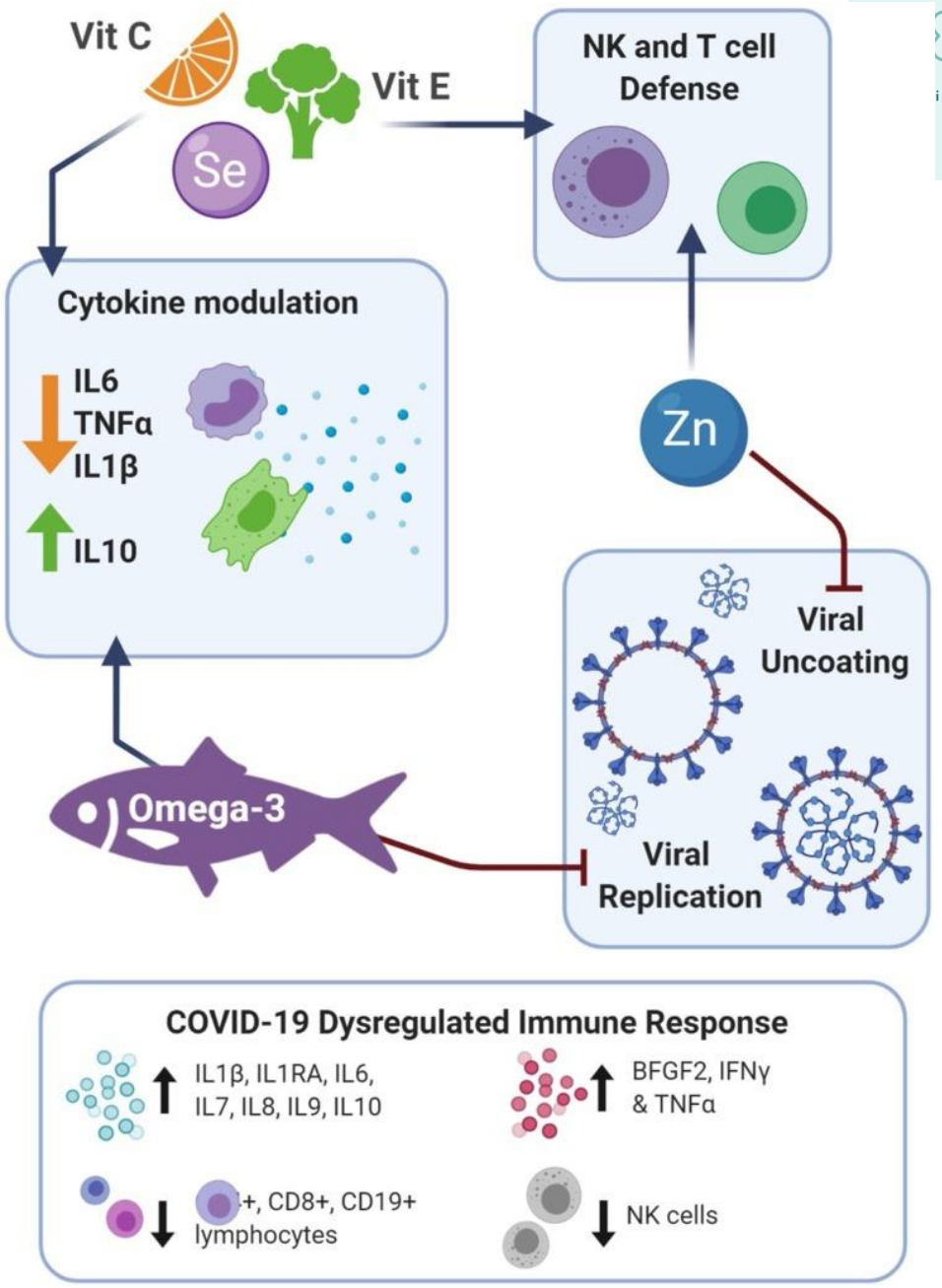
Currently, there are no approved treatments for COVID-19 but prevention strategies such as social distancing, public hygiene and wearing facial masks are the best current approaches to reduce COVID-19. Recent evidence has highlighted that nutritional supplementation could play a supportive role in COVID-19 patients. Administration of higher than recommended daily doses of nutrients such as vitamins D, C, E, Zinc and omega-3 fatty acids might have a beneficial effect, potentially reducing SARS-CoV-2 viral load and length of hospitalization [5–8]. These nutrients are well-known for their antioxidant properties

* Corresponding author at: Department of Food, Nutrition and Health, College of Food and Agriculture, Al Ain, United Arab Emirates University, United Arab Emirates.
E-mail address: lily.stojanovska@uaeu.ac.ae (L. Stojanovska).

https://doi.org/10.1016/j.maturitas.2020.08.003
Received 29 June 2020; Received in revised form 28 July 2020; Accepted 4 August 2020
Available online 9 August 2020
0378-5122/© 2020 Elsevier B.V. All rights reserved.

