

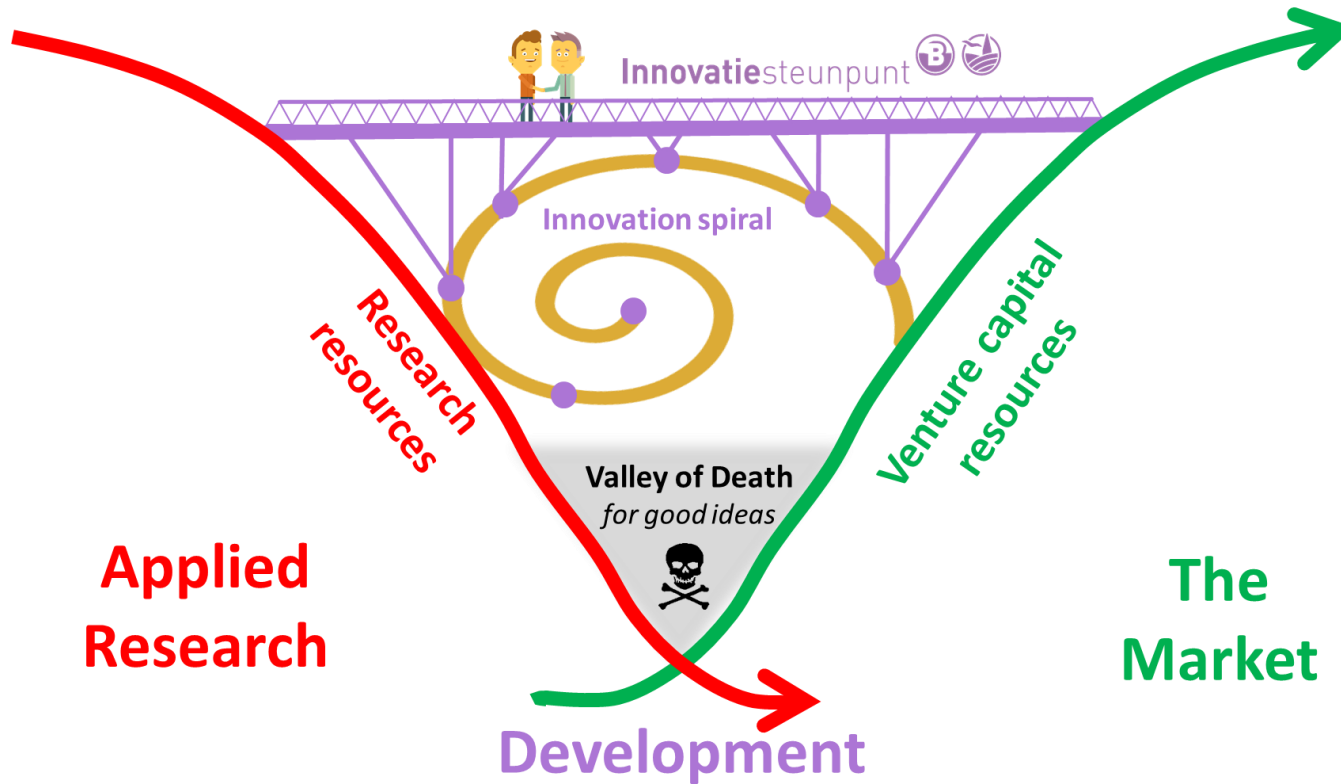


Potential uses and markets

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Why start growing algae?

- Wide range of applications
 - Food (nutraceutical – proteins, lipids, pigments, carbohydrates, natural colorants)
 - Feed (feed supplements, as whole algae for the aquaculture)
 - Cosmetics
 - Chemistry (dyes, ...)
 - Water treatment
 - Gaining resources out of watery streams on the farm
 - Reuse of water in greenhouse
 - Fertilizer
 - Biofuel
 - ...

