
THE FUTURE OF FOOD
Engineering Flavors of Single Cell Protein Ingredients


WEAR YOUR
SAFETY GLASSES

DISCLOSURE


NSF
CORPS
NSF Innovation Corps


HALCYON
incubator


REBELBIO™


LIGHTHOUSE
LABS


WFP


bethesda
green

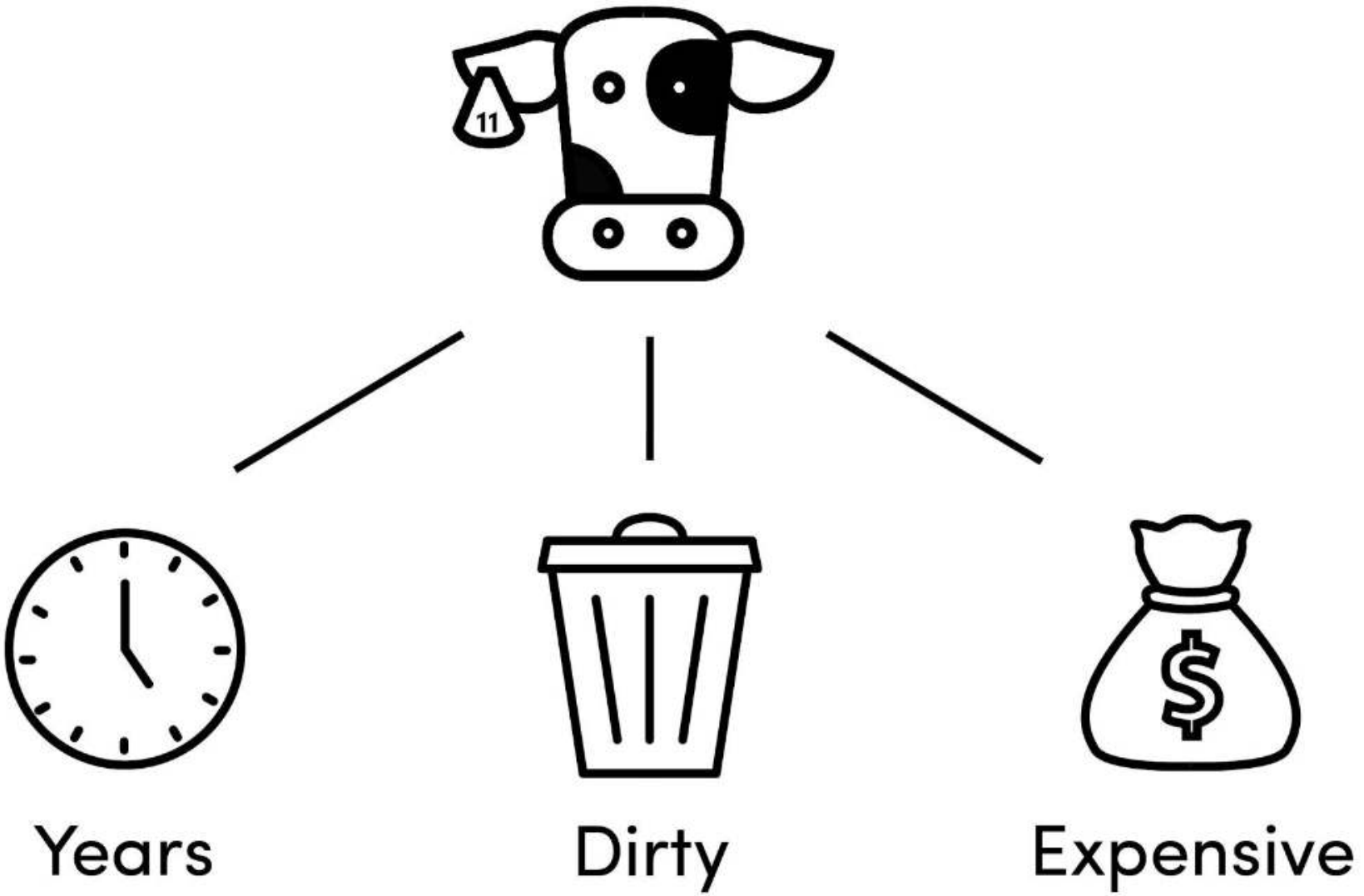
TAKEAWAYS

- TREND: Animal → Fermentation → Photosynthetic
- NON-GMO is NON-SENSE
- PROTEINS can produce any TASTE

The World Needs to Close a 70% Food Gap

70% **REQUIRED INCREASE** in food calories to feed **9.7 billion** people by 2050

Problem



SUSTAINABLE PRODUCTION ISN’T ENOUGH

EXHIBIT 3 | Growth Leaders Are Substantially Outperforming Their Peers

Sources: IRI ILD POS database, 2011–2017, MULOC; IRI and BCG analysis.
Note: Large is more than $5.5 billion, midsize is $1 billion to $5.5 billion, and small is less than $1 billion in sales in the past 52 weeks.