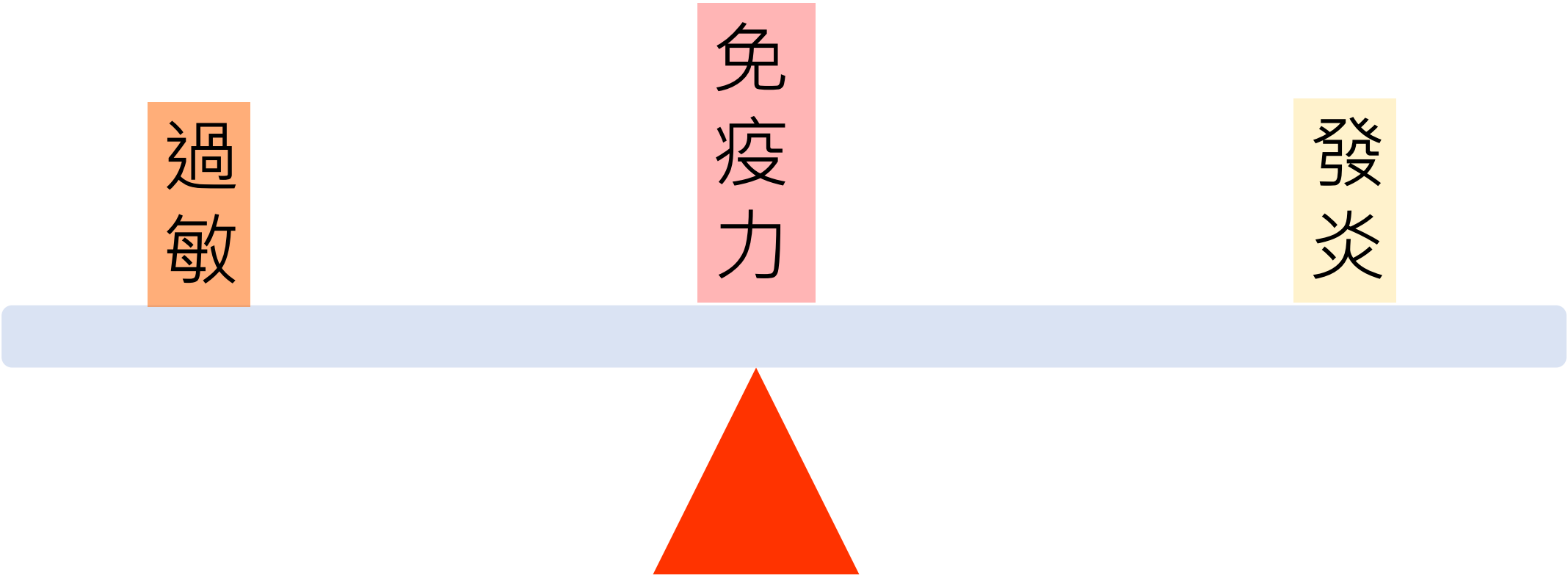
其他營養補充

- **元素硒**跟**維生素E** 目前已知可以增加呼吸系統被感染時的**防禦能力**。
- 其他有潛力對應 COVID-19 的營養素如**維生素 A 及 鎂**。
- **鎂**的缺乏會引起免疫缺陷，缺乏鎂會使免疫細胞活性降低，造成過度的免疫反應，譬如COVID-19 的免疫風暴。
- **鎂跟維生素D**的生理代謝也有關係，在人體內也能協助荷爾蒙的調節。
- **維生素A** 有助於對抗 COVID-19 及 SARS-CoV-2 的呼吸系統感染，是一個**廣泛性健康有益處的維生素**。
- **鋅**本身有抗病毒的效果，可增加細胞對病毒的免疫反應以外，鋅本身可以抑制並不複製的能力。
- **Omega 3** 本身有很好的**抗發炎**及**抗流感病毒複製的作用**，還可以修護因發炎反應受損的身體細胞。
- **營養補充劑**效果比飲食好



https://pubmed.ncbi.nlm.nih.gov/33308613/

免疫系統平衡才是身體最佳狀態



增進免疫力卻又能減少過敏之食材

- 1. **溫暖性香料**入菜或是做飲品，**通鼻**緩解鼻塞：如**薑**、**薑黃**、茴香、**黑孜然油**、八角、辣根、芥末
- 2. **維生素C** 豐富的水果：**減緩過敏症狀**，水果如：柑橘類、芭樂、草莓

- 3. 富含**類黃酮類**的蔬果、食物：類黃酮類中的**槲皮素（Quercetin）**減輕過敏症狀特別有效，食物中如：蘋果、洋蔥、茶、紅酒皆富含，建議可燉洋蔥蘋果雞湯。
- 4. 富含**鎂**的食物：鎂本身對身體有**鎮靜**的作用，減緩過敏反應，如：海帶、杏仁、腰果

增進免疫力卻又能減少過敏之食材

- 5. 富含**維生素E的食物**：維生素E，**脂溶性的抗氧化劑**，如堅果、橄欖油、酪梨、芒果、奇異果
- 6.富含**維生素D的食物**：充足的維生素D可以減少過敏引起的氣喘症狀，如：黑木耳、香菇、鮭魚、秋刀魚
- 7.**含 Omega 3 不飽和脂肪酸**的食物：Omega 3 不論 EPA、DHA 都有不錯的抗氧化效果，也可以修護皮膚組織，如：鮭魚、鮪魚、亞麻仁籽、核桃、黑孜然等
- 8. **益生菌：益生菌+益菌生**效果最好! 富含益生菌的食物：優格、優酪乳、起司、泡菜、味噌等

https://pubmed.ncbi.nlm.nih.gov/29723942/

同場加映　天菜營養師　Ricky