VANGUARD INITIATIVE
New growth through smart specialisation

Bio-economy pilot

Case for joint-demonstration
"Food & Feed from Agrofood Waste"
Leader: Scotland
Co-Leaders: Navarra, Asturias, South Holland, Flanders

Concept Note

- Description of the application(s) envisaged, with detailed description of the specific application

Extraction of valuable proteins, lipids and carbohydrates from agrofood waste. There is interest in a number of waste streams, but specifically:

1. Extraction of proteins from distilling and brewing waste to be used in fish feed instead of fish waste and soya proteins. Proteins are concentrated and extracted from the pot ale by a patented technology. At the same time the digestion process has been optimized to be more energy efficient. Can be adapted to other distillation processes. (Horizon Proteins - Scotland). Small wine production (PDO Vino de Cangas) and cider production (Asturias).
2. Extraction of amino acids and short peptides from fish waste (viscera and skeletons) to manufacture food supplements and drinks that are balanced for human nutritional needs. (CellsUnited - Scotland). Fish processing companies that would be interested in exploiting fish waste (as far as the extraction process is more profitable than selling the waste for fish flour - Asturias).
3. Extraction of carbohydrates and proteins from faba beans (displacing imported soya) for livestock and fish feed. Project looked at improving the growth and nutritional value of the beans and formulating different types of feed for fish, poultry and pigs. (Harbro, JHI – Beans4Feeds - Scotland)
4. Extraction of polyphenols from vegetal waste (Asturias)
5. Pure keratin powder can be recovered from low cost and renewable sources. In particular, both high molecular weight keratin (HMW-Ker) from raw wool and lower molecular weight keratin (LMW-Ker) from chicken feathers are extracted by an in-water process with efficiencies ranging from 60 to 70%. Keratin represents **a novel resource-efficient biomaterial** in the manufacturing chain as it can be processed into films, sponges, gels, nano and microparticles, (nano)fibres for the pharmaceutical, biomedical, cosmetic industry. Thus, industrialization of keratin recovery from agricultural wastes represents an important advancement in terms of environmental remediation and production of high added-value materials (Emilia Romagna).
6. Extraction of vegetable proteins, natural flavours, natural colourants, dietary fibres, vitamins and anti-oxidants from vegetable site and by streams (carrots, beets, cucumbers, kale, spinach, peas, bell peppers and tomatoes). Ingredients are concentrated and extracted from the feedstock by a

press, dry and extraction technology. Already 5m litres of juice is produced and sold right now. The drying and extraction process has to be optimized and upscaled. Can be adapted to other vegetable feedstocks (Flanders, Asturias, Navarra) and animal feedstocks (Scotland).

Other areas that would be of interest include extraction of other useful nutrients such as lipids, oils, polyphenols from various plant and livestock sources (Scotland), extraction of nutrients from meat processing wastes (Asturias). North-Brabant has interest in extraction of proteins, minerals, fats, gelatins and numerous other specialty ingredients (food and pharma applications) from slaughter house by-products (like pig blood and pig bones).

- Assessment of the "distance-to-market" (TRL 5, 6, 7 or 8) and of the business potential for the own companies.

1. Extraction of proteins from distilling and brewing waste: TRL5/6 – demonstrated technology, needs to be scaled up. Discussions are underway with a distillery. The product meets a global and accelerating demand for cost-effective fish feed. Scotland is one of the world's largest salmon farming regions.
2. Extraction of amino acids and short peptides from fish waste: TRL6/7 – an initial product has been manufactured, and there is now a pilot plant being built in Scotland near a salmon farm. The product is an easily digestable, nutritional drink containing amino acids and short peptides. The target markets are hospitals, athletes and developing countries (malnutrition).
3. Extraction of carbohydrates and proteins from faba beans: TRL5 – this technology is being developed within a project which concludes early 2016. As above it addresses the increasing demand for farmed fish and therefore affordable fish feed. At present a lot of fish food includes soya protein which cannot be grown in Scotland. Faba beans represent an alternative, thus reducing cost and creating new jobs within the region. In addition, it makes use of the carbohydrate component of the beans to develop new feeds for pigs and poultry.
4. TRL polyphenol extraction (to be confirmed) – Asturias
5. Extraction of keratin: TRL5 – demonstrated technology, needs to be scaled up. Discussions are underway with a venture capital and an Italian Company dealing with packaging for setting up a pilot plant for the extraction of keratin from waste raw wool. The target markets are biomedical devices, pharmaceutical, cosmetic and plastics companies, among the others.
6. Extraction of useful products from vegetable waste: TRL 5/7 – pilot and demonstration technology, needs to be scaled up. Supersonic drying technology still in applied research stage. The juice production is already in market stage, 5000 tons of carrots, beets and cucumbers are processed. Challenge: erection of 1 central demonstration/production facility, incl tolling facilities for applied research and pilot production and logistics to realize a year round production. 1 production facility in planning (50-100k tons of feedstock). Target markets: food, feed, cosmetics.

- Description of the key assets of the regions participating

I.e. mention and describe key assets such as:

- research/testing/certification/characterization facilities
- companies along the value chain, including downstream users (!) who might be interested to join the case

Scotland

1. IBioIC – provides a focus for industrial biotechnology in Scotland, linking universities and industry and supporting new RTD and training. Delivers a number of exemplar project that are focused on industrial RTD. The Centre has testing and scale up facilities
2. JHI – crop breeding and growing facilities including for soft fruits, legumes, root vegetables and cereal crops. Key partner in Beans4Feeds.
3. SAMS – marine research centre, including biotechnology and aquaculture. Could be involved in development of new fish feeds. SAMS is developing new processing facilities which may be available to project partners.
4. Ingenza – an SME that delivers synthetic biology applications to improve or design new metabolic processes across a variety of IB domains.
5. CelluComp – knowledge of managing fibrous vegetable waste, such as carrot, to extract cellulose for the manufacture of 'green' composite materials. The company opened a processing plant earlier this year.
6. Peel Tech - developed a small scale potato waste-water treatment & starch recovery process.
7. Various end-users such as fish feed manufacturers (e.g. BioMar and EWOS both have sites in Scotland), fish farms, and livestock feed manufacturers (e.g. Harbro).