Photograph by Adam Levy
for Fortune Magazine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for Fortune Magazine
Campbell's
CONDENSED
DEATH BY 1,000 CUTS


Coca-Cola
Kraft
PepsiCo
Kellogg's
Mars
Nestlé
P&G
Johnson & Johnson
Unilever
Glacéau
Cadbury
Dr Pepper Snapple
Yum!
Quaker
Wrigley
Uncle Ben's
Wonka
L'Oréal
Pringles
Iams
Splenda
Spin-off
$$$
$$$ (30%)
(Parfums)

ALL need better ingredients

Opportunity

The food industry's relentless quest for better alternative **proteins** (soy, insect, pea protein, etc) continues as consumer demand for better ingredients grows rapidly.

79%

of US Millennials eat meat alternatives.[1]

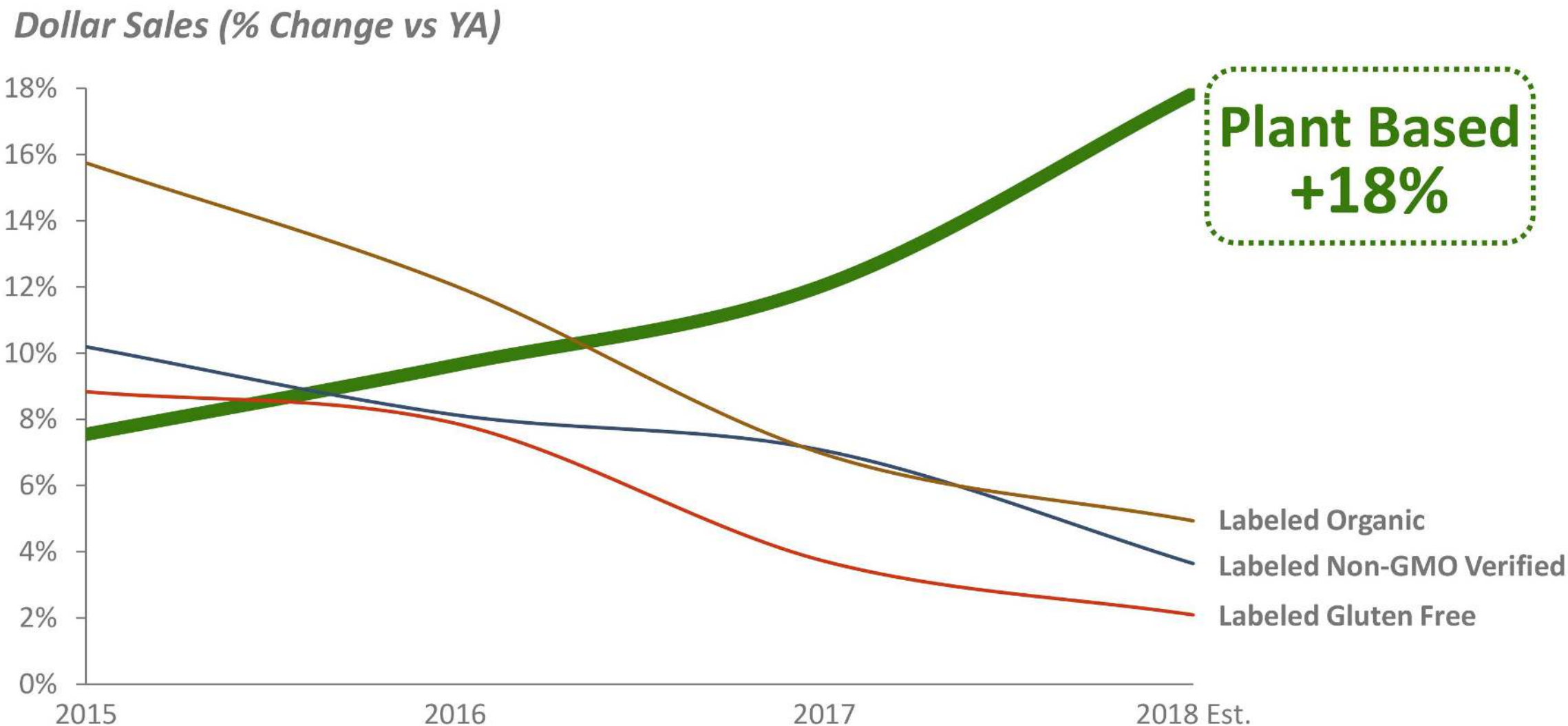
5.9% CAGR

Global Plant Based Protein Market was **$8.35 Billion in 2016** and is Estimated to Reach **$14.22 Billion by 2022**[2]

