Alternative proteins: food authenticity implications

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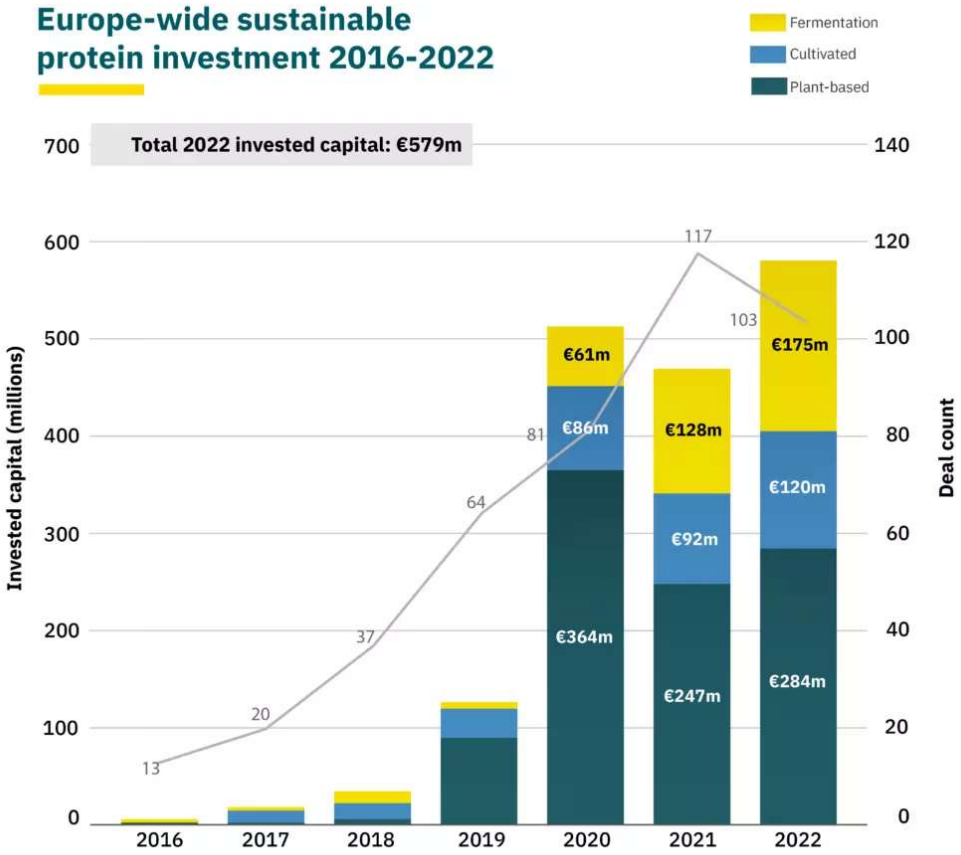
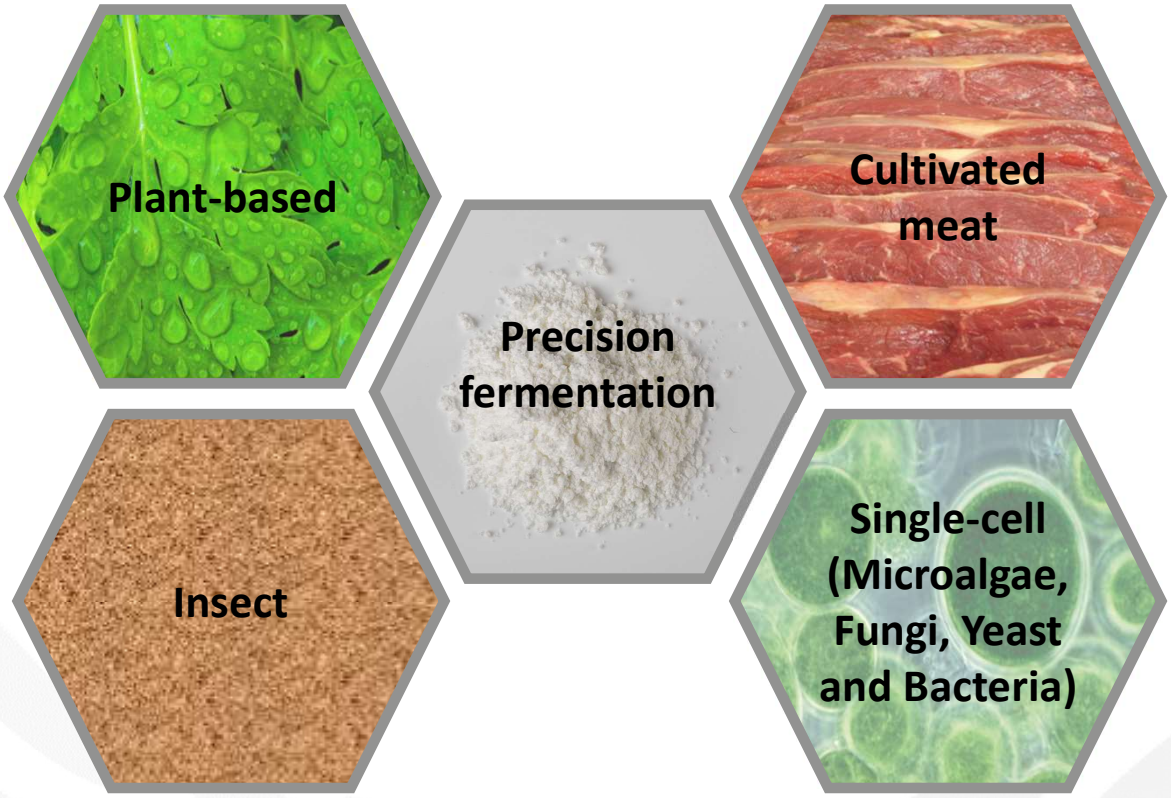
Growing interest in alternative sources of proteins

- Food security
- Environmental impact
- Health perceptions
- Animal welfare



From GFI Europe

Accelerating innovations



Potential to greatly impact the food system

Challenges remain

Defra Food Authenticity Programme

Research Project - Implications of emerging novel protein sources for food authenticity

Emerging risks for food authenticity and fraud?

