Alternative Protein India

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UNIVERSITY & RESEARCH

schouten

E3

CCE

Agenda

- Introduction into the project
- Overview of fermentation processing for proteins
- Project findings
- Changes in the project + conclusions

India-Dutch API Consortium

The API Indian-Dutch consortium envisions a two-tier supervision structure for delivering the ambitious objective of introducing safe- and affordable AP products to the Indian domestic market by Q3 2023.

Role: To Launch an API Protein Powder based protein enrichment production facility in India

Objectives:

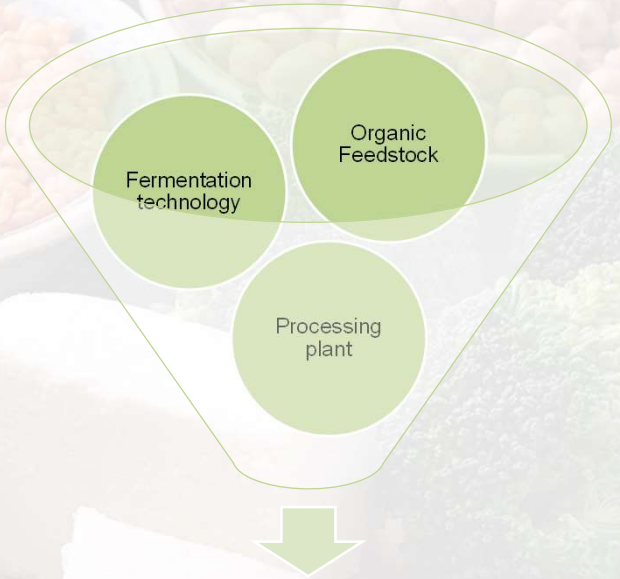
- **The What?**: Mitigate structural protein deficiency for 80% of India's population starting 2023.
- **The How?:** Through sales of domestically produced Protein based protein enriched product(s)
- **The When?:** To Start production Q3 2023 @ installed capacity of 50 Kton/annum

Stakeholders Framework:

- A 10 year co-siting governance agreement based on multiple year strategic outlook
- Operational plan/SLA's and supervised by a board structure.

Program Milestones

Milestones	Target Date
Develop First Cut-Business Case for API Project	February 2021 - Complete
SMP Program update and Raw Material Selection Framework with Wageningen University	Q3 2021
Technology, Market and Location Feasibility	Q3 2021
Shortlist qualified site locations Conditional plan for compliance pre-construction and CTE/CTO approvals	Q4 2021
Concept design for API site and facilities ready, and EPCM for critical path buildings/infrastructure ready for kick-off	Q3 2022
Start API Protein Powder production	Q3 2023



Q3 2023: start API production and distribution in India

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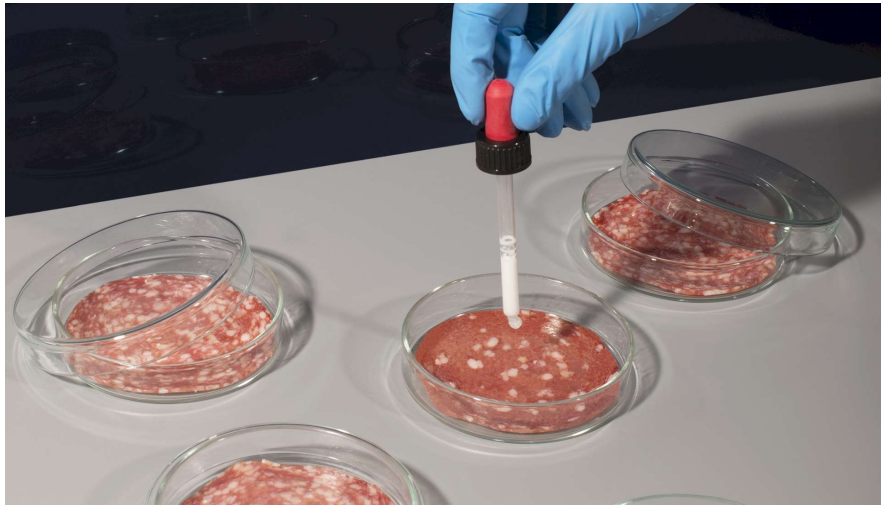
Fermentation technologies for proteins 1
Fermentation of protein-rich feedstock

- substrate: soy protein, wheat protein, ...
- micro-organisms for instance funghi/moulds
- added value:
  - reduce non-protein fraction
  - improve attractiveness or protein bioavailability
- example: tempeh

https://www.schoutenfood.com/vegetarian-products/vegan-tempeh-cubes-naturel/

Fermentation technologies for proteins 2
In vitro meat

- substrate: specific (proteins!)
- "starter": animal tissue (stem cells)
- added value:
  - similar to real meat
  - specialty!
- current challenges:
  - only thin layer production
  - prevent contamination
  - substrate
  - costs



https://www.volkskrant.nl/kijkverder/2018/voedselzaak/artikelen/kweekvlees-is-hard-op-weg-naar-uw-bord/