1: https://downloads.mintel.com/private/JL2q8/files/700023/

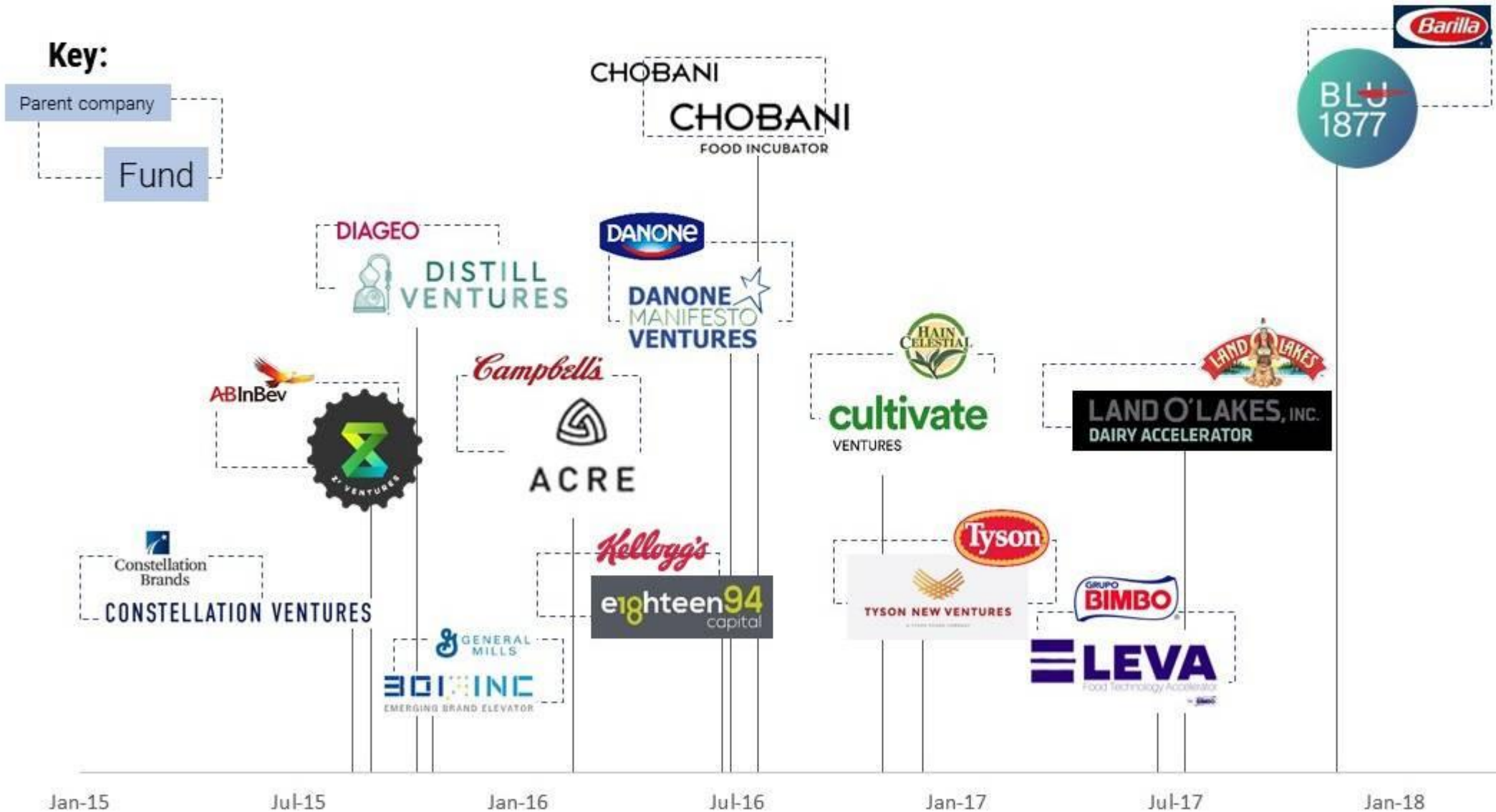
2: https://www.researchandmarkets.com/reports/4342820/global-plant-protein-market-by-sources

Plant Based is outpacing growth of Labeled Organic, Gluten Free, and Non GMO



Major food companies launch investment vehicles

A timeline of recently launched venture funds/incubators by date of initial announcement