Human food

- Thousands of algae species, some edible, some toxic
- Whole algae or only fractions
- Companies that market *Chlorella* for human nutrition (located in e.g. Japan, USA, Taiwan, Germany and Kazakhstan)
- Companies that market omega-3 from chlorella (located in e.g. USA, New Zealand, Germany and the Netherlands)
- Healthy compounds
 - Arachidonic acid (growth of muscles and fatty acid in the brain)
 - EPA: reduce inflammation, decrease depression
 - DHA: structural component of human brain, eye, skin, heart, ...

Nutraceutical

- Rich in compounds that have health benefits:
 - E.g. spirulina
 - High protein content (55-70%)
 - Vitamins (B1, B2, B3, B6, B9, B12, vitamin C, D and E)
 - Essential amino acids
 - (Dietary) minerals (K, Ca, Cr, Cu, Fe, Mg, Mn, P, Se, Na and Zn)
 - Essential fatty acids
 - Lipid
 - Polyunsaturated fatty acids (PUFAs) constitute 1.5-2% of the total lipid content of this alga.
 - Linolenic acid (36% of the total PUFAs)
 - Pigments (e.g. chlorophyll a, betacarotene, C-phycoerythrin, allophycocyanin)
 - Enzymes (e.g. lipase)
 - Carbohydrates (starch, glucose, sugars and other polysaccharides)

Lipids

- 1%- 70% (90% reported) depending conditions
- Sugars
- Glycerol
- Bases esterified to saturated or unsaturated fatty
- $\omega 3$ and $\omega 6$
- Can vary by conditions: nutrition, environment, nitrogen

Vitamins

- Nearly all essential vitamins
- Quantity depends on
 - Environmental factors
 - Harvesting method
 - Drying method

Did you already eat algae?



Algae
products on
the market

Green smoothie gourmet



The algae factory

chocolat bar with spirulina



Vegan Chocolate Chip Cookies With Matcha and Chlorella



Bertolini farm



Animal feed

- *Frequently used: Chlorella* as a whole for fish, shellfish and shrimps.
- As animal feed supplements, e.g. *Chlorella*, *Scenedesmus* and *Spirulina* for enhanced immune response, improved fertility, better weight control, healthier skin and coat.

Cosmetics

- Sun protection (Chlorophyll-a)
- Skin care compounds: anti-aging, refreshing, regenerant, emollient, anti-irritant
- UV protection
- Products already commercially available
- Mostly based on *Chorella* species
- High added value
- High requests

Waste water treatment

- Third step in waste water treatment after sedimentation and oxidation
- Remove heavy metals and toxic organic compounds
=> algae have to be checked for those compounds
- Nutrient recovery in feeding water of greenhouses.
- Application:
 - Remove nutrients from waste water of fish farm
 - Recover nutrients from anaerobic digestion: ALG-AD

Biofuel

- Biofuel: biodiesel and biogas
- Lipids in algae
- On land that isn't usefull for other purposes and where salt water is present
- Low production costs needed.
- Huge amounts of algae needed => huge investments
- Not economically feasible yet.

Where to start?

- Purpose?
- Destination of the algae => client
- What algae to grow?
- Where to grow/ growth system
- Nutrients
- Salinity
- PH
- Temperature
- Light intensity
- Harvesting method (stress)
- Moisture content
-

How to valorize?

- Process in own products
 - feed for your animals (expensive)
 - Use for own aquaculture
 - in ice cream
 - in cookies
 - In smoothies
 - ...
 - Sell as whole dried algae
 - Attention with novel food legislation!!
- Sell to processor

Challenges for algae farming

- 1) Find the application the want to grow algae for
- 2) Energy source they want to use for feeding the algae (autotrophic, heterotrophic)
Ideally a source that is excessive present on the farm (CO₂ from biodigester and digestate)
- 3) Growth system
- 4) Growth conditions for the aimed application of the algae
- 5) Further processing steps:
 - Harvesting
 - Conservation
 - Transport
 - Drying
 - ...

Federation

- Starting on your own = risky
- Work together
- Tackle common challenges together

Thank you for your attention

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