29th Sta DG ER, 07-08 June 2023

FUTURE FOOD AND FEED LAB

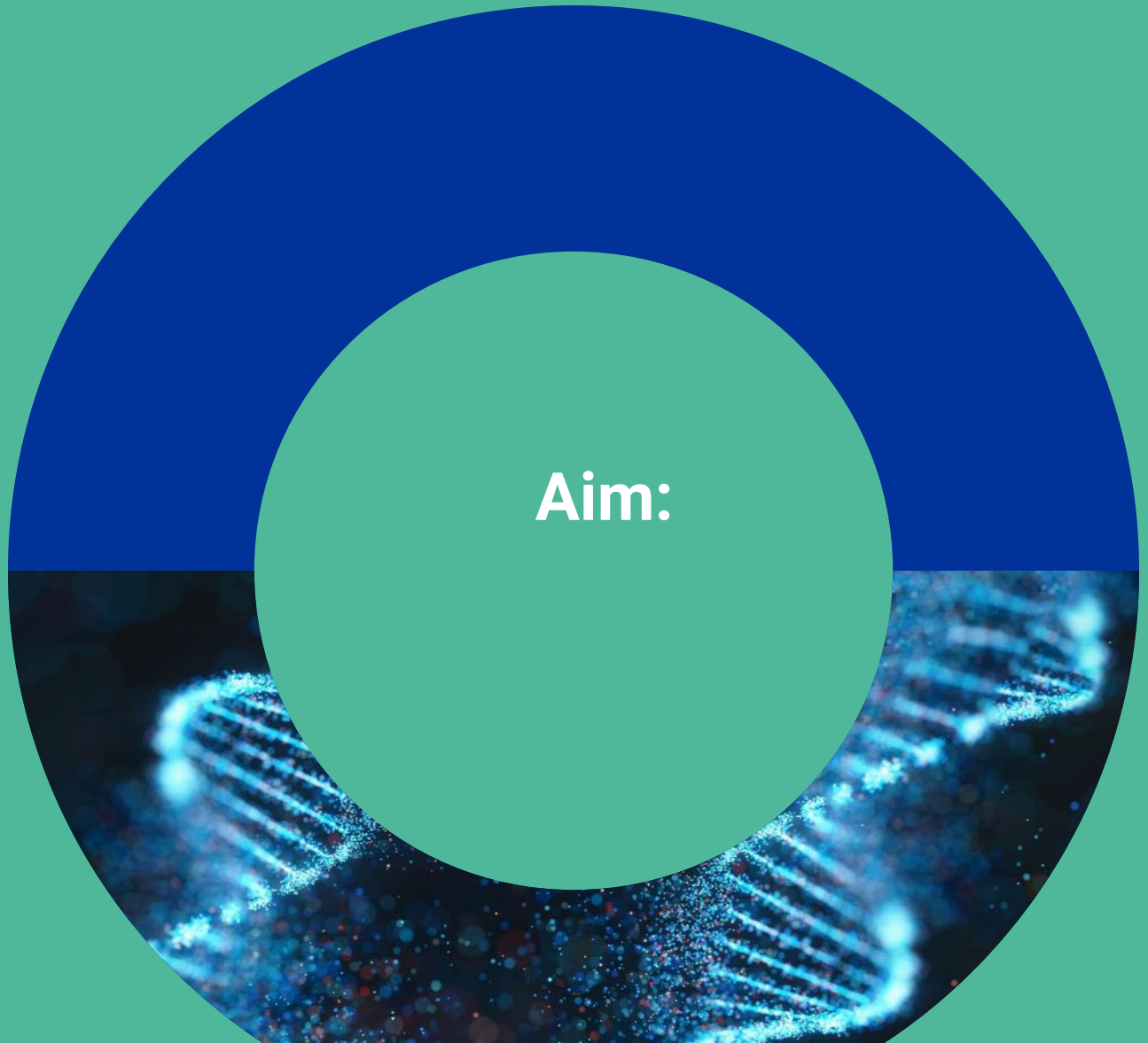
EFSA ENVIRONMENTAL SCANNING

DETECTING WEAK SIGNALS IN THE AREA OF NEW FOOD FEED SOURCES AND PRODUCTION TECHNOLOGIES

Dr Georgia Gkrintzali, SNE, EXPLORE Team, KNOW Unit

EUROPEAN FOOD SAFETY AUTHORITY

THE INNOVATION PROJECT



Aim:

Weak signals: *signals defined as unclear observable trends or patterns that warn about the possibility of future events. They illustrate potential future developments (i.e. emerging issues) for which limited and scattered evidence is currently available (Donohoe, et. al., 2018)*