SINGLE-CELL PROTEINS

TREND

animal → fermentation → photosynthesis

TREND

animal → fermentation → photosynthesis

CELLULAR AGRICULTURE

algae-based shrimp

Perfect Day
animal-free milk

plant-based burger patties

IMPOSSIBLE

Hampton Creek
plant-based mayonnaise

cheese from yeast

Finless Foods
slaughter-free fish

MEMPHIS MEATS
cell-cultured chicken

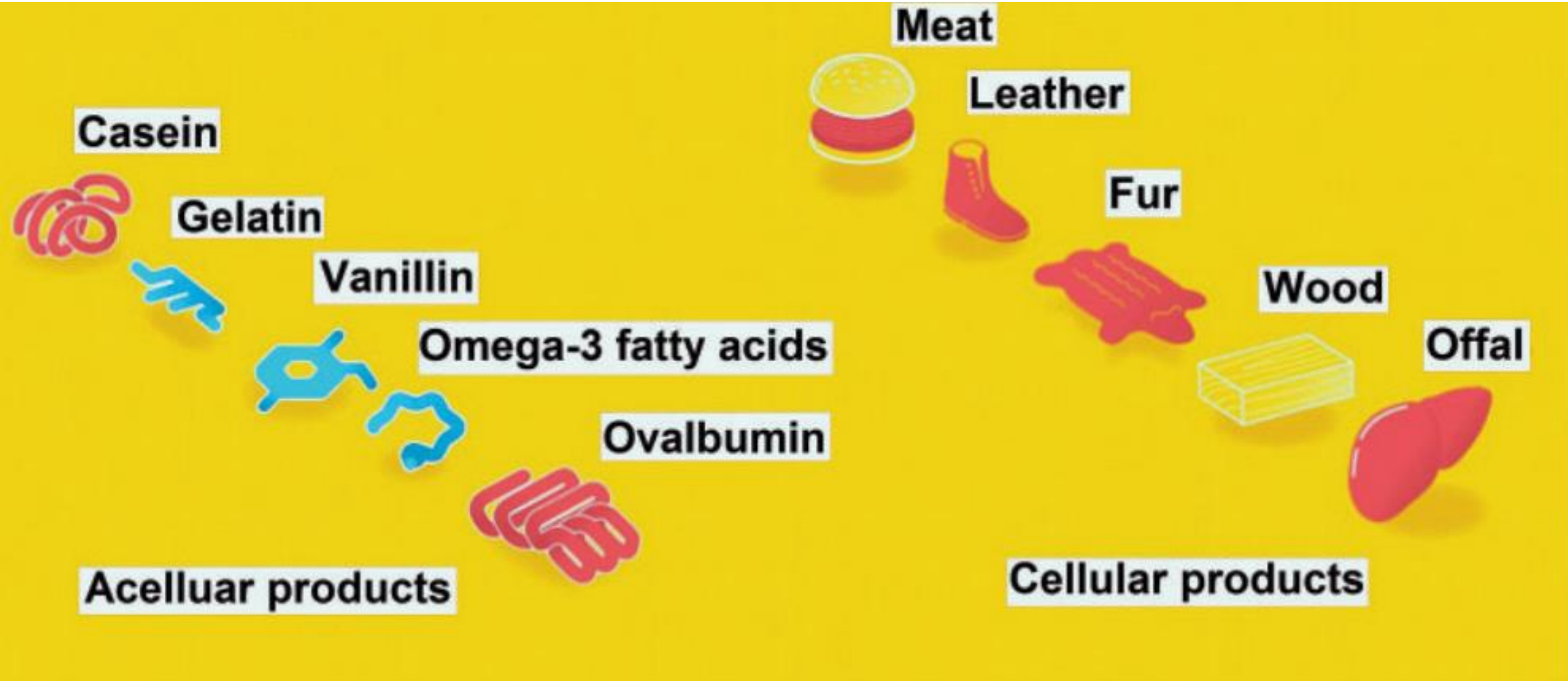
Ava Winery
grape-free wine

Clara Foods
egg whites from yeast

evolva
microbial vanillin

afineur
civet coffee without the civets

CELLULAR AGRICULTURE




Clara Foods


MEMPHIS
MEATS


Perfect
Day
Animal-free
Milk
2%
Brewed with love
in San Francisco, CA
1 Liter (750 mL)


GINKGO BIOWORKS
BIOLOGY BY DESIGN


NON-GMO is NON-SENSE
PRO
GMO
soylent
400 kcal


ALL of these companies still rely on sugar

TREND

animal → fermentation → photosynthesis

FOOD IS POWERED BY THE SUN

#originalenergy

EVERY STEP LOSES ENERGY

10% each trophic level


BACK TO THE BASICS

“Spirulina is the best food for the future”

-UN Food Conference (1974)

Spirulina

60% Protein-by-weight

10x iron as spinach

more carotenoids than carrots

low calorie + carb

13 vitamins **8** minerals

Doubles Daily

THE LEAN GREEN ALGAE BALL

Tomorrow's Meatball

Future of Alternate Protein Market

The global protein alternative market is currently valued at **$8.1b** and is expected to witness a **CAGR of 6.8%** during 2017-2022. By 2022 global demand is expected to be **20-25%** higher than current levels.

Pea

The number of new products containing pea protein grew by **195%** from 2013 to 2016.

Insect

The edible insect market is valued at about **$100m** and is forecast to grow to more than **$1.5bn** in 2021.

The insect feed sector is expected to reach **$1bn** in 2022 from more than **$30m** in 2017.

Soy

The global soy market is expected to reach **$5.8 billion** by 2022.

Whey

The global whey protein market is forecasted to reach **$12.4 billion** by 2021.