Do we have adequate analytical capabilities?

What are the research priorities in this field?

Approach

The Future of Protein production Summit 2022 - world leading experts in the field to update on the most recent developments, technologies, policies and concepts across the food system

Light touch review of selective sources - academic and grey literature, internet sources.

Focus on authenticity

Stakeholder consultations (n=10)

Findings

Authenticity issues and **methodologies** have not been an area of focus for the alternative protein sector

Food industry – higher awareness

- Consumer trust
- Health implications
- Wider implications of fraud

Authenticity main challenges

- Species of origin / Ingredient verification
- Complex formulations / highly processed products – more challenging
- Supply chain may be complex / fragmented

Drivers of fraud

Economic factors	Conventional protein may be cheaper – substitution
	Adulteration with non-protein material, e.g., powders
	Hybrid products potentially more vulnerable
Excess of a particular commodity may lead to substitution	
Ingredient shortages (supply / demand)	Some novel ingredients / raw materials may be in short supply
	Supply chain potentially more vulnerable – disruptions
	Impact of climatic events - crops
Preference for short ingredient lists / natural ingredients may lead to failure to declare	
Competition	

Plant-based

Species substitution

Presence of animal ingredients

Quantification of AP in hybrid products

Substitution/dilution with nitrogen powders

Cultivated meat / seafood

Species substitution

Adulteration with conventional meat / seafood

Discrimination from animal counterpart

Use of unauthorised cell lines

Quantification of AP in hybrid products

Substitution of culture medium / scaffolding ingredients

Fermentation

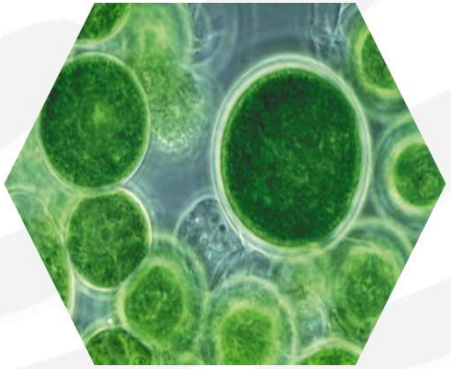
Species substitution (Biomass)

Presence of animal ingredients

Quantification of AP in hybrid products

Distinction from animal counterpart (Precision)

Substitution/dilution with nitrogen powders



Insects

Species substitution, wild vs farmed

Insect protein for feed used for food

Use of unauthorised / undeclared rearing substrates

Quantification of AP in hybrid products

Substitution/dilution with nitrogen powders

Anticipated analytical challenges

Species identification – genomic information	
Discrimination between AP and conventional counterpart	
Identification of gene editing	
Potential impact of novel processing techniques on performance of current methods	potential structural modification of target molecules
Databases and reference materials	
Validated methods	

Analytical tools

Plant-based	Spectroscopy/chemometrics for powders	Neves *et al.*, 2022 – classification soy, whey, wheat
	Sensors/AI – metabolomic fingerprints of plant-based products	
	Faller *et al.*, 2019 – ingredient identification in plant protein powders	PCR, NGS – issues with DNA integrity LC-MSMS – poor protein solubility in isolates Orthogonal methods / data fusion
	Huschek *et al.* 2018 - Proteomics - detection and quantification of garden pea, meat and honey in processed plant-based products	

Analytical tools

Insect protein	PCR for species identification	
	Proteomics / spectral comparison – commercial insect meals (Bhelgit *et al.*, 2019)	Potential marker peptides for four species
	Francis et al., 2020 – non-targeted proteomics - limited success due to lack of genomic data	
	These studies highlight the need for **more comprehensive genome** sequence data	

Analytical tools

Insect protein	Entometabolomics (Snart *et al*., 2015)	
	Poma *et al.,* 2022 – non-targeted metabolomic screening as a tool for traceability and authenticity monitoring "farm to fork"	complementary to proteomics/genomics
		discovery of unexpected – safety
		other aspects – wild vs farmed

Need for reliable databases / annotations, *in silico* tools for structural elucidation, shared repositories

Additional tools

Approaches to collect information about supply chains globally

AI, big data and block chain technologies, combined with other tools

- Intelligent packaging
- Sensors – radio frequency ID tags
- DNA tags – e.g. DNAblockchain tool for traceability of olive oil

Standards and certification – guidelines

- BRCGS - Plant-based Global Standard
- BSI - PAS 224:2020 – 100% plant-based ingredients (composition)
- ISO 23662:202 – vegetarian, vegan, definitions, criteria, labelling
- IPIFF – guides on good hygiene practices and on labelling of insect products

Learning from other sectors (e.g. pharma)

Research needs

- Impact of new processing technologies on performance of existing authenticity tests
- Identify and address points of vulnerability in the supply chain
- Methods for detection of adulteration with nitrogen compounds
- Investigate biomarkers to support authenticity testing of APs
- Support databases as tools for authenticity testing – genome, proteome, metabolome, spectral data, isotope ratios. Collaboration and data sharing are essential.

Acknowledgements

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Thank you