- **identification of weak signals in the field of new food, feed sources and innovative production technologies using JRC TIM tool**
- **setting up new stakeholders' engagement approaches**

THE INNOVATION PROJECT

Data

Scopus and Patstat patents collection were used for the detection of raw signals

Methodology

2 complementary processes:

- targeted searches were made in TIM technology environment to constitute specific collections of documents,

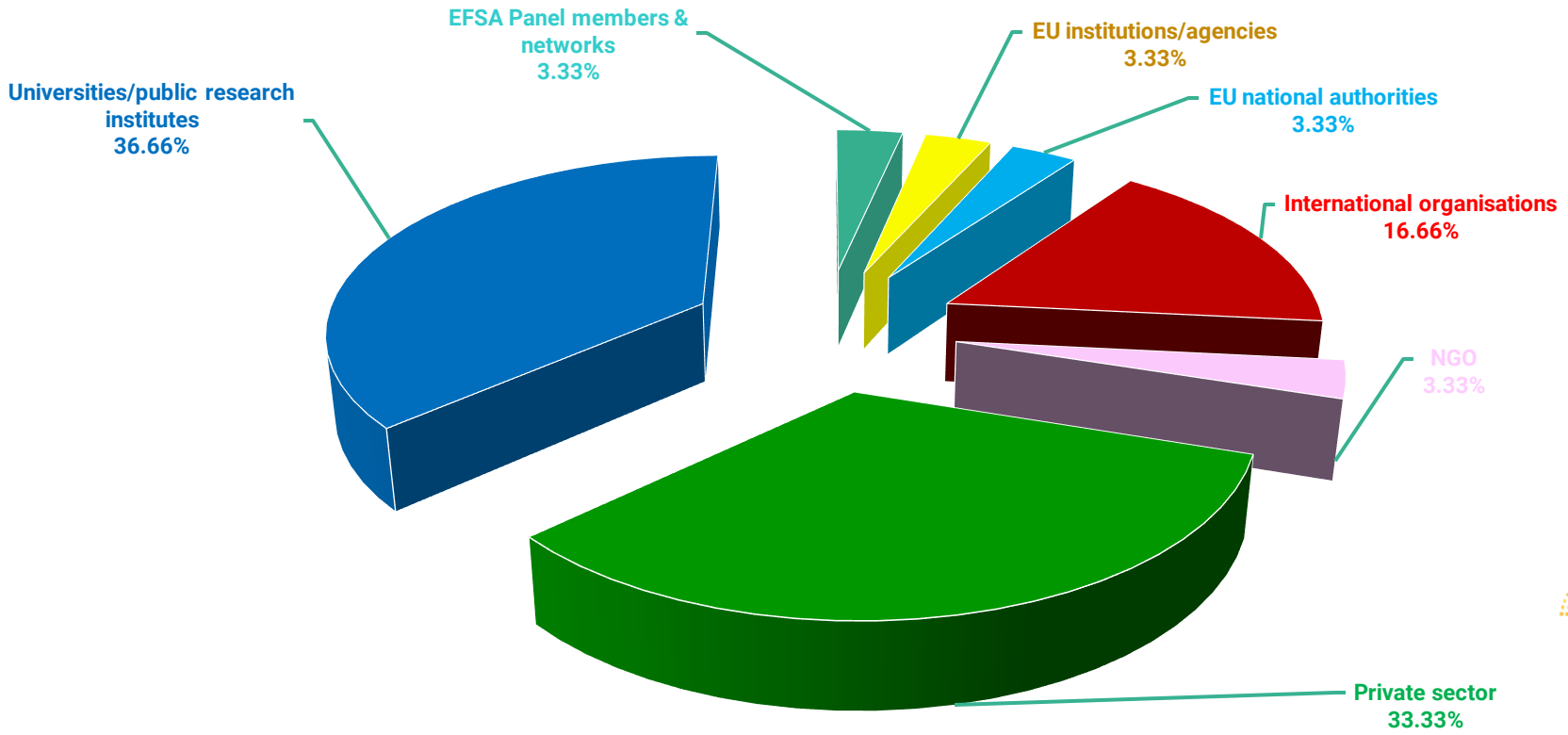
- TIM tool: extracted from Scopus relevant keywords and used to build collections of documents that then were ranked and selected according to various indicators

FUTURE FOOD/FEED LAB

Date/Place: 06-07 March 2023, Milan

4 Break out groups: i. Edible insects (novel food)
ii. Cell culture-derived meat (novel food)
iii. Nanotechnology (cross cutting)
iv. Feed from marine resources, insect as feed, feed from aquatic plants, other novel feed (novel feed)