Future of Alternate Protein Market
Continued

Microalgae Competitive Advantage

- Higher protein yield per unit (**2.7-7.5 tons/year**) compared to soybean and legumes (**.6-1.2 tons/year**)
- Minimal flavor and texture impact compared to other alternatives
- Contains higher amount of amino acids and other vitamins

Companies that have invested in alternative protein in 2016-2017:

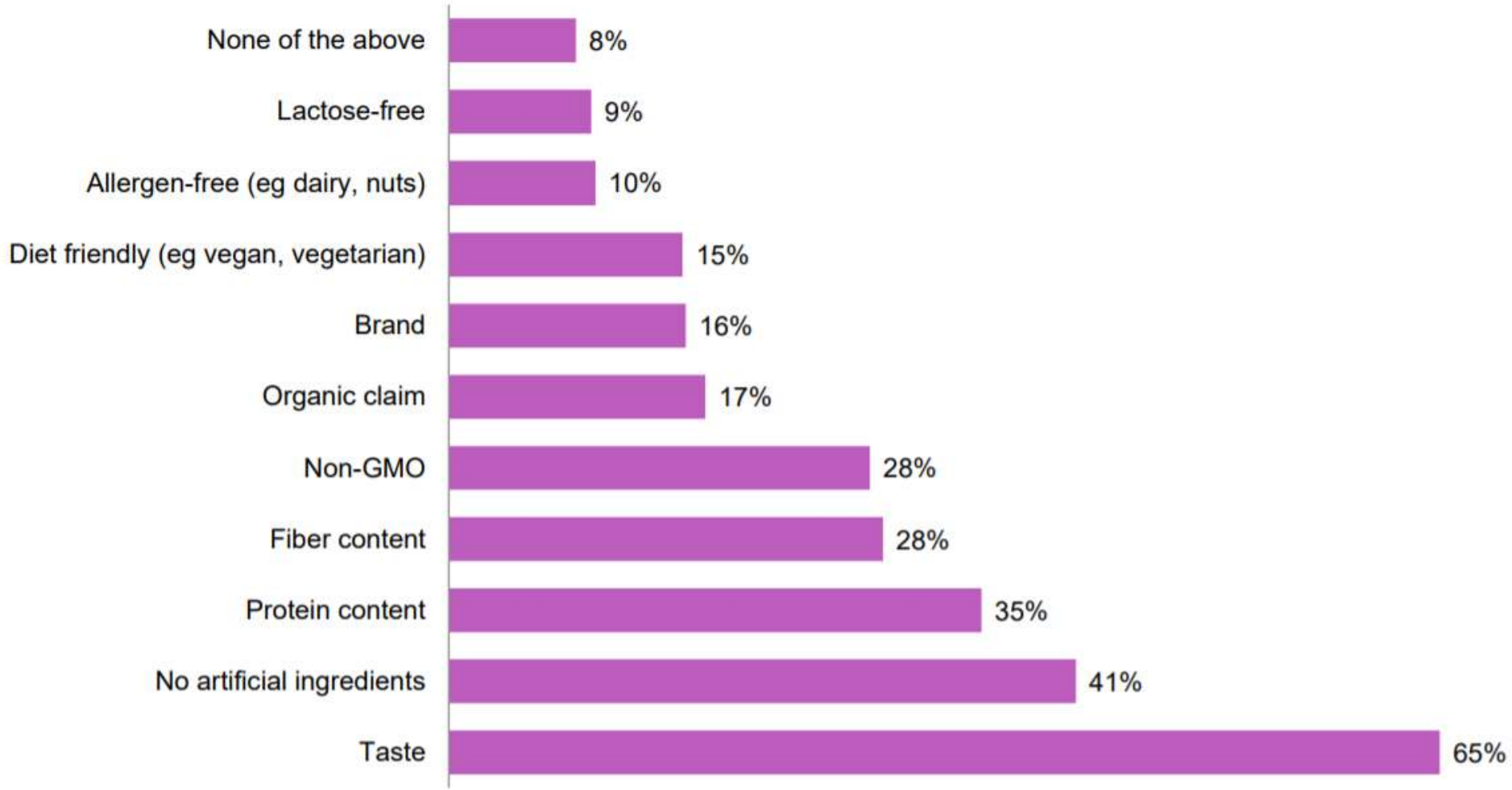
Frito Lay Tyson Nestlé Campbell's

Spirulina: Advantage

	Protein %	Growth rate (days)
Spirulina	**60%**	**1**
Insects	45%	28
Soy	35.9%	210
Peanuts	26%	150

Sustainability isn't enough. Products must taste great.