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Fermentation technologies for proteins 3
Convert sugar or starch to protein

- substrate: sugar, starch + N-source
- dedicated funghi
- added value:
  - sugar/starch from high-productive crops

https://www.quorn.nl/producten/vegetarische-stukjes

Fermentation technologies for proteins 4
Convert sugar or starch in crops to protein

- substrate: potatoes, sugar beet, ...
- dedicated
- added value:
  - sugar/starch from high-productive crops
  - texture of substrate
- 2021: demo plant (The Protein Brewery)

Image credit: The Protein Brewery

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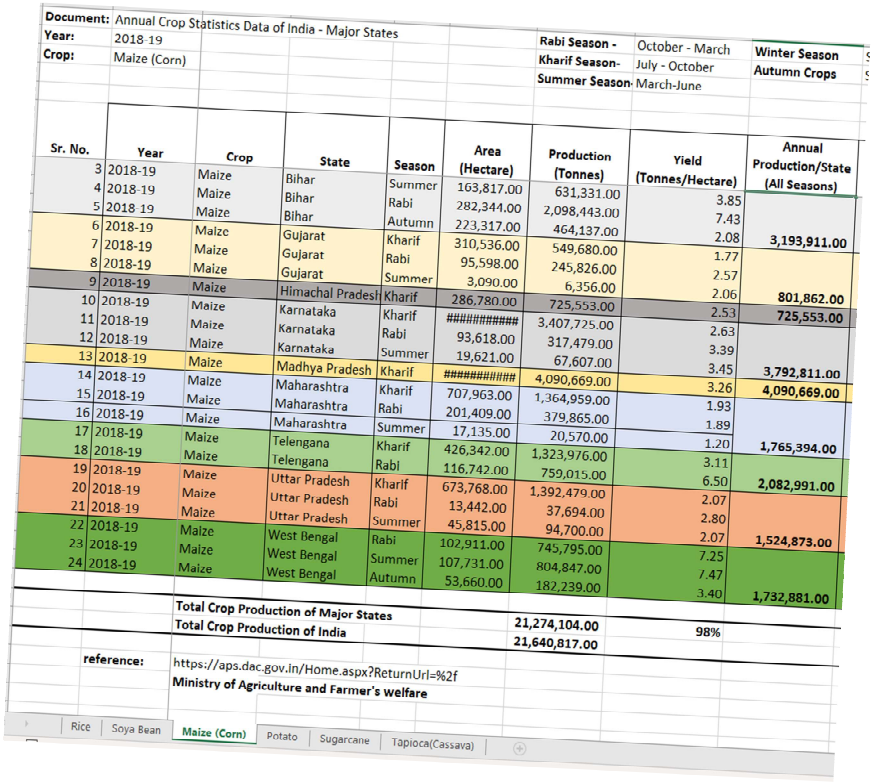
SMP project scope

- Technology
  - (considered) provided by third party
- Intended feedstocks:
  - residues (from agriculture and processing)
  - inventory of side streams in SMP-API project:
    - availability
    - composition/suitability



Document: Annual Crop Statistics Data of India - Major States
Year: 2018-19
Crop: Maize (Corn)

Rabi Season - October - March
Kharif Season- July - October
Summer Season- March-June

Sr. No.	Year	Crop	State	Season	Area (Hectare)	Production (Tonnes)	Yield (Tonnes/Hectare)	Annual Production/State (All Seasons)
3	2018-19	Maize	Bihar	Summer	163,817.00	631,331.00	3.85	
4	2018-19	Maize	Bihar	Rabi	282,344.00	2,098,443.00	7.43	
5	2018-19	Maize	Bihar	Autumn	223,317.00	464,137.00	2.08	3,193,911.00
6	2018-19	Maize	Gujarat	Kharif	310,536.00	549,680.00	1.77	
7	2018-19	Maize	Gujarat	Rabi	95,598.00	245,826.00	2.57	
8	2018-19	Maize	Gujarat	Summer	3,090.00	6,356.00	2.06	801,862.00
9	2018-19	Maize	Himachal Pradesh	Kharif	286,780.00	725,553.00	2.53	725,553.00
10	2018-19	Maize	Karnataka	Kharif	###########	3,407,725.00	2.63	
11	2018-19	Maize	Karnataka	Rabi	93,618.00	317,479.00	3.39	
12	2018-19	Maize	Karnataka	Summer	19,621.00	67,607.00	3.45	3,792,811.00
13	2018-19	Maize	Madhya Pradesh	Kharif	###########	4,090,669.00	3.26	4,090,669.00
14	2018-19	Maize	Maharashtra	Kharif	707,963.00	1,364,959.00	1.93	
15	2018-19	Maize	Maharashtra	Rabi	201,409.00	379,865.00	1.89	
16	2018-19	Maize	Maharashtra	Summer	17,135.00	20,570.00	1.20	1,765,394.00
17	2018-19	Maize	Telengana	Kharif	426,342.00	1,323,976.00	3.11	
18	2018-19	Maize	Telengana	Rabi	116,742.00	759,015.00	6.50	2,082,991.00
19	2018-19	Maize	Uttar Pradesh	Kharif	673,768.00	1,392,479.00	2.07	
20	2018-19	Maize	Uttar Pradesh	Rabi	13,442.00	37,694.00	2.80	
21	2018-19	Maize	Uttar Pradesh	Summer	45,815.00	94,700.00	2.07	1,524,873.00
22	2018-19	Maize	West Bengal	Rabi	102,911.00	745,795.00	7.25	
23	2018-19	Maize	West Bengal	Summer	107,731.00	804,847.00	7.47	
24	2018-19	Maize	West Bengal	Autumn	53,660.00	182,239.00	3.40	1,732,881.00