Number of participants: 30



FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel food	**Cell culture-derived meat**	3	**Scaffolding structures** Structures used for cell differentiation during the production of cell culture-derived meat	**Weak signal** - **Chemical and physicochemical behaviour of scaffolds** during food processing. - Synthetic/reusable scaffolds may pose safety issues via **migration**. Scaffolds may be dissolvable and their **potential residues in the final product** should be investigated.
			Stem cells The proliferation of stem cells in culture for many population doublings could lead to the accumulation of genomic alterations that might have negative implications for food safety. Additionally, there are some problems associated with cell lines derived from stem cells including genetic instability and phenotypic drift.	**Weak signal** - **Genetic stability of cell line** could impact the safety of the final product, but to what extent? - It is **impossible to fully exclude** that some cells, after genetic drifting, **may produce components with toxigenic potential**? - Use of **chemical substances** to check and regulate cell growth

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel food	**Cell culture-derived meat**	3	**Integration of nanosensors in the bioprocess of cell culture-derived meat** The integration of nano sensors in the bioprocess of cell culture-derived meat eased the quality assessment throughout the food supply chain but the potential of food safety risks stemmed from the maintenance of nanosensors in the final product should be investigated.	**Not weak signals** It was characterised as an **outlier**. - The participants declared not being familiar with this element. Could be relevant to "future foods" in general.

Additional weak signals

- **outflow of by-products from the bioreactors** during culturing (e.g., ammonia, products of decay, biogenic amines)
- **micronutrients** and factors involved in their **dietary bioavailability** (the effect of matrix)
- **culture ingredients/input materials** (serum replacers, chemical substances, growth factors). Other input materials: components with antibiotic activity (e.g., peptides, antibiotics, "natural" antibiotics)
- possible risks linked to **upscaling and recycling (re-use) of input materials** (feasibility, and impact on food safety/environment).
- **co-culturing**: currently not practiced

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel Food	**Edible insects**	**9**	**Gonimbrasia belina** Microbial contamination/Allergenicity/Aflatoxin	All identified weak signals were specific insect species, which were not relevant for the participants. The weak signals should be the hazards that the insect consumption might have on human health. The following weak signals were suggested: **Consumption of plastic materials by insects** The metabolism of plastics by insects remains an unexplored field. The participants highlighted that consumption of insects fed with plastics on purpose is not expected, it is rather expected as incidental events; as examples they referred to uncontrolled raring practices, via contaminated feed, via microplastics. The participants also agreed that not all species are expected to consume plastics, and in those specific insect species that are prone to consume plastic may come as an environmental/ biodegradation tool, though only by accidental interchange with edible insects, those insect species may pose a risk .
			Gryllus bimaculatus Allergenicity/Microbial contamination	
			Musca domesitca Microbial contamination/contribute to the global spread of pathogenic resistant bacteria	
			Ruspolia differens Microbial contamination/Allergenicity	
			Schistocera gregaria Allergenicity	
			Zophobas atratus Microbial contamination/Allergenicity	

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel Food	**Edible insects**	**9**	**Schistocera gregaria** Allergenicity	**Antinutrients and specific metabolites:** Antinutrients or toxic metabolites depend on the feed the insects are fed with and the degree of metabolism of those substance by insects. **Antimicrobial resistance (AMR):** There is lack of veterinary medicines allowed for farmed insects despite the fact that insects may be reared in large quantity.
			Zophobas atratus Microbial contamination/Allergenicity	
			Henicus whellani Presence of saponins, oxalates and tannins	
			Protaetia brevitarsis Presence of alkaloids	
			Zophobas morio Polysterene biodegradation	

Additional weak signals

- **genetically modified insects: v**ery few articles on this topic

- **veterinary medicines: n**o veterinary medicines have been approved for edible insects for the moment. Their presence in edible insects may come via the feed and may pose a risk for human health or lack of approved veterinary medicines for edible insects may lead to diseases

- **innovative feed:** may impact on hazard profile of edible insects (e.g. other type of contaminants)

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Cross cutting	**Nanotechnology**	4	**Nanowarming** Nanowarming is a form of bioheat transfer and has been approved and applied in biomedical applications. It's a new trend with possible application in food sector.	**Weak signal** Limited knowledge about nanowarming application
			Foodborne nanoparticles The research activities in the foodborne nanostructures that arise during natural food processing, to characterize their chemical composition, characteristics, and formation mechanisms are limited, and there are gaps in the current knowledge.	**Weak signal** Misinterpretation of the definition. The size and scale of nanomaterials falls between 1 and 100 nanometers, but there's no fixed cut-off point for what is considered a nanomaterial. The Commission defines it as 1-100 nm, but particles larger than 100 nm can still be considered nanomaterials. However, for industry purposes such as labelling, cut-off values are necessary.
			Essential oils nano-emulsions Essential oils based nano emulsions in general are increasingly used in the food sector due to their antimicrobial properties. It could be considered as weak signal as it could lead to an increased bioavailability of unwanted substances (e.g. naturally occurring genotoxic carcinogens in basil, rosemary, thyme etc.).	**Weak signal** Companies need to take into account safety considerations, such as bioavailability and toxic effects, when determining functionality