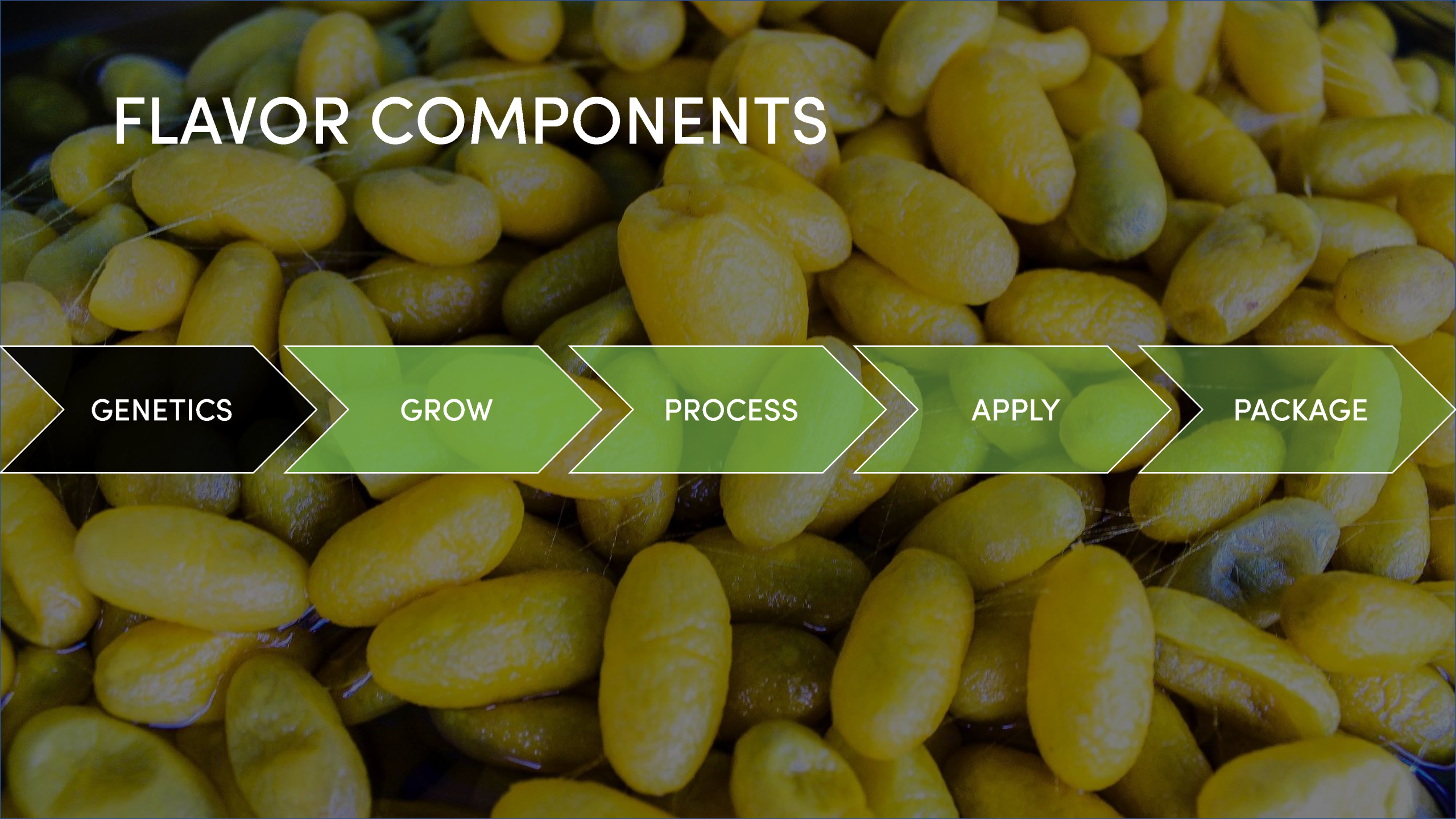
US: Important factors when buying a product with plant-based protein, October 2017



Base: 1,876 internet users aged 18+ who eat plant-based proteins
Source: Lightspeed/Mintel