Asturias

1. ASINCAR – food cluster and agro-food technology centre. It supports agro-food companies to develop their innovation activities in different work lines, including exploitation of agro-food by-products and new product development. The centre has a pilot plant and laboratory facilities.
2. Various end users such as dairy manufacturer meat and fish processing companies, etc.
3. University of Oviedo-Cluster of Biomedicine and Health. Research and connection with regional stakeholders (regional government, industries, etc)
4. SERIDA (Regional Agrofood Research Center)
5. Fisheries Regional Research Center

Emilia Romagna

1. **MEDLAINE project**: recovery and enhancement of wool from local and native sheep breeds, and research for new technological application of wool in order to tune it from ―special waste‖ into real resource, thus increasing business incomes. Besides MEDLAINE, most of the Italian textile industries have wool wastes to be disposed and which represent a cost. The same for shepherds.
2. LAR Spa: plastic-based packaging. Italian food is known worldwide because of the high quality and enormous diversity of the products produced. Companies along this value chain are strongly interested in the availability of plastic-based packaging with improved properties. Keratin as well as properly functionalized keratin would be able to respond to these needs.
3. PROTER venture capital: interested in the scale up of keratin extraction from raw and renewable sources.
4. Many cosmetic companies have been contacted and express their interest in this topic.

North-Brabant

1. Proverka - pilot/demonstration facility (6m litres/year) and production facility for juice, fibres and

ingredients from vegetable side and by-products. Large range of (mild) separation, extraction and drying technologies in place for small pilot productions and tests extractie, drogingtechnologieën. Also expertise and tests for determination of cost prices for products from side/by streams.

2. Bodec – process optimisation expertise, product and process development, small scale pilot and demonstration technologies; focus on separation, extraction, drying, concentration.
3. Wageningen University; agriculture and food university and research centre
4. Van Rijsingen group - feedstock supplier. Large breeder, contractor and food producer of carrots, beans, spinach, kale
5. Foodtech Park Brainport - expertise, product/business development support and testing facilities
6. TOP – shelf life extension expertise of vegetable – and fruit juices by mild conservation techniques; bio cascading techniques for upgrading of vegetable feedstocks
7. Darling ingredients - collect and repurpose millions of metric tons of inedible materials annually. Beef, poultry and pork by-product streams are converted into usable and specialty ingredients, such as gelatin, tallow, feed-grade fats, meat and bone meal, poultry meal, yellow grease, fuel feedstocks, green energy, natural casings and hides, which are sold to the pharmaceutical, food, pet food, feed, fuel, bio-energy and fertilizer industries

- What is the added value of **joint** demonstration activities here?

Assess and demonstrate the added value of interregional collaboration on the case, e.g. this could relate to :

- Bundling complementary expertise (which?)
- Getting involvement of larger community of lead users
- Increasing access to/knowledge on different feedstocks

Scotland

1. Opportunities to adapt process technologies developed in Scotland to other feedstocks, e.g. from brewing and wine-making.
2. Use of enabling technologies from companies such as Ingenza to valorize feedstocks being exploited in other regions.
3. Access to scale-up facilities in other regions.
4. Access to new markets.

Emilia-Romagna

1. First worldwide production of high-molecular weight keratin from agricultural wastes
2. Open new markets and scale-up productions in other regions
3. Use of key enabling technologies for production diversification
4. Use of key enabling technologies for the manufacturing of keratin-based products (electrospinning)

North Brabant

1. Share, spread development costs, optimal use of pilot facilities
2. Opportunities to adapt process technologies developed in Brabant to other feedstocks, e.g. from slaughter house by-products, brewing and other vegetable feedstocks.

3. Use of enabling technologies from companies such as Bodec, TOP and Proverka to valorize feedstocks being exploited in other regions.
4. Access to technologies and scale-up facilities in other regions.
5. Access to new markets
6. Total innovation chain from idea up to market introduction via an integral approach with multi country expertise and via cross boundary exchange of knowledge

- Description of a first set of common demonstration activities.

1. Use of feedstock from breweries and from breeders and food (vegetable and fruit) producers in other regions, on or near-site processing.
2. Incorporation of extracted proteins and carbohydrates into balanced feed for other domesticated animals or other markets.
3. Use of feedstock from livestock rearing (sheep, chicken) and textile industries.
4. Plant for pilot scale production of keratin.
5. Use of keratin powder for new plastics and cosmetic formulations.
6. Incorporation of extracted proteins, fibres and ingredients into balanced food, feed or pharma applications or other markets.

- Who would be interested to join the case?

This concept note will be disseminated across the network. Please indicate here which different type of actors that in your opinion might have an interest to join the case, and why.

1. Agricultural associations.
2. Food associations (reducing food spoiling).
3. Brewers, distillers, wine-makers, juice makers, vegetable production companies.
4. Bio-processing plants.
5. Animal feed manufacturers.
6. Companies specializing in industrial biotech processes.
7. Research organizations with IB, synbio and/or microbial fermentation expertise.
8. End users such as meat and fish processing companies, etc
9. Livestock rearing companies for meat; cheese and milk production
10. Textiles companies
11. Association for raw wool collection and storage
12. Cosmetic companies
13. Biomedical and medical companies
14. Packaging and storage companies