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
			Nanoencapsulation The increased use of the technology of nano - encapsulation may require new considerations on exposure and nano-specific assessment	**Weak signal**

Additional weak signals

- **perinatal exposure to foodborne inorganic nanoparticles**
- **prevalence of unlabelled nanomaterials**

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel feed	**Feed from marine resources,** **insect as feed,** **feed from aquatic plants,** **other novel feed**	3	**High dietary level of wheat gluten** High dietary level of wheat gluten -> negative impact on the intestinal and liver health of salmon with symptoms similar to gluten sensitivity in humans	**Weak signal** when applied to a specific sub-category i.e., fish, while it would not be a weak signal for others because of extensive relevant knowledge.
			Undesirable substances in novel feed The inclusion of plant ingredients pose a potential threat to fish due to the presence of various undesirable substances including anti-nutritional factors (ANFs), such as phytoestrogens and mycotoxins as well as chemical contaminants, which can negatively affect growth and health.	**Not weak signal** Undesirable substances (mycotoxins) already well known

FUTURE FOOD/FEED LAB

Macro-area	Category	No of weak signals	Weak signal	Comments from participants of the B/G
Novel feed	**Feed from marine resources,** **insect as feed,** **feed from aquatic plants,** **other novel feed**	3	**Cultivation of microalgal biomass on waste nutrients and use of the resultant microalgae crops as a feed source for aquaculture industries or animal production** Potential risks of cultivating microalgae on digestate as a feed stock, either directly after dilution or indirectly from effluent remaining after biofertilizer extraction. Challenges in large scale cultivation of algae on digestate	**Not weak signal** Already very well known issue

Additional weak signals

Limited supply of phosphorus and the need for a more conservative and circular approach to its use in animal nutrition

FUTURE FOOD AND FEED LAB : FEEDBACK ON THE INNOVATION PROJECT METHODOLOGY

Break out group on cell culture derived meat

- Methodology offers centralized access to a large amount of data but the screening of results is very resources intensive
- It's not sensitive enough to detect emerging "unknowns"
- Suggestion: to engage with industry and authorities to analyse and validate results as well as identify gaps

Break out group on edible insects

- Acknowledgment that the goal of the process was to a level met, however high level of human resources needed
- It was considered that the input to detect signals was highly specific
- The human factor seemed to have a big impact
- The participants considered the interaction of different types of stakeholders as an important source for detecting weak signals

FUTURE FOOD AND FEED LAB : FEEDBACK ON THE INNOVATION PROJECT METHODOLOGY

Break out group on nanotechnology

- TIM tool is a useful tool to detect grey and unknown weak signals, assisted with manual literature search
- Recommendation for TIM tool: focus of the tool on innovation in other areas also: medicine, cosmetics and investigate whether there are applications related to food area
- Inclusion of industry is crucial, especially startups

http://www.thecomicstrips.com/subject/The-Collaboration-Comic-Strips.php

Break out group on novel feed

- "Time is of essence": publications or patents may come after years of research and development, to identify weak signals, it may be too late
- Human intervention may bring subjectivity
- More and additional sources of information should be considered e.g., market info, early research, media

FOLLOW UP ACTIONS: INNOVATION PROJECT

Feedback to EFSA's Scientific Colloquium "Cell culture-derived foods and food ingredients" (11-12 May, 2023, Brussels)

Communication to EFSA Nano WG: weak signals identified within the innovation project in the area of nanotechnology

Feed the discussion of EREN and Sta DG ER networks

Create a community of knowledge in the area of new food/feed sources and innovative production technologies?

STAY CONNECTED

SUBSCRIBE TO
efsa.europa.eu/en/news/newsletters
efsa.europa.eu/en/rss
Careers.efsa.europa.eu – job alerts

LISTEN TO OUR PODCAST
Science on the Menu –Spotify, Apple Podcast and YouTube

FOLLOW US ON TWITTER
@efsa_eu @methods_efsa
@plants_efsa @animals_efsa

FOLLOW US ON LINKEDIN
Linkedin.com/company/efsa

FOLLOW US ON INSTAGRAM
@one_healthenv_eu

CONTACT US
efsa.europa.eu/en/contact/askefsa

efsa
EUROPEAN FOOD SAFETY AUTHORITY