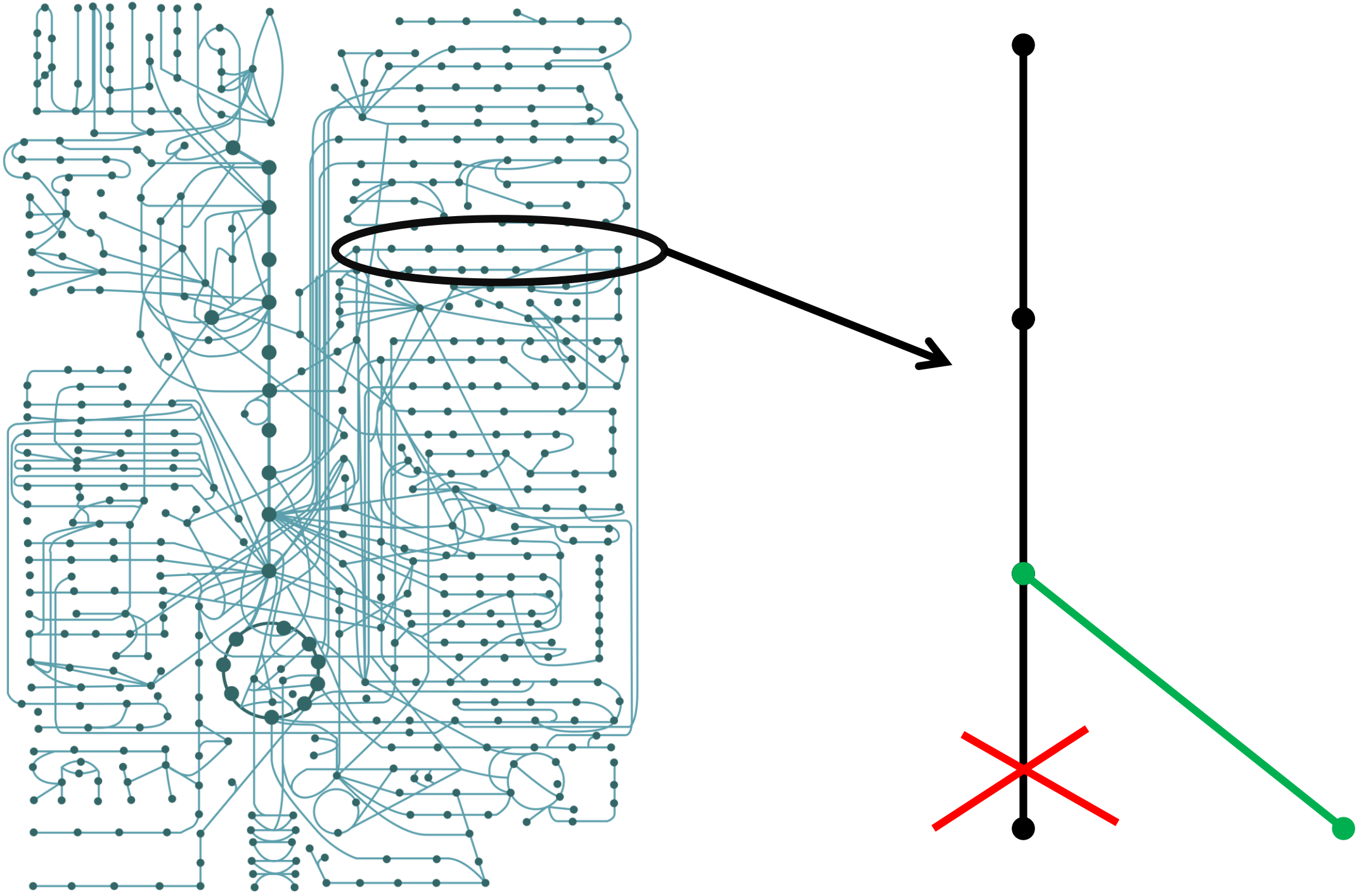

ENGINEERING TASTE

FLAVOR COMPONENTS



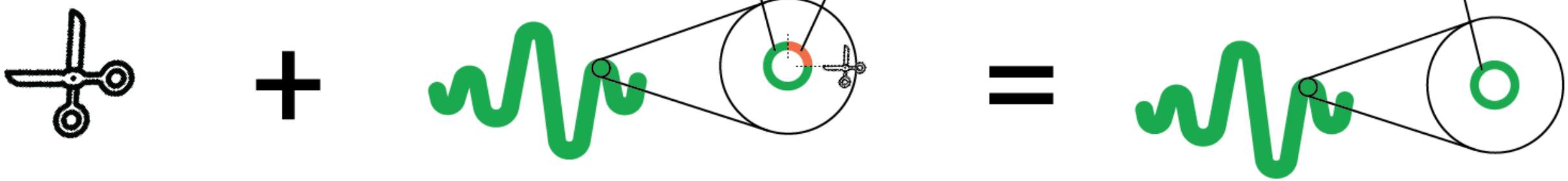

3C
2OH
H_2O
ADP
OXYGEN


Glycan Biosynthesis and Metabolism
Nucleotide Metabolism
Metabolism of Cofactors and Vitamins
Biosynthesis of Other Secondary Metabolites
Lipid Metabolism
Carbohydrate Metabolism
Amino Acid Metabolism
Energy Metabolism
Metabolism of Terpenoids and Polyketides
STEP 1: PATHWAY SELECTION