	Total Crop Production of Major States	21,274,104.00	98%
	Total Crop Production of India	21,640,817.00	
reference:	https://aps.dac.gov.in/Home.aspx?ReturnUrl=%2f		
	Ministry of Agriculture and Farmer's welfare		

Rice | Soya Bean | Maize (Corn) | Potato | Sugarcane | Tapioca(Cassava)

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Change in the project

Cumulation of “uncertainties”

- new market for Schouten
  (addressed through partnership with E3 and CCE)
- new feedstocks (side streams)
- new technology (link with Protein Brewery)
- new type of application (food fortification)
- even more challenging that current state-of-the-art in western world

Drop-out of technology supplier

Mitigation action: scan alternative technology suppliers

"Attractiveness matrix"

Version 2021-11			
Protein Fermentaton Technology (FT) attractiveness matrix (material – technology combinations)	**Zaki & Said (2018, Indonesia): Trichoderma Reesei single cell protein production from rice**	**Methane fermentation – Calysta/FeedKind (California) and Unibio/Uniprotein (Denmark)**	**Superbrewed Foods, formerly White Dog Labs**
Who collected the information below?	Jan Broeze		
Is technology proven and validated for production of Food products?	No	No	Yes, for cheese toppings on pizza and burgers
Is technology proven and validated for production of Feed products?	Proven in lab conditions.	Yes, FeedKind for shrimp and other aquacultivation, Uniprotein as additive in cattle feed	
Is technology proven and validated for production of Non-food products?	No	No	
Which applications are currently operationalized for products using this FT?	None to our knowledge	Use of total microbial biomass as protein-additive to feed	Non-animal cheese from microbial biomass
Is technology suitable for valorizing agriculture/food processing sidestreams?	Yes	Valorization of biogas deriving from digesters	Yes
Describe process cycle on pfd level (including pre-processing and fractionation)	Rice straw pulp and urea mixture is used as substrate for the production of local Trichoderma reesei single cell protein in a solid state fermentation system. The fungus used was Trichoderma reesei. Purification or further treatment of the product was not described.	Methane-oxidising bacteria have been isolated and growth on minimal media (only methane, ammonia and some salts) has been optimalised.	
Which sidestream componants (raw material) are targeted (carbohydrates fi) specifically, and why?	The authors explicitly mention lignin.	Methane in combination with ammonia is targeted specifically	
Does the process require catalyst/additives (Nitrogen/Ammonia fi)?	yes, urea	It requires ammonia and some growth-stimlating growth components	
If so; for which purpose?	nitrogen source	Ammonia addition is necessary for high protein production	
What are the typical operating temperatures/pressures/cultivation durage?	30 degrees celsius, atmospheric pressure, 21 days.	High-pressure increases the protein productivity, 30 C is typically used	
What is the nominal production capacity achieved by technology?	-		
What is the estimated maximum commercial production capacity?	-		
Which amino acids are typically targeted as output?	not mentioned		
What is the estimated water consumption rate/output unit?	Water used in pretreatment and for rinsing the pretreated material. No information about purifcation. No explicit mentioning of volume of water use.		
What limitations do you see for scaling up (like fresh material availability)?		The needed fermentors are very big, leading to safety issues/exploisan risks (Methane/oxidation mixtures)	Anaerobic fermentation typically leads to low protein production. Fermentatio big to produce significant amouints of protein
What would be the benefit of an Indian or western technology supplier?	-	Methane should be used, locally, to avoid long-distance transportation	
Does FT provider have existing IP/investor constraints to be taken into consideration when exploring collaboration?	not aware of		
What type of scale is the FT (lab, pilot, demo, commercial)?	lab		
Link to information source:	doi:10.1088/1757-899X/345/1/012043	www.calysta.com,	www.superbrewedfood.com
company or research institute name:		www.unibio.dk	

Conclusion:
technologies that generate proteins from carbohydrate sources are at best in demo phase...

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Thanks for your attention

The idea of developing a new solution for a new market was proven a complex challenge

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