STEP 2: GENETICS

GENE DELETION

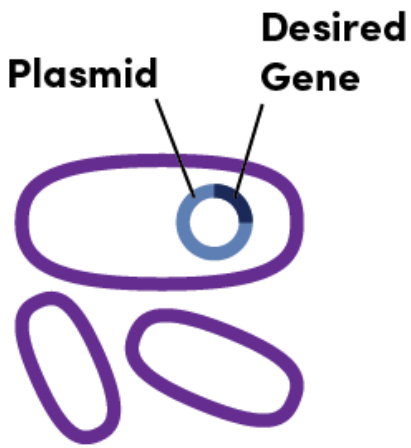


CRISPR / Cas Protein

Spirulina

Edited Spirulina

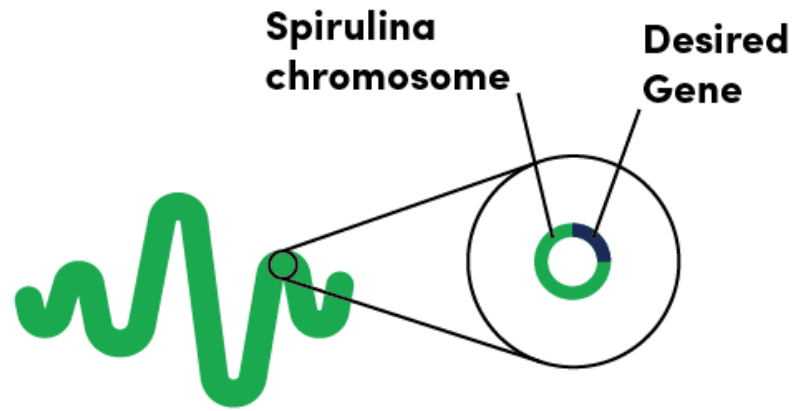
GENE INSERTION



+

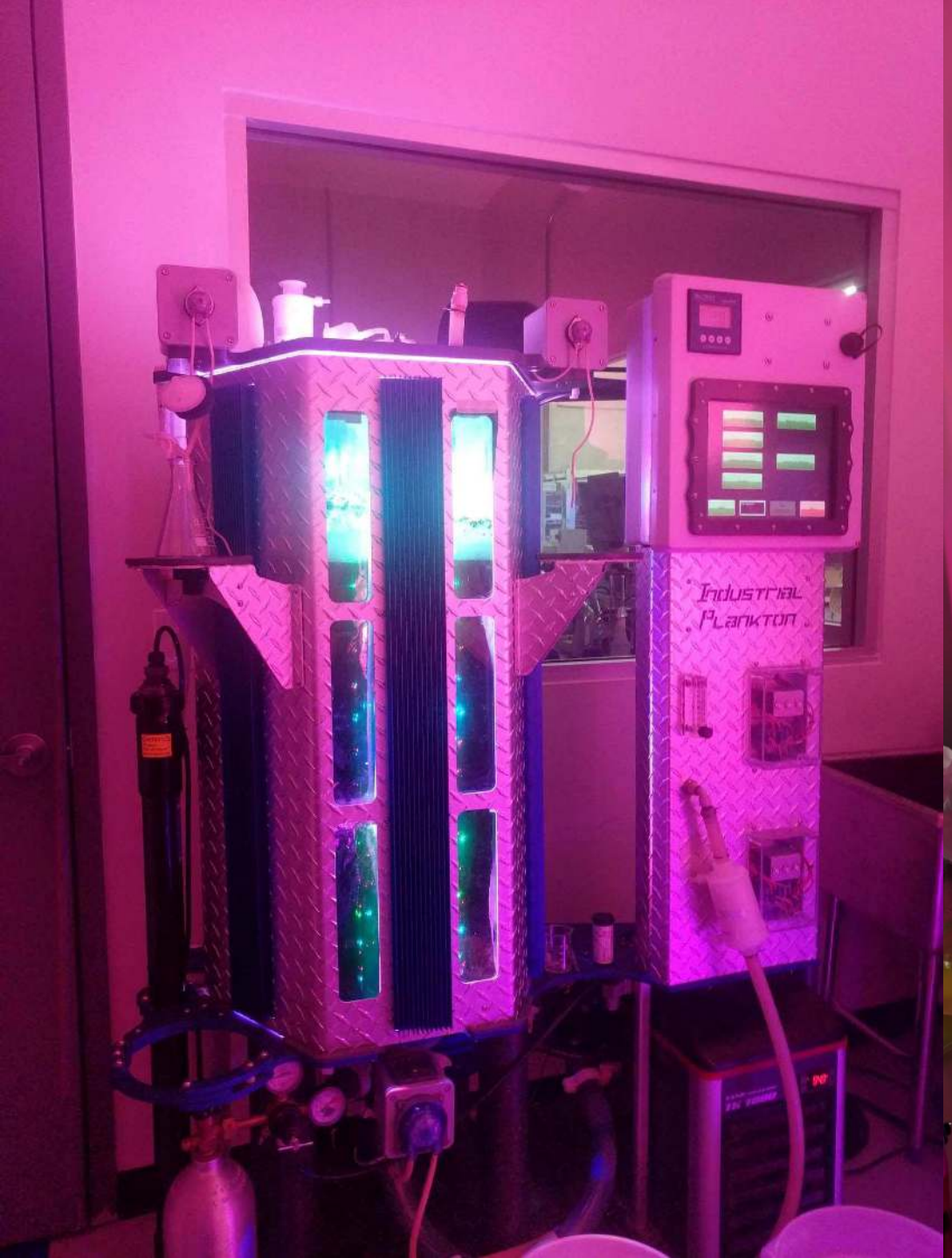
Spirulina

=



Edited Spirulina


STEP 3: GROW


Industrial
Plankton



STEP 4: PROCESS

Ingredient Platform

Natural Spirulina

Phycocyanin

Protein Isolate

Chlorophyll


NUTRITION ANYWHERE
EFFORTLESSLY

TAKEAWAYS

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Thank you

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